
Cave adsum
DAVID JARDINE JARDINE

THE

CYCLOPÆDIA;

OR,

Universal Dictionary

OF

ARTS, SCIENCES, AND LITERATURE.

VOL. XXXVIII.

Printed by A. Strahan,
New-Street-Square, London.

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UNIVERSAL DICTIONARY

OF

Arts, Sciences, and Literature.

BY

ABRAHAM REES, D.D. F.R.S. F.L.S. *S. Amer. Soc.*

WITH THE ASSISTANCE OF

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OF

ARTS and SCIENCES.

WATER.

WATER. This important fluid was believed by the ancients to be one of the four elements out of which they imagined every other fubftance is compofed. This opinion maintained its ground for a very long period. At length, however, it began to be fufpected, from the experiments of Van Helmont, Boyle, and others. Van Helmont fhewed that plants would grow for a very long time in pure water, whence it was concluded that water was capable of being changed into all the fubftances found in vegetables. Mr. Boyle fuppofed, that by long digeftion and boiling in glafs-veffels, he had converted water partly into an earth. Margraaff, who repeated his experiment, drew the fame conclufion; but the opinion was never very generally admitted, and at length was proved to be erroneous, the earth being fhewn to be derived from the glafs-veffels employed in the experiments.

The combuftible nature of hydrogen gas was obferved about the beginning of the 18th century, and the celebrated Scheele, many years afterwards, was the firft who attempted to difcover what was produced by this combuftion. In this, however, he did not fucceed; nor were Macquer, Bucquet, Lavoifier, Dr. Prieftley, and others, who fubfequently repeated the experiment with fimilar views, more fortunate. The diftinguifhed honour of difcovering the compofition of water was referved for Mr. Cavendifh, who, in 1781, proved beyond a doubt that the combuftion of hydrogen and oxygen produced this fluid, and nothing elfe. Water, therefore, fince the period juft mentioned, has been univerfally admitted to be compofed of thefe two gafeous principles.

Water is found in abundance in every part of the globe, and is abfolutely neceffary for the exiftence of organized beings. When quite pure, as obtained by diftillation, it is perfectly tranfparent and colourlefs, and free from tafte and fmell.

A cubic foot of diftilled water, according to the beft experiments, weighs, at a temperature of 40°, 437102.4946 grains troy. Hence, a cubic inch of water at the fame temperature weighs 252.952 grains; and at the temperature of 60°, 252.72 grains. The fpecific gravity of water is always fuppofed to be 1.000, and it is made the meafure of the fpecific gravity of every other body. (See *Specific* GRAVITY, and HYDROSTATICS.) Water, at a temperature of 32°, becomes folid, and affumes the form of ice. In this ftate it poffeffes confiderable hardnefs and elafticity, and its fpecific gravity is diminifhed to .94. See FREEZING, and ICE.

When water is raifed to the temperature of 212° it boils, and is gradually converted into fteam, which is an invifible and highly elaftic fluid like air. The fpecific gravity of fteam, according to the moft recent obfervations, is .625, that of air being reckoned 1.000. See BOILING, EBULLITION, and STEAM.

Water is capable of undergoing a flight degree of compreffion. See COMPRESSION.

Water undergoes no alteration by expofure to heat or light. Thus it may be made to pafs through a red-hot tube without fuffering any change.

On expofure to the atmofphere, it abforbs a portion of air, the greater part of which is capable of being again driven off by boiling. To expel the whole, however, it is ftated to be neceffary to continue the operation at leaft two hours in a flafk, with its mouth inverted over mercury. To this fmall proportion of air which it holds in folution, water chiefly owes its agreeable flavour, boiled water being infipid. See ABSORPTION, and GAS.

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Hydrogen gas, even at a red heat, has no action upon water. Charcoal, when cold, does not decompoſe it. But when red-hot charcoal is brought in contact with water, carbonic acid and carburetted hydrogen are formed in abundance. Sulphur and phoſphorus do not appear to be capable of decompoſing water, even when aſſiſted by heat; but potaſſium and ſodium, and doubtleſs alſo the metallic baſes of the alkaline earths, decompoſe it rapidly. Of the other metals, iron, zinc, antimony, and tin, decompoſe it, when aſſiſted by heat. Silver, gold, copper, and platina, produce no effect upon it.

Water diſſolves the alkalies and alkaline earths. The acids alſo, and many ſaline compounds, are ſoluble in this fluid; but it is incapable of diſſolving the earths properly ſo called.

Water combines with bodies in two different ways. It either diſſolves them, in which caſe the proportion of water is unlimited, or it combines with them, and forms ſolid compounds, termed *hydrates*, into the compoſition of which the water enters in a definite proportion. The metallic hydrates, in general, are remarkable for the brilliancy of their colours. They are more ſoluble in acids than the oxyds, and in ſome inſtances affect the organs of taſte even more perceptibly than the metallic ſalts. This ſubject has been particularly inveſtigated by M. Prouſt. See HYDRATE.

According to the lateſt and moſt perfect experiments, water is compoſed of two volumes of hydrogen gas, and one volume of oxygen gas. Hence, its combining weight or atom will be 1.125, oxygen being reckoned 1; or, if we conſider the ſpecific gravity of hydrogen gas to be .6944, and of oxygen gas 1.1111, it is compoſed of one part by weight of hydrogen, and eight parts by weight of oxygen. The union of oxygen and hydrogen gaſes to form water is attended by the extrication of much light and heat. See COMBUSTION and DETONATION.

WATERS, *Natural.* "Water," ſays Dr. Saunders, "is found throughout the earth in every degree of purity, except the higheſt, for ſuch is never procured, except by artificial diſtillation, as all natural waters are conſtantly coming into contact with ſome ſubſtance which they can either diſſolve or hold ſuſpended." Waters to which the epithet *mineral* is applied, in many inſtances differ from other natural waters in the degree only in which they are impregnated with ſimilar foreign ſubſtances: in other inſtances, they differ in the nature of the impregnating ingredient; but for the moſt part they differ in both theſe circumſtances. In preſenting our readers with an account of natural waters in general, we ſhall commence with an enumeration and ſhort account of the different foreign ingredients uſually met with in waters, and influencing their operation on the animal economy.

1. *Caloric.*—The temperature of natural ſpring-waters is the ſame, in general, as the mean annual temperature of the particular place in which they occur. It is evident, therefore, that this temperature muſt vary with the latitude. (See the articles CLIMATE, TEMPERATURE, &c.) Waters rarely occur of a temperature much lower than the mean annual temperature of the latitude in which they are found; but inſtances are met with in every part of the globe in which they occur of a higher temperature. This degree of increaſed temperature is very different in different inſtances. Commonly it is not very ſtriking, while in other caſes it is very remarkable: thus, the waters of Carlſbad, in Bohemia, have the extraordinary temperature of 165°. In this country, the hotteſt ſprings are thoſe of Bath and Buxton, the higheſt temperatures of which are ſtated to be 116° and 82° reſpectively. In ſome inſtances, theſe deviations from the natural temperature are obviouſly referrible to the neighbourhood of volcanoes, but generally their cauſe is very obſcure, as we can hardly form any idea of agents operating for ſuch a length of time, and ſo uniformly, as thoſe of neceſſity muſt do which give origin to the phenomena in queſtion: all we can infer is, that although local, they are deep-ſeated and permanent.

2. *Atmoſpheric Air: Azote.*—All natural waters of a mean temperature hold a portion of common air in ſolution. The quantity, however, has been ſtated by Bergman not to exceed $\frac{1}{18}$th of the bulk of the water; and even this can only be retained at a mean temperature, and under the ordinary preſſure of the atmoſphere, for the greater part of it eſcapes under the air-pump, or on ſubmitting the water for a ſhort time to a temperature of 212° or 32°. It is the oxygen contained in this ſmall portion of atmoſpheric air, retained by water, that ſupports the reſpiration of fiſhes, and other aquatic animals, which ſpeedily die from ſuffocation in water deprived of air. It is this air alſo, as before obſerved, which renders water ſapid and grateful to the palate; for by boiling or diſtillation, this fluid is rendered inſipid and diſagreeable, "and has long been in diſrepute," ſays Dr. Saunders, "for lying heavy on the ſtomach, and even producing ſcrofulous tumours and obſtructions." The preſence of atmoſpheric air in water is eaſily accounted for, from the affinity which ſubſiſts between the two ſubſtances, and which is ſuch, that they ſoon become mutually impregnated by being expoſed to each other.—Azotic gas has been found to exiſt in ſmall quantity in ſome waters, and in theſe inſtances it has been obſerved to be extricated from the ſpring itſelf in union with the water. As far as is at preſent known, this gas imparts no medicinal or even ſenſible property to the waters containing it.

3. *Carbonic Acid.*—This gas is likewiſe ſtated by Bergman to exiſt in greater or leſs quantity in all natural ſpring-waters. The limits in which it occurs is ſaid to lie between about $\frac{1}{100}$, and an equal bulk of the water. In mineral waters it is a moſt important ingredient, not only from its operation upon the animal economy, but from its being the ſolvent of various other active ingredients. When waters contain this principle in exceſs, they aſſume a bright and ſparkling appearance to the eye, have an agreeable pungent acidulous taſte, and ſometimes exert a kind of intoxicating power when largely drunk. Fiſhes are unable to exiſt in them, and ſpeedily die from ſuffocation. On expoſure to the air, however, theſe properties in a ſhort time become ſenſibly diminiſhed, and at length almoſt totally diſappear, owing to the ſeparation of the gas—an operation which may ſtill more ſpeedily be effected by boiling. The preſence of this gas in water is eaſily explained, from its natural affinity to that fluid. In almoſt every inſtance it is extricated from the ſpring in union with the water; but the ſource from whence it is derived is, in general, obſcure and inexplicable.

4. *Hydrogen and its Compounds, carburetted, ſulphuretted, and phoſphuretted Hydrogen.*—Hydrogen gas is barely ſoluble in water, and probably, therefore, never exiſts alone in that fluid. The ſame is true of carburetted hydrogen. Both theſe gaſes, however, are often extricated from waters, eſpecially when ſtagnant, and containing organic ſubſtances in a ſtate of putrefaction. Sulphuretted hydrogen is a frequent ingredient in mineral waters, and gives them ſo characteriſtic a feature, that they are inſtantly recognized. Waters holding this gas in ſolution have an offenſive ſmell, like that of rotten eggs, or a foul gun-barrel, and which is more or leſs ſtrong, according to the degree in which they are impregnated. Such waters alſo have a taſte ſomewhat ſweetiſh, and they generally appear turbid. Water, at a mean

mean temperature, is stated to absorb from $\frac{2}{3}$ds to $\frac{3}{4}$ths of its bulk of this gas, and by long agitation more than its bulk. At a temperature of 80° or 90°, however, this fluid can with difficulty be made to dissolve any of it. Sulphuretted waters, therefore, on exposure to heat, or even to the open air without heat, soon lose their characteristic properties, and become turbid, the hydrogen being dissipated, and the sulphur deposited. The source of this gas, in general, is not obscure, it being formed in great abundance during the decomposition of pyrites, and other minerals containing sulphur. Phosphuretted hydrogen is said to be occasionally extricated from marshes and stagnant pools, but it is not known to constitute an ingredient in mineral waters.

5. *The Alkalies and their Salts.*—The fixed alkalies seldom, if ever, occur in natural waters in a free state. Even the number of their salts is so limited, that Dr. Saunders thinks it necessary to enumerate only two, namely, the sulphate and muriate of soda. The first of them is a very common ingredient in mineral waters, but rarely occurs alone in any quantity, so that it can hardly be said ever to give a peculiar character to a water. Muriate of soda is so extensively and abundantly diffused through nature, that we rarely meet with a natural water which does not contain more or less of it. Sea-water, and many natural waters or *brines*, owe their peculiar characters to this salt, which has been known from the earliest times, and seems to be almost a necessary ingredient in our food. The muriate of soda, however, never occurs alone in natural waters, but is commonly accompanied by some of the earthy salts, especially the sulphate of lime. Chemists have been puzzled to account for the origin of the vast quantity of this salt which is met with in the sea and elsewhere; but a little reflection will shew, that the existence of this substance is not more difficult to be accounted for than that of any other ingredient of our globe. From its property of being soluble in water, it is, perhaps, more generally diffused than any other principle; but it is doubtful if it actually exists in greater abundance than silex, and many other solid substances, and which, in a geological point of view, differ from it only in the mechanical circumstance of their insolubility in water. The carbonate of soda is occasionally met with in waters. Its distribution, however, is very partial, being usually in very minute quantities, or in very large ones. When in small quantity, it is generally supersaturated with carbonic acid. The most remarkable instance of an excess of this salt is in "the natron lakes of Upper Egypt. It is here often mixed with common salt, and they both are largely dissolved in the water, and form a crust of several feet in thickness at the edge of the lake, owing to the copious evaporation of their water of solution effected by a tropical sun." Potash, or its salts, very seldom occur in mineral waters. Carbonate of ammonia is occasionally found in small quantities in some waters, arising probably, as Dr. Saunders conjectures, from decomposed animal or vegetable substances.

6. *The Earths and their Salts.*—The earth most frequently occurring in natural waters is lime, and so generally is this the case, that very few instances are known in which this earth is not met with in some state or other. The neutral carbonate of lime, or *chalk*, is one of the most insoluble substances known; but the supercarbonate of lime is very soluble, and is a frequent ingredient in many springs. "It is one source of *hardness* in waters," says Dr. Saunders, "but is easily got rid of by boiling, which drives off the excess of carbonic acid, and thus causes the chalk to be precipitated; hence the earthy crust or *furr* on kettles in which hard water has been boiled for a number of times. Some natural waters contain an unusual quantity of this calcareous earth, which is rapidly deposited as soon as they become exposed to the air, and thereby give an earthy lining to every tube through which they flow, and encrust with the same material every substance that accident or design may put in their way. Of this kind are the various petrifying springs that form part of the natural curiosities of several mountainous districts, and have been applied to use in a very ingenious manner at the baths of St. Philip, in Tuscany, and still more extensively at Gualecavelica, in Peru."—"The sulphate of lime (the gypsum or selenite of the older writers) is one of the commonest of all the earthy salts that are found in natural waters, and generally accompanies every saline substance, except where there is an excess of alkali. It is almost invariably found in conjunction with the carbonate of lime; and hence the calcareous depositions, petrifactions, and the like, frequently contain a small admixture of selenite." This salt imparts very little taste to water, but gives it "that rough and harsh feel to the fingers and tongue, which characterize the insipid *hard* waters." The muriate of lime commonly accompanies the other salts of lime, but especially the muriate of soda. When in excess in any water, it imparts to it a bitter and disagreeable taste, and active medicinal properties. The great bitterness of "the waters of the Dead sea is owing to the muriates of lime and magnesia, and not to bitumen, as was erroneously supposed." The carbonate of magnesia is insoluble in water; the supercarbonate of magnesia, when it occurs in waters, is always accompanied by the supercarbonate of lime, both the earths being held in solution by an excess of carbonic acid. The supercarbonate of magnesia, however, is more soluble than the supercarbonate of lime, and is not, therefore, so easily separated by boiling. The sulphate of magnesia, or *Epsom* salt, as it was formerly denominated, is the most important of the salts of this earth. It almost always accompanies the sulphate of soda; and to these two salts most of the natural purging waters owe their cathartic properties. It is likewise frequently combined with the sulphate of lime, and also with iron. The sulphate of magnesia imparts to the waters containing it in any considerable quantity a strongly bitter and saline taste. It was first discovered in a spring at Epsom, whence its name; but is usually prepared at present from the refuse salt of sea-water, after the common salt has been separated. The muriate of magnesia, as before-mentioned, commonly accompanies the muriates of soda and lime; hence it is found in various brine-springs, and forms a considerable part of the saline contents of sea-water, to which fluids, especially when concentrated by evaporation, it imparts a strong bitter taste. Salts of alumina are not of very frequent occurrence in waters. The most common is the supersulphate of alumina, or common alum, which is usually associated with the sulphate of iron. The source of this salt is for the most part alum-slate, the sulphur contained in which becomes acidified on exposure to the air, and forms sulphuric acid, which, uniting with the alumina, produces the salt in question. The presence of the sulphate of iron is easily accounted for upon similar principles, since more or less of iron pyrites almost invariably accompanies alum-slate. Silex, in a state of minute division, is sometimes found suspended in small quantity in running waters, but is soon deposited on their remaining at rest. This earth, however, occasionally occurs in a state of solution in hot and tepid springs, especially in the neighbourhood of volcanoes. The menstruum appears to be usually a little free or carbonated alkali, the solvent

powers

powers of which are doubtlefs much increafed by heat, or by fome unknown caufe.

7. *Metals and their Salts.*—The metal moft ufually met with in natural waters is *iron;* never, however, in its metallic ftate, but in a ftate of oxyd combined with an acid. The carbonate of iron is a frequent ingredient of natural waters, the bafe of which is the black or protoxyd of the metal, for the red oxyd does not feem capable of combining with carbonic acid, or at leaft of forming with it a foluble compound. This is, doubtlefs, a wife provifion of nature; for, as Dr. Saunders juftly obferves, if the contrary were the cafe, almoft every natural water would be a chalybeate. The carbonate of iron, like all the other falts of this metal, imparts to waters containing it a peculiar inky tafte, "which," fays Dr. Saunders, "is very perceptible, even when the proportion of iron is fo fmall as hardly to be eftimable by any chemical procefs." Waters containing the carbonate of iron depofit this metal readily on expofure to the air, partly from the efcape of the carbonic acid, and partly from the further oxydation of the metal. The fulphate of iron or green vitriol is met with occafionally in waters in confiderable quantity. This falt, as before obferved, generally occurs in union with the fulphate of alumina, or alum, and is the natural production of the decompofition of iron pyrites. Waters containing this falt in any quantity, poffefs the properties of chalybeates in a high degree, and are peculiarly ftyptic. The muriate of iron is occafionally met with in natural waters; but its exiftence in any confiderable quantity is a rare occurrence. *Copper,* or rather its falts, and efpecially the fulphate of *copper,* is occafionally met with in natural waters. This generally, however, occurs in the neighbourhood of copper-mines; and the fulphate of copper, as Dr. Saunders obferves, is probably formed, like the fulphate of iron, by the decompofition of copper pyrites. Waters containing this metal are highly poifonous, and are never ufed internally. *Manganefe* is occafionally found in fmall quantity in natural waters. It appears, in general, to be affociated with iron; but the ftate in which it exifts is not accurately known. As far as prefent obfervation goes, it imparts no fenfible or other properties to the waters containing it. *Lead,* perhaps, never naturally occurs in waters; but fome waters have the property of diffolving, or holding in fufpenfion, a minute portion of this pernicious metal, when expofed to it in the metallic ftate. Pure foft waters are faid to poffefs this property in the moft ftriking degree.

8. *Mineral Acids.*—Both the muriatic and fulphuric acids are occafionally met with in mineral waters in a free ftate. Such fprings ufually occur in volcanic countries.

9. *Bitumen.*—Bitumen is faid by many of the older writers to be a frequent ingredient in mineral waters. This ftatement, however, has been generally found erroneous by modern chemifts, who have in moft cafes demonftrated the fuppofed bituminous principles of their predeceffors to be fubftances of a very different nature. There are fome fprings, however, which yield a real bitumen; but this, from its infolubility in water, is never diffolved in that fluid, except in a few rare inftances, through the medium of an alkali.

Such is a fhort account of the principal mineral fubftances which are met with in natural waters when they iffue from the earth. "When," fays Dr. Saunders, "they flow within a channel over the furface of the ground, they often become much changed in their chemical compofition, lofing fome of their contents by evaporation, others by flow depofition, or by being decompofed through the influence of light and air. At the fame time they often acquire new contents, which are furnifhed by the foil over which they flow. Thus the ftreams which pafs over a country covered with vegetable matter, or which water large towns, will contain a fenfible quantity of mixed alluvial contents, or a heterogeneous compound of animal and vegetable extract of mucilage.

Different authors have chofen different principles of arrangement in treating of natural waters. An arrangement purely chemical, or purely medicinal, cannot be effected in the prefent ftate of our knowledge; we fhall not therefore attempt either, but fhall confider them under the following heads:

1. Potable waters.
2. Saline waters.
3. Chalybeate waters, fimple and compound.
4. Acidulous waters, fimple and compound.
5. Sulphureous waters, fimple and compound.
6. Thermal waters, fimple and compound.

This arrangement of natural waters, according to their *fenfible* properties, coincides likewife, as well perhaps as the prefent ftate of the fubject will admit, with their *chemical* and *medicinal* properties. It may, however, be objected to the divifions *fimple* and *compound,* that neither of them is accurately correct, and this muft be admitted in a ftrictly chemical point of view; but taken in the enlarged and general fenfe here underftood, there feems to be no ferious objection to this mode of divifion.

1. *Potable Waters.*—Under this divifion we wifh to include every variety of this fluid ordinarily ufed by mankind and other animals for fatisfying their thirft. Thefe may be comprehended under the heads of, *a,* pure or diftilled water; *b,* atmofpheric water; *c,* fpring-water; *d,* running water; and *e,* ftagnant water.

a. The chemical properties of pure water have been already defcribed at the head of this article. As before obferved, it never occurs in nature, and was therefore probably never intended as an article of drink for mankind; certainly, at leaft, not as one abfolutely neceffary for their exiftence, or even healthy condition.

b. Under *atmofpheric* waters are included rain-water, fnow-water, dew, &c.

Rain-water, collected at a diftance from large towns, or any other object capable of impregnating the atmofphere with noxious materials, approaches more nearly to a ftate of purity than perhaps any other natural water. Even collected under thefe circumftances, however, it invariably yields traces of the muriatic acid, and, according to Margraaff, of the nitric alfo. Rain-water of courfe differs according to the ftate of the atmofphere through which it paffes. "The heterogeneous atmofphere of a fmoky town," fays Dr. Saunders, "will communicate fome impregnation to rain as it paffes through; and this, though it may not be at once perceptible on chemical examination, will yet render it liable to fpontaneous change: and hence rain-water, if long kept, efpecially in hot climates, acquires a ftrong fmell, becomes full of animalculæ, and in fome degree putrid." Rain-water in general, in warm climates, is much more impure and liable to become offenfive than in cold and temperate ones. Rain alfo that falls in the fpring and fummer, or after a long-continued drought, or very hot weather, is faid to be more impure than that which falls at other feafons of the year, or after a long-continued moift feafon; circumftances, doubtlefs, owing to the exiftence of a greater proportion of animal and vegetable principles in the atmofphere in fuch climates and feafons. Thefe foreign fubftances have fometimes been fo abundant and peculiar in their appearance, as to have given origin to many marvellous ftories, fuch as the raining of blood, &c. (See the article RAIN.) The fpecific gravity of rain-water hardly differs from that of diftilled water; and from the minute portions of the foreign ingredients which it generally contains, it is very *foft*, and admirably adapted for many culinary purpofes, and various proceffes in different manufactures and the arts.

Snow-water equals, if not furpaffes, rain-water in purity, when collected under the fame circumftances, it being for obvious reafons more free from animal and vegetable impregnations; thus Dr. Rutty found it perfectly fweet after keeping it in a clofe veffel for eighteen months. Snow-water, like rain-water, even in its pureft ftate, yields traces of muriatic acid, and perhaps alfo of the nitric.

Hail-water may be compared to fnow-water, which it clofely refembles: indeed

Ice-water in general is very pure, as the air and faline fubftances are feparated by freezing. Common ice-water, however, is lefs pure than rain and fnow water, as the foreign fubftances, though perhaps feparated by freezing, ftill remain incorporated with the ice, fo that it is impoffible to melt the ice without retaining at leaft a portion of thefe foreign matters.

Dew, being depofited chiefly from the lower parts of the atmofphere, is commonly much more impure than rain or fnow water. According to Dr. Rutty's obfervations, it foon becomes fœtid and offenfive. It yields alfo more fenfible traces of the prefence of muriatic acid than rain-water. This fluid, however, collected at different places and times, differs exceedingly in its properties, as might be naturally expected.

c. Spring-water includes *well*-water, and all others that arife from fome depth below the furface of the earth, and which are ufed at the fountain-head, or at leaft before they have run any confiderable diftance expofed to the air. Although all fpring-waters are originally of atmofpheric origin, yet they differ from one another according to the nature of the foil or rock from which they iffue; for though the ingredients ufually exifting in them are in fuch minute quantities as to impart to them no ftriking medicinal or fenfible properties, and do not render them unfit for common purpofes, yet they modify their nature very confiderably. Hence the water of fome fprings is faid to be *hard*, others *foft*, fome *fweet*, others *brackifh*, &c. according to the degree and nature of the impregnating ingredients. Common fprings pafs infenfibly into mineral or medicinal fprings, as their foreign contents become larger or more unufual; or in fome inftances they derive medicinal celebrity from the abfence of thofe ingredients ufually occurring in fpring-water; as, for example, is the cafe with the Malvern and other fprings. Almoft all fpring-waters poffefs the property termed *hardnefs* in a greater or lefs degree. This hardnefs, as we formerly mentioned, depends chiefly upon the fulphate and carbonate of lime which they hold in folution. The quantity of thefe earthy falts varies very confiderably in different inftances; but Dr. Saunders obferves, that when they exift in the proportion of five grains in the pint, fuch water will be hard, and from its property of decompofing foap will be unfit for wafhing, and many other purpofes of houfehold ufe or manufactures. The water of deep wells, according to Dr. S., is always, *cæteris paribus*, much harder than that of fprings which overflow their channel; but there are many exceptions to this rule. The *foftnefs* of fpring-waters depends on their containing fmaller proportions of the earthy falts above-mentioned. Spring-waters are faid to be brackifh, when they contain a fmall proportion of the muriates of foda, magnefia, or lime, as is frequently the cafe in the neighbourhood of the fea. *Sweetnefs* is generally underftood as oppofed to *brackifhnefs* or *fœtor* when applied to fpring-waters. The fpecific gravity of fpring-waters in general is greater than that of diftilled or any other potable water. See SPRING.

d. Running waters include *river*-waters, and every other fpecies of water expofed to the air, and moving in an open channel. On this part of our fubject we cannot do better than quote from Dr. Saunders. "River-water," fays Dr. S., "in general is much fofter, and more free from earthy falts than fpring-waters, but contains lefs air of any kind; for by the agitation of a long current, and, in moft cafes, a great increafe of temperature, it lofes common air and carbonic acid, and with this laft much of the lime which it held in folution. The fpecific gravity thereby becomes lefs, the tafte not fo harfh, but lefs frefh and agreeable, and out of a hard fpring is often made a ftream of fufficient purity for moft of the purpofes where a foft water is required. Some ftreams, however, that arife from a clean filecious rock, and flow in a fandy or ftony bed, are from the outfet remarkably pure, fuch as the mountain lakes and rivulets in the rocky diftricts of Wales, the fource of the beautiful waters of the Dee, and numberlefs other rivers that flow through the hollow of every valley. Switzerland has long been celebrated for the purity and excellence of its waters, which pour in copious ftreams from the mountains, and give rife to fome of the fineft rivers in Europe."—"Some rivers, however, that do not take their rife from a rocky foil, and are indeed at firft confiderably charged with foreign matter, during a long courfe, even over a richly cultivated plain, become remarkably pure as to faline contents, but often fouled with mud and vegetable or animal exuviæ, which are rather fufpended than held in true folution. Such is that of the Thames, which, taken up at London at low water, is very foft and good water, and after reft and filtration it holds but a very fmall portion of any thing that could prove noxious, or impede any manufacture. It is alfo excellently fitted for fea-ftore, but it here undergoes a remarkable fpontaneous change. No water carried to fea becomes putrid fooner than that of the Thames. When a cafk is opened, after being kept a month or two, a quantity of inflammable air (carburetted or fulphuretted hydrogen) efcapes, and the water is fo black and offenfive as fcarcely to be borne. Upon racking it off, however, into large earthen veffels, and expofing it to the air, it gradually depofits a quantity of black flimy mud, becomes clear as cryftal, and remarkably fweet and palatable. The Seine has a high reputation in France, and appears, from the experiments of M. Parmentier, to be a river of great purity. It might be expected that a river which has paffed by a large town, and received all its impurities, and been ufed by numerous dyers, tanners, hatters, and the like, that crowd to its banks for the convenience of plenty of water, fhould acquire thereby fuch a foulnefs as to be very perceptible to chemical examination for a confiderable diftance below the town; but it appears from the moft accurate examination, that where the ftream is at all confiderable, thefe kinds of impurity have but little influence in permanently altering the quality of the water, efpecially as they are for the moft part only fufpended, and not truly diffolved; and therefore mere reft, and efpecially filtration, will reftore the water to its original purity. Probably, therefore, the moft accurate chemift would find it difficult to diftinguifh water taken up at London from that procured at Hampton-court, after each had been purified by fimple filtration." The water of the Ebro alfo, notwithftanding this river paffes through feveral large towns, is remarkable for its purity. In general, thofe rivers which iffue from lakes are moft pure and tranfparent, while thofe chiefly

fupplied

supplied by springs and rain are the reverse. The water of some rivers is remarkable for its colour: thus that of the Tinto, in Spain, at its source is of a fine topaz, a circumstance from which the river takes its name. Others are of a yellowish or greyish-white, and the water of all such rivers usually holds a large proportion of some salt of lime in solution. In countries where bogs and marshes abound, the rivers are often tinged of a brownish colour.

e. Stagnant Waters.—Under this head are included the waters of lakes, pools, and reservoirs of every description, in which this fluid is exposed to the air in a state of rest. Stagnant waters, in general, present greater impurities to the senses than any others, from their usually containing a large proportion of animal and vegetable matters in a state of decomposition. Their taste in general is vapid, and destitute of that freshness and agreeable coolness which distinguish spring-water. Stagnant waters have various origins, but usually they are a mixture of rain, spring, and river water; and hence, besides the animal and vegetable matters they contain, may be supposed to be impregnated with the various saline matters usually met with in such waters. Many stagnant waters are said to contain the nitrate of potash; others, and especially some lakes, abound in the sulphate of magnesia; others in the carbonate of soda, as, for example, the natron lakes of Egypt and Hungary, which are generally very shallow. A lake in Thibet is impregnated with the borate of soda mixed with the muriate of soda, the waters of which seem to have a subterranean origin. Some lakes also are found impregnated with sulphuretted hydrogen gas. Stagnant waters are seldom perfectly colourless and transparent. Lakes, when deep, are usually of a blueish tinge, mixed with green; and when the neighbouring hills are covered with peat, &c. their water is always of a muddy-brownish tinge, as, for example, is the case with most of the lakes in Scotland.

1. *Uses of Potable Waters.*—If we were to be directed by the evidences of the senses alone, *spring*-waters would undoubtedly be pronounced to be the most wholesome, for they are universally admitted to be the most agreeable. All other waters have more or less of a flat insipid taste. This is especially the case with *distilled* and *rain* water; the first of which is quite pure, and the second nearly so. *Distilled* water, therefore, is seldom employed for drinking; and the difficulty of procuring it in large quantities almost precludes its use to any extent in the preparation of food, or in manufactures. Much, however, has been lately said of its medicinal powers by Dr. Lambe, who has recommended it in cancerous and other affections; and, as Dr. Saunders justly observes, water, when not already loaded with foreign matters, may become a solvent for concretions in the urinary passages; and as much good has been obtained from the use of very pure natural springs, a course of distilled water may be considered as a fair subject of experiment. *Distilled* water is an essential ingredient in the composition of many medicines, and often absolutely necessary in the prosecution of all nicer chemical processes in the liquid way. *Snow* and *ice* water form almost the constant drink of the inhabitants of cold climates during winter; and the masses of ice which float on the polar seas afford an abundant supply of fresh water to the mariner. "*Snow*-water," says Dr. Saunders, "has long lain under the imputation of occasioning those strumous swellings in the neck which deform the inhabitants of many of the Alpine valleys; but this opinion is not supported by any well-authenticated indisputable facts, and is rendered still more improbable, if not entirely overturned, by the frequency of the disease in Sumatra, where ice and snow are never seen, and its being quite unknown in Chili and Thibet, though the rivers of those countries are chiefly supplied by the melting of the snow with which the mountains are always covered." *Dew*, especially when collected in the month of May, was formerly in great repute as a cosmetic, and for many other purposes; but its use has been long entirely laid aside. *Spring*-waters, as before observed, from the air they contain, and from their grateful coolness, constitute by far the most agreeable of the potable waters, and are in more general use than any others. Their use, however, is stated sometimes to occasion in delicate stomachs an uneasy sense of weight, followed by a degree of dyspepsia. They have also been accused, especially when of the description termed *hard*, of inducing calculous affections; but this notion by most modern writers is considered as ill-founded. *Spring*-waters, in general, also, from their property of hardness, are, as before observed, very ill adapted for many domestic and other purposes; while, in particular instances, this quality is of advantage. Hard *spring*-waters, for example, are very ill adapted for the purposes of the dyer or bleacher. "On the other hand," says Dr. Saunders, "there are several saline substances which are very readily soluble in any kind of water, and here a hard water may be employed when the object is only to procure these particular salts. For culinary purposes, water is used either to soften the texture of animal or vegetable matter, or to extract from it, and present in a liquid form some of its soluble parts. Soft pure water will fulfil both these objects better than hard water; and at the same time the colour of the substance employed will vary as well as its solution. Green vegetables and pulse are rendered quite pale, as well as tender, by boiling in soft water; whereas in a hard water, the colour is more preserved, and the texture less altered, because in the former case the colouring matter of the vegetable is readily extracted by the menstruum, whilst in the latter more of it remains, and is likewise altered by the chemical action of the earthy or neutral salts." Dr. S. then relates some comparative experiments he made with hard and pure water upon tea; from which he concludes that hard water is less powerful in softening the texture of vegetable leaves than soft water, and that it is not able to exert its full effect in heightening their colour till assisted by heat; and also, that the gallic acid (or tannin) is equally well extracted by hard as by soft water, when by raising the temperature, the power of the former as a solvent is fully exercised. It may be therefore laid down as a general rule in domestic economy, that when the object is to extract the virtues of any substance, and to retain them in solution, *soft* waters should be used; but that when the object is the reverse, or to preserve as entire as possible the article used as food, *hard* waters are preferable.

Some fine springs of very pure and soft water have been long celebrated for their medicinal properties; as, for example, the *Malvern* springs, in Worcestershire, and *St. Winifrid's Well*, at Holywell, in Flintshire. *Malvern* water is used both externally and internally. Externally applied, it is stated to be a most useful application to deep-seated ulcerations of a scrofulous nature, and to various cutaneous affections. Its internal use is often of advantage "in painful affections of the kidneys and bladder, attended with the discharge of bloody, purulent, or fœtid urine; the hectic fever produced by scrofulous ulcerations of the lungs, or very extensive and irritating sores on the surface of the body; and also fistulas of long standing, that have been neglected, and have become constant and troublesome sores." The internal use of this water sometimes induces nausea at first, and occasionally drowsiness, vertigo, and head-ache, which soon go off, or may be readily removed by a mild purgative.

purgative. This water occafionally purges, but moft commonly the body becomes coftive under its ufe. "In all cafes, it increafes the flow of urine, and improves the general health of the patient; fo that his appetite and fpirits almoft invariably improve during a courfe of the water, if it agrees in the firft inftance." The duration of a courfe of this water depends in a great degree upon the nature of the difeafe under which the patient labours. Thefe obfervations upon the effects of the Malvern water are perhaps equally applicable to all fpring-waters of a fimilar degree of purity.

What has been faid of fpring-waters may be applied perhaps with little modification to *running* waters, which in general differ from *fpring*-waters only in being fofter, in containing lefs air, and in being therefore better qualified for many purpofes for which fpring-waters cannot be employed. *Stagnant* waters in general, efpecially in marfhy countries and hot climates, are ufually efteemed unwholefome, and perhaps defervedly fo. This arifes chiefly from the large quantity of vegetable and animal exuviæ which they contain, and perhaps from other circumftances of which we are at prefent ignorant. They fhould never be ufed, therefore, till they have been boiled and filtered; by which proceffes moft of the foreign fubftances will be probably removed. In general ftagnant waters, as Dr. Saunders obferves, are unpalatable; and this circumftance has probably caufed them to be fometimes in worfe credit than they actually deferve to be on the fcore of falubrity.

2. *Simple faline Waters.* — Under this denomination we include all thofe waters impregnated with neutral, alkaline, and earthy falts only. Waters of this defcription may be arranged under the following heads: — *a.* Brines, or waters whofe principal faline ingredients are the muriates of foda and magnefia; and *b.* Bitterns, or waters containing principally the fulphates of foda and magnefia.

a. Sea-water, which may be confidered as an example of the faline waters termed brines, is one of the moft abundant and extenfively diffufed compounds occurring upon our globe. When taken up at a confiderable diftance from the fhore it is quite tranfparent and colourlefs, and free from any fmell. Its tafte is ftrongly faline, and at the fame time naufeous and bitter. When kept for a fhort time it becomes highly offenfive, from the putrefaction of the animal and vegetable matters which it holds in folution. Its fpecific gravity varies in different latitudes and circumftances, but may be faid to lie between 1.0269 and 1.0285. The fpecific gravity is faid to be lefs within the polar circles than at the tropics, owing probably to the vaft quantities of ice found in thofe regions. The waters of inland feas alfo, that have little connection with the ocean, and the water of bays, &c. into which frefh-water rivers empty themfelves, contain in general lefs faline matters than the open ocean. This is particularly the cafe with the Baltic, efpecially when the wind blows from the eaft. The Mediterranean fea, on the contrary, is faid to be more faline than the Atlantic. Water taken from a confiderable depth is more faline than that taken from the furface, particularly after much rain, for rain-water being lighter appears to move upon the furface for a confiderable time before it becomes quite incorporated. The quantity of faline matter alfo is ftated to be greater in fummer than in winter. The water of the Britifh coafts is faid to contain upon an average about one-thirtieth of its weight of faline matter, and its temperature to vary between 40° and 65°. Sea-water does not freeze till cooled down to 28.°5. The following is one of the lateft analyfes of fea-water by Dr. Murray. A wine pint of water collected in the Firth of Forth was found to contain

	Grains.
Of lime - - - -	2.9
Magnefia - - - -	14.8
Soda - - - -	96.3
Sulphuric acid - - -	14.4
Muriatic acid - - -	97.7
	226.1

Or, fuppofing the elements to be combined in the modes in which they are obtained by evaporation; that is, as muriate of foda, muriate of magnefia, fulphate of magnefia, and fulphate of lime, the proportions of thefe falts in a pint will be,

	Grains.
Muriate of foda - - -	180.5
——— of magnefia - -	23.0
Sulphate of magnefia - -	15.5
——— of lime - - -	7.1
	226.1

Or, fuppofing that the lime exifts as muriate of lime, (which is the moft probable conclufion with regard to it); and farther, fuppofing that the fulphuric acid exifts in the ftate of fulphate of magnefia, the proportions will be,

	Grains.
Muriate of foda - - -	180.5
——— of magnefia - -	18.3
——— of lime - - -	5.7
Sulphate of magnefia - -	21.6
	226.1

Or, laftly, fuppofing that the fulphuric acid exifts in the ftate of fulphate of foda, the proportions will be,

	Grains.
Muriate of foda - - -	159.3
——— of magnefia - -	35.5
——— of lime - - -	5.7
Sulphate of foda - - -	25.6
	226.1

The bitter tafte of fea-water is owing chiefly to the muriate of magnefia which it contains. It may alfo arife, in part, from the prefence of decayed vegetable and animal fubftances. See the articles SALT, SALTNESS, and SEA.

Many attempts have been made to render fea-water potable. Of thefe the beft, and indeed the only good one, is diftillation.

The method of obtaining frefh water from the diftillation of fea-water was practifed by fir R. Hawkins, in the reign of queen Elizabeth, who thus obtained water that was wholefome and nourifhing. See Purchas's Collect. of Voyages, book vii. chap. 5.

Experiments were afterwards made by Hales, Lifter, Hanton, Lind, and others, to fimplify and render more perfect the procefs of diftillation, and at length it attained a great degree of perfection, both in France and England. Thus M. de Bougainville, in his Voyage round the World, bore ample teftimony to the utility of the machine for diftilling fea-water, which had been made public in 1763 by M. Poiffonnier, its inventor; and lord Mulgrave, in his

Voyage towards the North Pole, in 1773, did equal juſtice to the method of obtaining freſh water from the ſea by diſtillation, which had been introduced into the Engliſh navy in 1770, by Dr. Irving, and for which he obtained a parliamentary reward of 5000*l*.

Dr. Irving's contrivance conſiſted in converting the ſhip's kettle into a ſtill. Every ſhip's kettle is divided into two parts, by a partition in the middle; one of theſe parts is only in uſe when peas or oatmeal are dreſſed, but water is at the ſame time kept in the other, to preſerve its bottom. Dr. Irving availed himſelf of this circumſtance; and by filling the ſpare part of the copper with ſea-water, and fitting on the lid and tube, ſhewed that ſixty gallons of freſh water could be drawn off, during the boiling of either of the above-mentioned proviſions, without the uſe of any additional fuel. He recommended alſo the preſerving of the water diſtilled from the coppers in which peas, oatmeal, or pudding, are dreſſed, as both a ſalutary beverage for the ſcorbutic, and the moſt proper kind of water for the boiling of ſalt proviſions. Dr. Irving particularly directed that only three-fourths of the ſea-water ſhould be diſtilled, as the water diſtilled from the remaining concentrated brine was found to have a diſagreeable taſte; and as the farther continuation of the diſtillation proved injurious to the veſſels. For an account of the ſeveral experiments made on ſome of the beſt diſtilled water, prepared by Dr. Irving from ſea-water, by Dr. Watſon, ſee his Chem. Eſſ. vol. ii. p. 168, &c.

The ſhips of diſcovery lately ſent out by the French government are furniſhed with an economical diſtilling apparatus, and inſtead of water have taken with them a ſupply of fuel.

Dr. Prieſtley ſuggeſted a plan to give to diſtilled water the briſkneſs and ſpirit of freſh ſpring-water, and at the ſame time to render it, perhaps, a remedy or preventive againſt the ſcurvy, by impregnating it with carbonic acid gas. Diſtilled water alſo acquires, in a conſiderable degree, the grateful flavour of common water, by ſimple expoſure for ſome time to the atmoſphere.

Sea-water may be likewiſe rendered potable by converting it into ice. In the polar regions, therefore, there can be no want of freſh water. In warm climates, the ingenious freezing apparatus of Mr. Leſlie may be employed to procure a ſupply of freſh water from the ocean.

b. As an example of the bitterns we may ſelect the *Sedlitz water*, which is one of the beſt known, and ſtrongeſt of this deſcription of ſimple ſaline waters. Sedlitz is a village in Bohemia, and its waters, as well as thoſe of Seydſchutz in the immediate neighbourhood, and which cloſely reſemble them, were firſt brought into note about a century ago by the celebrated Bergman. The taſte of theſe waters is ſtrongly bitter and ſaline, but not in the leaſt briſk or acidulous, as they uſually contain a ſmall proportion of gaſeous matters. Thus the Seydſchutz water above-mentioned was found by Bergman to yield only 6 *per cent*. of gaſeous products, two-thirds of which only were carbonic acid. Its ſpecific gravity, as ſtated by the ſame chemiſt, is 1.006, and an Engliſh wine pint was found to contain of

	Grains.
Carbonate of lime - -	.944
Sulphate of lime - -	5.140
Carbonate of magneſia - -	2.622
Muriate of magneſia - -	4.567
Sulphate of magneſia - -	180.497
	193.770

Sulphate of ſoda is not mentioned as an ingredient in this water, although it doubtleſs exiſts in it; at leaſt this ſalt almoſt always occurs in waters of this deſcription.

Medicinal Properties and Uſes of the ſimple ſaline Waters.—All waters of this deſcription act more or leſs ſtrongly upon the bowels, according to the quantity of ſaline ingredients which they contain; hence they are often of the greateſt uſe in complaints where alvine evacuations are particularly indicated. They generally act alſo as diuretics. Sea-water and all brines have the property of inducing a ſenſation of thirſt. "Sea-water," ſays Dr. Saunders, "when uſed internally, ſhould be taken in ſuch doſes as to prove moderately purgative, the increaſe of this evacuation being the peculiar object for which it is employed: about a pint is generally ſufficient, and this ſhould be taken in the morning, at two doſes, with an interval of about half an hour between each. It is ſeldom neceſſary to repeat the doſe at any other time of the day. This quantity contains half an ounce of purgative ſalt, of which about three-fourths are muriate of ſoda."—"There is very little danger ever to be apprehended from an exceſſive doſe of ſea-water, except the inconvenience of a temporary diarrhœa, and ſometimes a ſoreneſs at the extremity of the rectum, which all ſaline purgatives are now and then apt to produce." The internal uſe of ſea-water, beſides its general uſe in diſeaſes where cathartics are indicated, has been recommended in various forms of ſcrofulous affection, eſpecially in indolent glandular tumours in the neck and other parts, which are commonly ſlow in ulcerating and in their cure; alſo in deep-ſeated ſcrofulous inflammations, followed by caries of the bones, profuſe diſcharges, and tedious exfoliation, and particularly in ſcrofulous ophthalmia. "In all ſuch caſes, the internal uſe of ſea-water is almoſt entirely confined to thoſe periods of the diſeaſe when there is no general fever and hectic tendency, when no ſymptoms of danger are preſent, and when the object is rather to prevent a relapſe than oppoſe any preſent diſeaſe. The external uſe of ſea-water either as a general cold bath, or as a topical application to indolent ſwellings, or granulating ulcers, when the healing proceſs has commenced, coincides perfectly well in theſe caſes with the general intention." The moſt important advantages of ſea-water are indeed probably derived from its external uſe as a bath. (See the articles BATH and BATHING.) With reſpect to the medicinal properties of the bitterns, we ſhall attempt to illuſtrate them by relating thoſe of the Sedlitz water, which we before ſelected as an example of the whole tribe. A pint of this water, taken in divided portions, is generally a full doſe for an adult, and the ſtrongeſt perſon ſeldom requires more than two pints. It operates very ſpeedily, and without producing griping or flatulency; and is ſtated by Hoffmann, as quoted by Dr. Saunders, to be of the utmoſt advantage in a foul ſtate of the ſtomach, and general torpor of the inteſtinal canal, as it not only ſtimulates theſe organs to expel their morbid contents, but by its bitterneſs reſtores their tone, and with it the appetite and digeſtive powers. "When the preſence of hypochondriaſis is marked by anxiety, general languor, perturbed dreams, a livid hue on the face, difficulty of breathing, pain of the back and head, vertigo and coldneſs of the extremities; when a bilious humour and a depraved ſecretion of the ſtomach impairs its tone and healthy action, and is attended with obſtinate coſtiveneſs; this water, by evacuating its contents and reſtoring the due force of contraction, enables it to throw off the offending matter."—"Numerous trials alſo have ſhewn the efficacy of this ſaline water in that cachexy of females attended with a ſuppreſſion of the menſtrual diſcharge, whereby

whereby are produced a general languor, difficult reſpiration, febrile heat and irritation, waſting of the body, and loſs of appetite. Alſo when women have arrived at that time of life when this periodical evacuation begins to ceaſe, and is ſucceeded by a number of anomalous diſorders, ſuch as proſtration of appetite, flatulent pains, irregular fluſhings, pains in the back and ſwelling of the feet, a courſe of Sedlitz water reſtores the wavering appetite, and diſperſes the tumours and other morbid ſymptoms. Men of from forty to fifty years of age, who have led a very ſedentary life, and have been accuſtomed to intenſe thought and profound meditation, become frequently affected with œdematous tumours in the extremities, a want of due action in the ſtomach, eructations after taking food, and a generally impaired ſtate of health; all of which are for the moſt part very certainly removed by a liberal uſe of this water. Perſons alſo of a plethoric habit of body, who from ſome obſtruction of blood in the abdominal viſcera, and have acquired a ſtrong diſpoſition to hæmorrhoidal affections, become thereby often expoſed to very ſerious evils. To ſuch perſons a ſaline water like that of Sedlitz is often of great utility, eſpecially if accompanied by blood-letting when requiſite, and a general antiphlogiſtic plan of cure. Another important uſe of theſe waters is in removing from the ſyſtem thoſe impurities and acrid humours which are uſually termed ſcorbutic." Such are the properties of the Sedlitz ſaline waters according to the celebrated Hoffmann, whoſe account, as quoted by Dr. Saunders, we have extracted, becauſe it preſents in few words a comprehenſive and rational view of the medicinal properties of this important tribe of waters in general. We wiſh however to obſerve, that when the ſtomach is in a very weak ſtate, and dyſpepſia is preſent in a very great degree, ſaline purgatives and waters in general may do harm by increaſing theſe affections; their uſe, therefore, in ſuch caſes is rather contra-indicated, or at leaſt ſhould be combined with other remedies calculated to invigorate theſe organs, eſpecially chalybeates.

3. *Simple chalybeate Waters.*—Chalybeate waters are either *ſimple* or *compound*. Under this head of *ſimple chalybeates* we include all waters whoſe characteriſtic ingredient is one or more of the neutral ſalts of iron. Theſe may be conſidered as of two general deſcriptions:—*a*. Waters containing the carbonate of iron, without any ſtriking exceſs of carbonic acid; and *b*. Waters containing the ſulphate or muriate of iron, generally in combination with a large proportion of the ſulphate of alumina. Waters of this laſt deſcription are much more rare than the former, and are uſually formed from the decompoſition of iron pyrites.

a. As an example of the firſt of theſe varieties of ſimple chalybeate waters, we may adduce that of Tunbridge Wells. This water has been lately ſubmitted to a careful and accurate analyſis by Dr. Scudamore, from whoſe pamphlet on the ſubject we chiefly take the following account. The temperature of the ſpring throughout the year is uniformly 50°; and its ſp. gr. in the month of Auguſt, at its natural temperature, was 1.0007. The freſh water is perfectly tranſparent, and does not ſend forth air-bubbles. It exhales a ſmell which is diſtinctly chalybeate. Its taſte in this reſpect is ſtrongly marked, but is neither acidulous nor ſaline. It has an agreeable freſhneſs, and is by no means unpalatable. Submitted to analyſis, one gallon was found to contain,

	Cubic Inches.
Of carbonic acid	8.05
Oxygen	.50
Azote	4.75
	13.30

	Grains.
Of muriate of ſoda	2.47
——— of lime	.39
——— of magneſia	.29
Sulphate of lime	1.41
Carbonate of lime	.27
Oxyd of iron	2.29
Traces of mangaueſe, inſoluble matter (vegetable fibre, ſilex, &c.)	.44
Loſs in proceſſes	.13
	7.69

Or, ſtating the reſults according to Dr. Murray's view, which will be particularly explained when we treat of the *analyſis* of mineral waters, the following eſtimate will appear:

	Grains.
Muriate of ſoda	1.25
Sulphate of ſoda	1.47
Muriate of lime	1.54
——— of magneſia	.29
Carbonate of lime	.27
Oxyd of iron	2.29
Traces of manganeſe, &c.	.44
Loſs, &c.	.13
	7.68

This latter eſtimate, which renders the carbonate of iron the moſt abundant ingredient in the water, appears much more probable than the former, and to account more ſatiſfactorily for its medicinal effects.

b. One of the moſt ſtriking examples of the ſecond variety of ſimple chalybeate waters is that occurring in the Iſle of Wight, and lately analyſed by Dr. Marcet. This ſpring iſſues from a cliff on the S.S.W. ſide of the iſle, immediately under St. Catherine's Down, in the pariſh of Chale, between which village and the village of Niton it is nearly equidiſtant. The diſtance from the ſea-ſhore is about 150 yards, and elevation about 130 feet above the level of the ſea. Its properties, &c. are the following:—When it firſt iſſues from the rock it is perfectly tranſparent, and remains ſo if kept in cloſe veſſels; but when expoſed to the air, reddiſh flakes are ſoon depoſited in it. It has a ſlight chalybeate ſmell, and a highly aſtringent and ſtyptic taſte. Its ſpecific gravity, in a courſe of ſeveral experiments, was found to be 1007.5. One pint or ſixteen-ounce meaſures yielded

Of carbonic acid $\frac{3}{10}$ths of a cubic inch,

	Grains.
Sulphate of iron, in the ſtate of cryſtallized green ſulphate	41.4
Sulphate of alumina, a quantity of which, if brought to the ſtate of cryſtallized alum, would amount to	31.6
Sulphate of lime dried at 160°,	10.1
Sulphate of magneſia cryſtallized	3.6
Sulphate of ſoda cryſtallized	16.0
Muriate of ſoda cryſtallized	4.0
Silica	0.7
	107.4

This therefore is the ſtrongeſt aluminous chalybeate known.

Medicinal Properties and Uſes of ſimple chalybeate Waters.—*a*. The ſeaſon for drinking the Tunbridge water, which we have ſelected as an example of the ſimple carbonated chalybeates,

lybeates, is uſually from May to November. On entering upon the uſe of this water ſome aperient ſhould be premiſed; and Dr. Scudamore recommends that the firſt doſe ſhould be taken at ſeven or eight o'clock in the morning, the ſecond at noon, and the third about three in the afternoon. The exact quantity to be taken muſt be varied according to circumſtances; but "as a general ſtatement," ſays Dr. S., "I would ſay that half a pint daily is the extreme ſmalleſt quantity, and that two pints daily is the extreme largeſt amount to found a juſt expectation of benefit; and further, in the way of general outline of direction, I conceive that half a pint, a pint, a pint and a half, and two pints, ſhould form the progreſſive ratio of the total daily quantity to be taken at the three intervals. As the patient arrives at the larger proportions, they may with advantage be ſubdivided with the interval of a quarter or half an hour, which ſhould be occupied in exerciſe." Tea at breakfaſt is directed to be avoided; and in caſes when the water diſagrees at its natural temperature, it is recommended to be adminiſtered warm. "On the firſt employment of the water, either cold or warm, ſome inconvenient ſenſations very commonly ariſe, ſuch as fluſhing of the face, ſlight fulneſs of the head, with drowſineſs and an uneaſy diſtenſion of the ſtomach, together with continued flatulence. In general theſe effects are not of importance, either in degree or duration, and are much to be prevented by previous attention to the ſtomach and bowels."—"As a general ſtatement, it may be added, that the employment of this water is improper in a very plethoric ſtate of the circulation; alſo when there is an inflammatory determination to any particular organ, or even when local congeſtion exiſts without inflammation. In caſes of ſimple debility of the conſtitution, the water promiſes to produce its happieſt effects. The proofs of its immediately agreeing with the patient are increaſed appetite and ſpirits, and theſe auſpicious ſymptoms are followed by a gradual improvement in the general energy and ſtrength." The bowels uſually become conſtipated under its uſe, and require the aſſiſtance of medicine. The warm bath is occaſionally of ſervice in conjunction with this water, as was long ago pointed out by Hoffmann. Exerciſe alſo after its uſe is generally of great importance. In dyſpepſia depending on debility of the ſtomach, and accompanied with general languor and nervouſneſs, this water is remarkably reſtorative. In uterine debility alſo, and chloroſis, its uſe is often of the utmoſt ſervice. It has been much recommended likewiſe in ſome cutaneous affections. For the complaints of children, eſpecially when young, (that is to ſay, under ſix or ſeven years of age,) it is not in general adapted, for reaſons ſufficiently obvious. A courſe of this water may vary from three weeks to two or three months, according to circumſtances. *b.* With reſpect to the medicinal properties of waters containing the ſulphates of iron and alumina, as the Iſle of Wight and Hartfell waters above-mentioned, they differ little perhaps, except in degree, from thoſe of the ſimple chalybeate waters. The Iſle of Wight water is ſo ſtrong, that it is always proper to dilute it at firſt with twice its quantity of common water; and even then the doſe cannot well exceed two or three ounces, which may be gradually increaſed to about a pint in twenty-four hours. Dr. Saunders recommends the ſame quantity as the maximum doſe of the Hartfell water. Both theſe waters are often much improved by being gently heated, eſpecially in caſes where the ſtomach is very delicate and irritable. Dr. Lempriere, who has written a pamphlet on the Iſle of Wight water, ſtates, that he found it particularly ſerviceable in the debility induced by the Walcheren fever, chronic dyſentery, &c. as well as in every inſtance when the conſtitution had been undermined by previous illneſs, and the ordinary tonics had failed. It is particularly neceſſary to guard againſt coſtiveneſs during the uſe of theſe waters.

Compound Chalybeate Waters.—Theſe may be divided into *a. Saline chalybeates*, and *b. Acidulous chalybeates.*

a. The Cheltenham waters, properly ſo called, are a good example of the *ſaline chalybeates.* (For the hiſtory of theſe waters, ſee CHELTENHAM.) Since that article was written, however, ſeveral ſprings of different qualities and powers have been diſcovered by Mr. Thomſon; an abſtract of the compoſition and properties of which, as lately publiſhed, we ſhall now take the opportunity of laying before our readers.

The ſprings which have been deſcribed and analyſed by Meſſrs. Brande and Parkes are ſix, *viz.*

1. The ſtrong chalybeate ſaline water. Sp. gr. 1009.2.
2. The ſtrong ſulphuretted ſaline water. Sp. gr. 1008.5.
3. The weak ſulphuretted ſaline water. Sp. gr. 1006.
4. The pure ſaline water. Sp. gr. 1010.
5. The ſulphuretted and chalybeated magneſia ſpring, or bitter ſaline water. Sp. gr. 1008.
6. Saline chalybeate, drawn from the well near the laboratory.

The following Table preſents a view of the contents of a wine pint of theſe different ſprings.

Springs.	1	2	3	4	5	6
	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.
Muriate of ſoda	41.3	35.0	15.0	50.0	9.5	22.0
Muriate of magneſia	—	—	—	—	9.0	—
Sulphate of ſoda	22.7	23.5	14.0	15.0	—	10.0
Sulphate of magneſia	6.0	5.0	5.0	11.0	36.5	—
Sulphate of lime	2.5	1.2	1.5	4.5	3.5	—
Carbonate of ſoda	1.5	—	—	—	—	—
Oxyd of iron		0.3	0.5	—	0.5	1.5
Loſs	—	—	—	—	1.0	0.5
Total	74.0	65.0	36.0	80.5	60.0	34.0
	Cub. In.	Cub. In.	Cub. In.	Cub. In.	Cub. In.	Cub. In
Sulphuretted hydrogen	—	2.5	2.5	—	1.5	—
Carbonic acid	2.5	1.5	1.5	—	4.0	10.0
Total	2.5	4.0	4.0	0.0	5.5	10.0

The

The *medicinal properties* of theſe different ſprings of courſe vary according to their compoſition and ſtrength. Mr. Thomſon, the proprietor, procures from them ſix different ſaline preparations, neither of which, however, is preciſely ſimilar to the water drank at the ſpa. Theſe he denominates, cryſtallized alkaline ſulphates; ditto effloreſced and ground to an impalpable powder for hot climates; magneſian ſulphate in a ſtate of efloreſcence; a murio-ſulphate of magneſia and iron in brown cryſtals, highly tonic; ſub-carbonate of magneſia in powder, and calcined magneſia.

b. As an example of the *acidulous chalybeates*, we may adduce the celebrated waters of Spa. (See SPA.) Dr. Jones has lately publiſhed an intereſting paper on theſe waters, which contains, among other things, analyſes of the different ſprings, of the reſults of which the following table preſents a ſummary view.

TABLE exhibiting the Nature and Proportion of the Subſtances contained in One Gallon of the reſpective Spa Waters.

Fountains.	Temperature.	Specific Gravity.	Carbonic Acid Gas. Cub. In.	Solid Contents. Grains.	Sulphate of Soda.	Muriate of Soda.	Carbon. of Soda.	Carbon. of Lime.	Carbon. of Magneſia.	Oxyd of Iron.	Silex.	Alumina.	Loſs.
Pouhon -	50	1.00098	262.0	26.8	0.92	1.26	2.45	9.87	1.80	5.24	2.26	0.29	2.71
Geronſtere -	49½	1.0008	168.5	12.50	0.62	0.64	1.43	5.20	1.05	0.94	1.40	0.19	1.03
Sauviniere -	49½	1.00075	241.4	8.50	0.05	0.25	0.60	3.50	0.69	2.10	0.40	0.10	0.90
Groeſbeeck -	49½	1.0007	265.0	5.90	0.05	0.15	0.30	2.40	0.20	1.55	0.60	0.10	0.55
1ſt Tonnelet -	49½	1.00075	282.0	5.30	0.06	0.15	0.20	1.10	0.30	2.70	0.60	0.10	0.09
2d Tonnelet -	49½	1.00075	260.5	3.70	*	*	0.10	0.90	0.20	1.50	0.65	*	0.35
Watroz - -			not aſcertained.	9.30		0.2	0.10	1.40	1.90	2.60	0.90	0.60	1.80
The Pouhon, after much wet weather.				32.3	0.80	0.95	2.0	13.82	2.97	4.45	3.27	0.38	3.68

* Quantity not appretiable.

With reſpect to the *medicinal properties* of the compound chalybeates, they are, as might be expected, of a mixed character, and uſually correſpond with the nature of the predominant impregnating ingredients; hence their properties will be readily underſtood from what has been advanced. For further particulars reſpecting the medicinal properties of the CHELTENHAM and SPA waters, we refer our readers to theſe articles.

4. *Simple Acidulous Waters.*—Under this denomination may be included all waters whoſe characteriſtic ingredient is an acid. They may be conſidered as of two deſcriptions: *a.* Thoſe impregnated with a volatile acid, as the carbonic and ſulphurous acids; and *b.* Thoſe containing a fixed acid, as the muriatic and ſulphuric acids.

a. The waters of Seltzer may be adduced as an example of the firſt variety of acidulous waters. "Seltzer is a village ſituated in a fine woody country, about ten miles from Frankfort, and thirty-ſix from Coblentz, in a diſtrict which abounds with valuable mineral ſprings." This water has been examined by Hoffmann, Bergman, and others. When freſh from the well, it is perfectly clear and pellucid, and ſparkles much when poured into a glaſs. Its taſte is ſlightly pungent, but at the ſame time gently ſaline and alkaline. On expoſure to the air for a ſhort time, the carbonic acid eſcapes, and the alkaline taſte becomes more perceptible. According to Bergman, an Engliſh pint contains of

		Cub. Inches.
Carbonic acid upwards of	-	17
		Grains.
Carbonate of lime about	-	3
Carbonate of magneſia	-	5
Carbonate of ſoda	- -	4
Muriate of ſoda	- -	17.5
		29.5

b. Waters containing a free mineral acid in exceſs are very rare, and chiefly confined to volcanic countries. Mr. Garden has lately examined a water of this deſcription from White iſland, on the coaſt of New Zealand: it was of a pale yellowiſh-green colour; its odour reſembled that of a mixture of muriatic and ſulphurous acids. Its taſte was ſtrongly acid and ſtyptic, like that of a chalybeate. Its ſpecific gravity 1.073. On being ſubmitted to analyſis, its contents were found to conſiſt chiefly of muriatic acid, a ſlight trace of ſulphur, ſmall proportions of alum, muriate of iron, and ſulphate of lime. Waters impregnated with

ſulphuric

ſulphuric acid are ſometimes met with likewiſe in the vicinity of volcanoes.

As to the *medicinal properties* of theſe waters, they probably differ little from thoſe of a dilute ſolution of the different acids which they contain. For the particular properties of the Seltzer water, ſee SELTZER.

Compound Acidulous Waters.—Acidulous waters ſometimes contain ſo large a proportion of ſaline matters, that the nature of their operation is conſiderably modified. Such waters may be denominated *ſaline acidulous* waters. The nature of their *compoſition* and *medicinal properties* will be readily underſtood from what has been already advanced.

5. *Sulphureous Waters.*— Theſe are either *ſimple* or *compound*. A good example of a *ſimple* ſulphureous water is the Moffat ſpring. The village of Moffat is ſituated in Dumfriesſhire, on the banks of the Annan, about fifty miles ſouth-weſt of Edinburgh. The ſulphureous waters for which this village is noted, iſſue from a rock a little below a bog, whence, ſays Dr. Saunders, they probably derive their ſulphureous ingredient. This water, even when firſt drawn, appears ſomewhat milky. Its taſte is ſulphureous, and ſlightly ſaline. It ſparkles a little when poured from one glaſs into another. On expoſure to the air, it becomes more turbid, and throws up a thin film, which is pure ſulphur, and it thus loſes its diſtinguiſhing properties as a ſulphureous ſpring. This change even takes place in cloſe veſſels, ſo that it cannot be exported with any advantage. According to Dr. Garnett's analyſis, a wine pint of this water contains

	Cubic Inches.
Of ſulphuretted hydrogen -	1.25
Of carbonic acid - -	.625
Of azote - - -	.5
	2.375

And of muriate of ſoda 4.4 grains.

With reſpect to the *medicinal properties* of ſimple ſulphureous waters, they have been always celebrated for their good effects in cutaneous affections in general, and alſo in ſcrofula. They are applied externally in the form of a warm bath, as well as taken internally. They have been alſo recommended in bilious complaints, dyſpepſia, general want of action in the alimentary canal, and calculous caſes. The quantity of the Moffat waters uſually preſcribed internally varies from one to three bottles every morning. But Dr. Saunders juſtly obſerves, that few delicate ſtomachs can bear ſo much. On the other hand, the ſame eminent phyſician informs us, that the common people not unfrequently ſwallow from ſix to ten Engliſh quarts in one morning.

For further particulars reſpecting this ſpring, ſee MOFFAT.

Sulphureous waters frequently contain ſo conſiderable a proportion of ſaline ſubſtances as to merit the name of *compound*. An example of ſuch waters we have in the celebrated ſprings of Harrowgate, in Yorkſhire. (See HARROWGATE.) This water, when firſt taken up, appears perfectly clear and tranſparent. It emits a few air-bubbles. Its ſmell is very ſtrong, ſulphureous, and fœtid, like that of a foul gun-barrel. Its taſte is bitter, nauſeous, and ſtrongly ſaline; though it is remarkable that moſt perſons ſoon become reconciled to it. On expoſure to the air, it becomes turbid, the ſulphureous odour is diminiſhed, and the ſulphur is gradually depoſited. According to Dr. Garnett, its ſpecific gravity is 1.0064. A wine pint, according to the experiments of the ſame chemiſt, was found to contain about

	Cubic Inches.
Of ſulphuretted hydrogen -	2.375
Carbonic acid gas - -	1.000
Azote - - - - -	.875
	4.25

And of

	Grains.
Muriate of ſoda - - -	76.9
Muriate of lime - - -	1.6
Muriate of magneſia - -	11.4
Carbonate of lime - -	2.3
Carbonate of magneſia - -	.7
Sulphate of magneſia - -	1.3
	94.2

With reſpect to the *medicinal properties* of waters of this deſcription, and particularly of Harrowgate water, they are of the greateſt uſe in all thoſe complaints that require purgatives, and at the ſame time are benefited by ſulphur; hence they have been long celebrated in cutaneous affections, in piles, worms, &c. They have alſo been found of great uſe in that obſtinately coſtive habit of body which uſually accompanies hypochondriaſis. Harrowgate waters were formerly principally applied externally, but now they are generally recommended to be taken internally, in ſuch doſes as to produce a ſenſible effect upon the bowels; for which purpoſe it is commonly neceſſary to take in the morning three or four glaſſes, of rather more than half a pint each, at moderate intervals.

6. *Thermal Waters.*—There is ſomething ſo myſterious and remarkable in the circumſtances of thermal ſprings, that they have in all ages attracted great attention, and been ſuppoſed to poſſeſs extraordinary medicinal properties. Hence, by moſt writers on mineral waters, thermal ſprings have been arranged under a diſtinct head; and as there appears to be no ſerious objection to this arrangement, we have thought proper to adopt it. The inveſtigation of the *cauſe* of thermal ſprings belongs to the geologiſt, and will be found under EARTH, HOT *Springs*, TEMPERATURE, VOLCANO, and analogous articles.

They may be divided into *ſimple* and *compound*.

Simple thermal waters are either *tepid*, that is, poſſeſſing a temperature below that of the human body; or *warm*, poſſeſſing a temperature above that point. A good example of the ſimple tepid waters are thoſe of Buxton. (See BUXTON *Water*.) *Tepid* waters uſually occur in lime-ſtone diſtricts. *Warm* waters of every degree of temperature, even to the boiling point, are occaſionally met with in the neighbourhood of volcanoes. See VOLCANO.

With reſpect to the *medicinal properties* of the ſimple thermal waters, it is extremely doubtful if they poſſeſs any other powers than thoſe of common water artificially raiſed to the ſame temperature.

Thermal ſprings are liable to be impregnated with all the different ſubſtances which uſually enter into the compoſition of cold mineral waters; hence they are very various in their nature. Such *thermal* waters may be called *compound*, and without any great ſacrifice of the principles of arrangement we have adopted, may be compriſed under three heads; namely, *a*. Saline thermal waters, *b*. Acidulo-chalybeate thermal waters, and *c*. Sulphureous thermal waters;

waters; each of which varieties may be either *tepid* or *warm*.

a. Thermal waters fimply *faline* are very rare. Their properties can in no refpect be fuppofed to differ from cold faline waters raifed to the fame temperature. Sea-water, therefore, heated artificially, is a good example of this variety. It is generally ufed externally as a bath. See BATHING.

b. A good example of the *acidulo-chalybeate* thermal waters we have in the fprings of Carlfbad. For a full account of the chemical properties of thefe fprings, fee CARLSBAD.

c. The celebrated waters of Aix-la-Chapelle, or Aken, afford a good example of the *fulphureous* thermal waters. See AIX-LA-CHAPELLE.

With refpect to the *medicinal properties* of the compound thermal waters, they have all been in much repute as baths, which was, perhaps, the original mode in which the two laft varieties in particular were employed. In later times, they have been much ufed internally. The difeafes, fays Dr. Saunders, to the cure of which the internal ufe of Carlfbad waters are applicable, are as various as the nature of their foreign contents; and from the union of feveral valuable qualities in one water, it may be made ufe of in cafes of very oppofite natures, without incurring the cenfure of employing it indifcriminately as an univerfal medicine. In common with the other purgative chalybeates, it is found to be eminently ferviceable in dyfpepfia and other derangements of the healthy action of the ftomach, in obftructions of the abdominal vifcera, not connected with great organic difeafe, and in defect or depravation of the biliary fecretion. It is alfo of ufe in calculous affections, and is highly efteemed for reftoring the uterine fyftem to a healthy ftate. The fame precautions againft its internal ufe in plethoric and irritable habits, and thofe who are fubject to hæmoptyfis, or liable to apoplexy, require to be obferved here as with any of the other active thermal waters. The Aix-la-Chapelle waters, taken internally, are likewife found effentially ferviceable in the numerous fymptoms of diforders in the ftomach and biliary organs, that follow a life of high indulgence in the luxuries of the table. It alfo much relieves painful affections of the kidneys and bladder. The fame precautions in its ufe are to be attended to, as thofe abovementioned refpecting the Carlfbad waters. For the external ufes of thefe waters, fee BATHING, and the articles CARLSBAD and AIX-LA-CHAPELLE, before referred to.

Our readers will readily perceive, from the above fyftematic fketch, that the infinite variety which exifts among mineral waters abfolutely precludes a *perfect* arrangement of them: we truft, however, that no mineral water can occur which may not be referred to one or other of the above heads or their fubdivifions, without any great facrifice of our principles of arrangement; and, confequently, whofe general medicinal properties cannot be eftimated with tolerable accuracy *à priori* from its chemical compofition.

On the general Ufes of Water in a dietetic and medicinal Point of View.—No organic procefs nor interchange of elements can be fuppofed to take place without the intervention of a fluid; organized beings, therefore, contain a large proportion of fluid in their compofition, through the medium of which that endlefs feries of changes, effential to their exiftence, is principally effected. The bafis of this fluid is univerfally water, which of all other fluids is the moft eminently fitted for diffolving and holding in folution every variety of animal and vegetable matter. See FOOD *of Plants*.

In animals, the firft great ftep in the feries of vital proceffes is *digeftion;* and here nature appears to render the prefence of a fluid particularly neceffary, in order, as it were, to infure for herfelf a fufficiency for her future operations. Accordingly, we find that all animals inftinctively take in a certain proportion of fluid, either in the form of fimple water, or fucculent food. Man alone is the only animal accuftomed to fwallow unnatural drinks, or to abufe thofe which are natural; and this is the fruitful fource of a great variety of his bodily and mental evils.

We know little of the intimate nature of the digeftive procefs, but we know that it is chiefly effected by means of a highly animalized fluid fecreted by the ftomach itfelf. Now this important fluid, by drinking too little or too much, or by other caufes, may be rendered too concentrated or too dilute for the due performance of its operations; and dyfpepfia, and all its confequences, may thus enfue from habitual errors in the quantity of drink only. The remedy in fuch cafes is obvious, and confifts perhaps in nothing more than in duly regulating the quantity of watery aliment, as dictated by inftinct, or the fenfation of thirft only.

An eminent modern phyfiologift recommends to abftain from drinking during meals, and for fome time afterwards; and as a general rule, this may, perhaps, be proper, fince a healthy ftomach may be fuppofed to be always able to fecrete fluid enough for its own immediate operations: there can be no doubt, however, but many exceptions to this rule may be met with, arifing either from the nature of the food or condition of the ftomach, in which moderate dilution is not only grateful but falutary.

With refpect to the choice of water as an article of diet, (for our readers will underftand that we fpeak of water only in this place,) thofe which are hard and impure have long lain under the imputation of producing calculous affections; and we have good authority for ftating, that, in many inftances, the ufe of fuch waters actually increafes the painful fymptoms of thefe diftreffing complaints. It is not perhaps an eafy tafk to explain this, fince, with the exception of lime, the fubftances found in hard waters never enter into the compofition of calculi: their operation, therefore, muft be rather of a predifpofing nature, and is probably exerted upon the organs of digeftion, which are well known to be intimately connected with the kidney. A fact which renders this opinion the more probable is, that hard waters are often pofitively noxious to irritable ftomachs, by inducing dyfpepfia. In fhort, pure water, as we formerly obferved, muft obvioufly be much better adapted for the important purpofes of dilution and folution, than water already faturated as it were with foreign fubftances; and upon this principle may probably be fatisfactorily explained the good effects of Malvern and other waters, whofe only characteriftic property is, their remarkable degree of purity.

In a medicinal point of view, the ufe of water as a diluent is moft important; and, as Dr. Saunders juftly obferves, the long lift of ptifans, decoctions, &c. ufually prefcribed by phyficians in acute difeafes, owe their virtues almoft entirely to the watery diluent itfelf.

The inftinctive defires or averfions, continues the fame eminent writer, of perfons labouring under any fpecies of difordered functions, have been juftly confidered as deferving the higheft attention from the phyfician, and in moft cafes will furnifh him with ufeful hints for his treatment of the patient. In acute difeafes, the thirft after water is peculiarly remarked as a characteriftic fymptom, and is a direct inftinctive indication of increafed heat and want of dilution; and this is fo uniform, that the degree of fever may often be pretty well eftimated by the eagernefs of the fufferer after cold drink. The benefits arifing from large dilution in acute difeafes, however, are not confined to the mere

mere quenching of thirſt, though this is in itſelf highly advantageous; but it is after ſo much liquid is added to the circulating maſs, that the truly diluent effects are produced. Theſe conſiſt, in Dr. S.'s opinion, in diminiſhing the morbid heat and violence of reaction in the ſolids; in preſerving all the ſecretory organs in a pervious ſtate; and in checking that tendency to ſpontaneous change, which renders the fluids poſitively noxious to the veſſels in which they are contained, and unfit to perform thoſe functions, on which the health of the body ſo eſſentially depends.

It appears poſſible, however, in the opinion of the ſame author, to carry dilution in active fever to exceſs. In fever, as is well known, the exhalent veſſels are comparatively inactive, or morbidly conſtricted, and the ſecretion of urine is defective in quantity. In ſuch caſes, it is often better to take liquids in ſmall divided doſes, which has the effect of moderating the thirſt, without overloading the arterial ſyſtem, and bringing on that tenſion and plenitude liable to be produced by ſwallowing too large a proportion of liquids.

In the uſe of water in acute diſeaſes, the temperature ſhould be particularly attended to. As a general rule it may be laid down, that the temperature of diluents at the different periods of a cold, hot, and ſweating ſtage of a ſimple febrile paroxyſm, ſhould be hot in the firſt caſe, cold in the ſecond, and tepid in the third; and it is chiefly in the ſecond ſtage that the quantity may be moſt liberal.

Moſt of the above remarks are equally applicable to the uſe of water in chronic diſeaſes in general, but more eſpecially in the deranged functions of the ſtomach and bowels and biliary organs, occaſioned by a long and habitual indulgence in high food, ſtrong drink, and all the luxuries of the table, and which are well known to be ſo decidedly benefited by the uſe of water as a medicine. As in acute diſeaſes, ſo in chronic affections likewiſe, it is often of great importance to attend to the temperature of the water. A draught of cold water, for example, will often induce ſickneſs and other diſtreſſing ſymptoms in delicate dyſpeptic habits, while water rendered ſlightly tepid may be taken with impunity and even advantage. On the other hand, the habitual uſe of warm water or drinks is to be avoided, and doubtleſs always does much harm.

We ſhall cloſe theſe remarks by a quotation from Dr. Saunders on the habitual uſe of water. "Water-drinkers," ſays this eminent writer, "are in general longer livers, are leſs ſubject to decay of the faculties, have better teeth, more regular appetites and leſs acrid evacuations, than thoſe who indulge in a more ſtimulating diluent for their common drink."

For the *external* uſes of water, ſee the articles BATH and BATHING, where this part of the ſubject is treated at length.

On the general Contents of Mineral Waters and their Operation.—The proportions of ſaline and other ingredients in mineral waters are for the moſt part ſo ſmall, as apparently to be inſufficient for explaining the effects they often produce upon the animal economy. Many attempts, therefore, have been made to explain this circumſtance by different writers, and the ſubject is ſo intereſting, that we cannot let it paſs without making a few remarks upon it.

Dr. Saunders, one of the lateſt and beſt writers on mineral waters, very properly ridicules the idea of *ſpecific* and other myſterious properties, by which the older authors attempted to explain their operation. This intelligent phyſician ſuppoſes, that a very great proportion of their effects depends ſolely upon the diluent operation of the water itſelf. Of this, as we formerly obſerved, there can be no doubt, in many inſtances; and even in all, the mere bulk and temperature of the water muſt be allowed to produce a certain proportion of the effects. Still, however, innumerable inſtances occur, in which theſe are inſufficient to explain the whole, even when aided by the additional circumſtance of great dilution, on which the above eminent phyſician likewiſe lays great ſtreſs. The matter, therefore, has always appeared ſufficiently puzzling, and it is only lately that a little light has been thrown upon it by the ingenious views of Dr. Murray, which will be more fully explained in the next ſection.

There can be no doubt that ſoluble ſalts in general are capable of exerting a much more powerful effect upon the animal economy, *cæteris paribus*, than thoſe which are inſoluble. The muriates are the moſt ſoluble claſs of ſalts occurring in waters, and are moreover, independently of this, the moſt active; at leaſt, this is the caſe with the earthy muriates, eſpecially the muriate of lime. Now this ſalt, Dr. M. has rendered it probable, exiſts in all mineral waters found by the uſual analytic method to contain the ſulphate of lime and muriate of ſoda, which comprehend by far the greater number. The ſame ingenious author has alſo rendered it probable, that iron not unfrequently exiſts in the ſtate of muriate inſtead of carbonate, as commonly believed, as for example, in the Bath waters. With theſe views in general we perfectly coincide, and have no doubt that, in many inſtances, a large proportion of the good effects of mineral waters ariſes from the muriates they contain; but we muſt confeſs that many difficulties ſtill appear to us to remain on this obſcure ſubject, which cannot, in the preſent ſtate of our knowledge, be ſatisfactorily explained.

Analyſis of Mineral Waters.—The analyſis of mineral waters has been juſtly deemed one of the moſt difficult problems in practical chemiſtry. This ariſes partly from the diverſified nature of the ingredients, and partly from the minute proportions in which ſome of them exiſt. The celebrated Bergman was the firſt chemiſt who preſented the world with a general method or formula for analyſing mineral waters. This was eſteemed excellent in its day, and even at the preſent time may be conſidered valuable. Twenty years afterwards, Mr. Kirwan publiſhed an eſſay on the ſubject, which not only compriſed all that had been previouſly done, but contained many valuable additions made by himſelf. He alſo propoſed a new method of analyſis, of which we ſhall give a ſhort account hereafter.

a. The firſt ſtep in the examination of a mineral water, is to notice accurately its ſenſible properties, ſuch as its temperature, colour, tranſparency, taſte, ſmell, &c.

b. The ſecond ſtep is to aſcertain its ſpecific gravity, the ſpontaneous changes it undergoes on expoſure to the air, the application of heat, &c.

c. Theſe preliminary operations being performed, the next object of inquiry, is to endeavour to obtain a knowledge of the different ingredients preſent by means of *reagents*, or *teſts*, as they are uſually termed. We have already mentioned the different ingredients commonly met with in mineral waters, and ſhall now proceed to give a liſt of the different *teſts* by which their preſence may be detected. For this liſt we are chiefly indebted to Dr. Thomſon, who has compiled it from Kirwan and others.

1. The *Gaſeous Subſtances* may be ſeparated from water, by boiling it in a retort connected with a pneumatic apparatus, and their nature and proportions may be aſcertained in the manner to be preſently deſcribed.

2. *Hydrogen and its Compounds.*—*Sulphuretted* hydrogen is readily diſtinguiſhed by its peculiar ſmell, by its reddening litmus fugaciouſly, and by its blackening paper dipped in ſolution

lution of lead. *Carburetted* hydrogen may be detected by its inflammable nature, and by its yielding carbonic acid by combuftion. *Phofphuretted* hydrogen may be known by its peculiar fmell and fpontaneous inflammability.

3. *Atmofpheric Air: Oxygen and Azote.*—The prefence of *oxygen gas* may be known by its power of fupporting combuftion, and by the diminution which takes place on mixing it with nitrous gas or phofphorus. There is no teft for *azote*, but it is fufficiently characterized by its negative properties.

4. *Alkalies and Alkaline Earths.*—The *alkalies* and *alkaline earths*, as well as their *carbonates*, are diftinguifhed in general by the following tefts. Turmeric paper is rendered brown by alkalies, or reddifh-brown, if the quantity be minute. Brazil wood is rendered blue not only by the alkalies, but alfo by the alkaline and earthy carbonates. Litmus paper reddened by vinegar is reftored to its original colour by alkalies, and alfo by the alkaline and earthy carbonates. If thefe changes are fugacious, we may conclude that the alkali is ammonia. *Fixed* alkalies are indicated when a precipitate is produced by muriate of magnefia after being boiled. The *volatile* alkali, or ammonia, may be readily diftinguifhed by its fenfible properties. The *earthy* and *metallic* carbonates are precipitated by boiling the water containing them, except carbonate of *magnefia*, which is only precipitated imperfectly. With refpect to the individual fubftances of this clafs—*Potafh* may be diftinguifhed by the precipitate it produces with the muriate of platina, the fulphate of alumina, and tartaric acid. For *foda* there is no good teft, but its falts are eafily diftinguifhed from thofe of potafh. *Ammonia* may be known from its odour and other properties above-mentioned. *Lime* is detected by means of the oxalic acid, which occafions a white precipitate. To render its operation certain, however, the mineral acids, if prefent, muft be faturated with an alkali. *Magnefia* and *alumina*. Pure ammonia precipitates both thefe earths and no other, provided the carbonic acid has been previoufly feparated. Lime-water alfo precipitates only thefe two earths, provided the carbonic and fulphuric acids be previoufly removed. The *alumina* may be feparated from the *magnefia* by boiling the precipitate in pure potafh, which diffolves the alumina and leaves the magnefia. *Silica* may be afcertained by evaporating a portion of the water to drynefs, and rediffolving the precipitate in muriatic acid. The *filica* remains behind undiffolved.

5. *Metals.*—The prefence of *metals* may be fufpected, if precipitates are produced by the pruffiate of potafh and fulphuretted hydrogen. *Iron* may be difcovered by the following tefts. The addition of tincture of nut-galls gives water containing iron a purple or black colour. If the tincture has no effect upon the water after boiling, though it coloured it before, the iron is in a ftate of carbonate. Pruffiate of potafh produces a fine blue precipitate in water containing iron, provided no excefs of alkali be prefent, which muft be faturated with an acid. *Manganefe* is occafionally prefent in minute quantity, efpecially in chalybeate waters. It may be precipitated by ammonia with proper precaution, and is known by the beautiful violet hue it imparts to borax, on being fufed with that fubftance. *Copper* is occafionally met with in waters. It may be detected by the fine blue colour produced on the addition of ammonia; by the red-coloured precipitate produced by the pruffiate of potafh; or it may be obtained in the *metallic* ftate by plunging into the water a piece of polifhed iron. *Lead* is fometimes found in waters that have traverfed leaden pipes. Such waters are blackened by a current of fulphuretted hydrogen gas; but to render the prefence of the metal more certain, a portion of the water is to be evaporated to drynefs; the remainder is to be tefted with nitric acid, and afterwards tefted with folutions of the carbonate and fulphate of potafh, which produce white precipitates, from which the lead may be readily obtained in the metallic ftate.

6. *Acids.*—*Carbonic acid*, in a free or uncombined ftate, may be detected by lime-water, which occafions a precipitate foluble with effervefcence in muriatic acid; or by the infufion of litmus, which is reddened, but becomes again blue on expofure to the air. Water containing free carbonic acid lofes this property of reddening litmus by boiling. The *fulphuric acid* is readily diftinguifhed by the muriate, nitrate, or acetate of barytes, ftrontian, and lime, and alfo by the nitrate or acetate of lead. The moft delicate of thefe tefts is the muriate of barytes: this produces a white precipitate, infoluble in muriatic acid. To enfure the operation of this teft, it is neceffary that no earthy or alkaline combination be prefent in the water. The *muriatic acid* is detected by the nitrate of filver, which occafions a white curdy precipitate, infoluble in nitric acid. To enfure the operation of this teft, the alkaline and earthy carbonates muft be previoufly faturated with nitric acid; and the fulphuric acid, if any be prefent, muft be feparated by the nitrate of barytes. *Boracic acid* is detected by means of the acetate of lead. The precipitate formed is infoluble in acetic acid. To render this teft certain, the alkalies and earths muft previoufly be faturated with acetic acid, and the fulphuric and muriatic acids removed by means of the acetate of ftrontian and the acetate of filver.

Such is a brief account of the different *tefts* ufually employed to detect the ingredients prefent in mineral waters, and the moft obvious precautions to be obferved in their ufe. It is proper, however, to obferve, that there are many circumftances to be attended to, in the ufe of tefts in general, which can only be learnt by perfonal obfervation and practice, and that the inexperienced chemift is very liable to be mifled by them.

d. Having thus acquired, by the employment of tefts, a general knowledge of the ingredients contained in a mineral water, the next object is to endeavour to afcertain the quantities and modes of combination in which they exift; and this conftitutes by far the moft difficult part of the inquiry.

There are two general modes of conducting the analyfis of a mineral water: one is to feparate, by various appropriate manipulations, the different ingredients in the fame compound forms in which they are fuppofed to actually exift in the water. The other, recommended particularly by Dr. Murray, is to afcertain, chiefly by means of tefts, the quantities of the different *fimple* fubftances, and afterwards to *eftimate* from them the quantities of the compounds. The firft of thefe modes, and in fome inftances a combination of both, is the one which has hitherto been generally adopted by chemifts; we fhall, therefore, give a fhort account of the manipulations had recourfe to for feparating a few of the fubftances moft ufually occurring in mineral waters.

1. The gafeous matters are firft to be feparated in the manner formerly mentioned, and their grofs amount afcertained by admeafurement in a jar graduated into cubic inches. Sulphuretted hydrogen, if it be prefent with other gafes, is firft to be feparated by immerfing the jar in warm water, and introducing nitric acid, which abforbs the fulphuretted hydrogen, and the diminution of bulk denotes its quantity.

quantity. If ſulphurous acid be preſent, the above ſtep is unneceſſary, for ſulphuretted hydrogen never exiſts in water containing this acid. Sulphurous acid may be ſeparated by introducing into the gaſeous mixture a quantity of the peroxyd of lead, in a ſtate of powder. This will gradually abſorb the whole, and the diminution of bulk, as before, will denote its quantity. The introduction of a little potaſh, after this, will abſorb the carbonic acid. The remaining gaſes muſt be oxygen and azote. The oxygen may be ſeparated by introducing a piece of phoſphorus, or by other well-known eudiometrical means; and the azote will remain laſt of all, unaffected by any of theſe proceſſes.

2. The earthy carbonates, if any be preſent, are firſt to be ſeparated by boiling a given portion of the water for a quarter of an hour. The precipitate thus obtained may conſiſt of a mixture of the carbonates of lime, of magneſia, of iron, and of alumina, and even of the ſulphate of lime. Suppoſing all theſe to be preſent, the precipitate is to be treated with dilute muriatic acid, which will diſſolve the whole, except the alumina and ſulphate of lime. Dry this reſiduum in a red heat, and note the weight. Then boil it in a ſolution of carbonate of ſoda; ſaturate the ſoda with muriatic acid, and boil the mixture for half an hour: carbonates of lime and alumina will be precipitated; the lime may be then diſſolved by acetic acid, while the alumina will remain; and thus the weight of each may be aſcertained.

The muriatic ſolution contains lime, magneſia, and iron. To ſeparate theſe, add ammonia, which will precipitate the iron and part of the magneſia. Dry the precipitate, and expoſe it to the air for ſome time in a temperature of about 200°. The magneſia may be then ſeparated by acetic acid, and the acetate thus formed is to be added to the muriatic ſolution. The iron is now to be rediſſolved in muriatic acid, precipitated by an alkaline carbonate, and dried and weighed.

Muriate of lime and magneſia ſtill remain in ſolution. To ſeparate them, add ſulphuric acid as long as any precipitate appears, then heat the ſolution, and concentrate. The ſulphate of lime thus obtained is to be heated to redneſs, and its weight aſcertained. Laſtly, the magneſia may be ſeparated by an alkaline carbonate, or, what is much better, by the phoſphate of ammonia.

3. To aſcertain the quantity of the alkaline carbonates, ſuppoſing them to exiſt in waters, determine how much of any dilute acid, whoſe ſtrength has been previouſly carefully aſcertained, is neceſſary to ſaturate them; and from this the quantity of alkali can be readily eſtimated.

4. The alkaline and earthy ſulphates may be eſtimated by the following methods.

The alkaline ſulphates may be determined by precipitating their acid by means of the nitrate of barytes, having previouſly ſeparated all the earthy ſulphates.

Sulphate of lime is readily eſtimated by evaporating the water to a few ounces, the earthy carbonates being previouſly ſaturated with nitric acid, and precipitating the ſulphate of lime by means of dilute alcohol.

If the ſulphate of magneſia or alumina be the only ſulphate preſent, the quantity of either can be readily eſtimated. If they exiſt together, the two earths may be precipitated by ſoda, and afterwards ſeparated by acetic acid in the manner above-mentioned. If ſulphate of lime be alſo preſent, this may be previouſly ſeparated in a great degree, as above; or, what is preferable, the lime may be precipitated by an alkali along with the other earths, and afterwards ſeparated. The ſame holds good alſo with the ſulphate of iron; or the iron may be ſeparated by expoſing the water for ſome days to the air, and mixing with it a portion of alumina. The oxyd of iron and ſulphate of alumina are precipitated together, and may be eaſily ſeparated, and the quantity of iron aſcertained.

5. If muriate of potaſh or ſoda exiſt alone in water, its quantity can be readily eſtimated by precipitating the muriatic acid with the nitrate of ſilver. The ſame proceſs may be followed, if the alkaline carbonates be preſent; only theſe carbonates muſt be previouſly ſaturated with ſulphuric acid, and, inſtead of uſing the nitrate, the ſulphate of ſilver is to be employed.

If the alkaline muriates exiſt along with more or leſs of the earthy muriates, or with the muriate of iron, without any other ſalts, the whole of the earths may be ſeparated by barytes water, and their quantities eſtimated as before. To diſcover the proportion of the alkaline muriates, the barytes is to be ſeparated by ſulphuric acid, and the muriatic acid expelled by heat. The quantity of the alkaline muriates may be then aſcertained by evaporation.

When ſulphates and muriates exiſt together, they may be ſeparated by evaporating the whole to dryneſs, and diſſolving the earthy muriates in alcohol; or, when the water has been duly concentrated, by precipitating the ſulphates with the ſame fluid.

When alkaline and earthy muriates exiſt with ſulphate of lime, this laſt ſalt is to be decompoſed by means of the muriate of barytes. The eſtimation is then to be conducted as if nothing but muriates are preſent, only the proportion of muriatic acid which united in the muriate of barytes, added, muſt be allowed for.

When muriates of ſoda, magneſia, and alumina, are preſent, together with ſulphates of lime and magneſia, the water is better examined by two diſtinct operations. To one portion add carbonate of magneſia, till the whole of the lime and alumina be precipitated. Aſcertain the quantity of lime, which gives the proportion of ſulphate of lime. Precipitate the ſulphuric acid by muriate of barytes: this gives the quantity contained in the ſulphate of magneſia and ſulphate of lime; and the quantity of ſulphate of lime being previouſly known, that of the ſulphate of magneſia can be eaſily eſtimated. To a ſecond portion of the water add lime-water, till the whole of the magneſia and alumina be ſeparated. From the weight of theſe earths the quantity of their muriates may be eſtimated, that portion of the magneſia previouſly found to be in union with ſulphuric acid being deducted. After this, remove the ſulphuric acid by barytes water, and the lime by carbonic acid, and the liquid evaporated to dryneſs will leave the common ſalt.

6. Laſtly: If the fixed mineral acids ſhould alone be found to exiſt in a water, it need ſcarcely be obſerved that their quantities can be readily aſcertained; the ſulphuric acid by means of a barytic ſalt, and the muriatic acid by means of a ſalt of ſilver.

All theſe different precipitates ſhould be dried uniformly, or at leaſt at ſome known degree of temperature. It is not eaſy to fix this point, which muſt in a great degree be regulated by the nature of the ſalt, and the peculiar views of the analyſt; ſome chooſing to reduce the ſalts to an anhydrous, others to a cryſtallized ſtate. As a ſort of check alſo to the analyſis, it is proper to evaporate a known quantity of the water to dryneſs, in order to learn the groſs amount of the ſaline matters it contains, which amount is to be compared with the reſults as obtained by the different proceſſes of the analyſis.

Such are a few of the moſt common methods recommended for ſeparating and aſcertaining the proportions of the different ſaline ſubſtances contained in a mineral water. They muſt of courſe be varied according to circumſtances; but this, as well as the application of other methods, muſt depend upon the practical knowledge and judgment of the analyſt.

The principles, however, upon which many of the above analytical proceſſes are founded, have been lately called in queſtion by Dr. Murray of Edinburgh, and we think very juſtly. That gentleman has endeavoured to ſhew, that we by no means arrive at a juſt knowledge of the conſtituents of a mineral water by theſe proceſſes, and that many of the compounds obtained by them are determined by the proceſſes themſelves. The following quotation, from a paper by Dr. Murray, entitled "A general Formula for the Analyſis of Mineral Waters," in the eighth volume of the Tranſactions of the Royal Society of Edinburgh, will convey a diſtinct idea of his opinions and mode of reaſoning upon the ſubject.

Two methods of analyſis have been employed for diſcovering the compoſition of mineral waters, what may be called the *direct* method, in which, by evaporation, aided by the ſubſequent application of ſolvents, or ſometimes by precipitants, certain compound ſalts are obtained; and what may be called the *indirect* method, in which, by the uſe of reagents, the principles of theſe ſalts, and baſes of which they are formed, are diſcovered, and their quantities eſtimated, whence the particular ſalts and their proportions may be inferred.

Chemiſts have always conſidered the former of theſe methods as affording the moſt certain and eſſential information. They have not neglected the latter, but they have uſually employed it as ſubordinate to the other. The ſalts procured by evaporation have been uniformly conſidered as the real ingredients; and nothing more was required, therefore, it was imagined, for the accuracy of the analyſis, than the obtaining them pure, and eſtimating their quantities with preciſion. On the contrary, in obtaining the elements merely, no information, it was believed, was gained with regard to the real compoſition; for it ſtill remained to be determined in what mode they were combined: and this, it was ſuppoſed, could be inferred only from the compounds actually obtained. This method, therefore, when employed with a view to eſtimate quantities, has been had recourſe to only to obviate particular difficulties attending the execution of the other, or to give greater accuracy to the proportions, or, at furtheſt, when the compoſition is very ſimple, conſiſting chiefly of one genus of ſalts.

Another circumſtance contributed to lead to a preference of the direct mode of analyſis,—the uncertainty attending the determination of the proportions of the elements of the compound ſalts. This uncertainty was ſuch, that even from the moſt exact determination of the abſolute quantities of the acids and baſes exiſting in a mineral water, it would have been difficult, or nearly impracticable, to aſſign the preciſe compoſition and the real proportions of the compound ſalts: and hence the neceſſity of employing the direct method of obtaining them.

The preſent ſtate of the ſcience leads to other views.

If the concluſion was juſt, that the ſalts obtained by evaporation, or any analogous proceſs from a mineral water, are its real ingredients, no doubt could remain of the ſuperiority of the direct method of analyſis, and even of the abſolute neceſſity of employing it. But no illuſtrations, I believe, are required to prove that this concluſion is not neceſſarily true. The concentration by the evaporation muſt, in many caſes, change the ſtate of combination; and the ſalts obtained are hence frequently products of the operation, not original ingredients. Whether they are ſo or not, and what the real compoſition is, are to be determined on other grounds than on their being actually obtained; and no more information is gained, therefore, with regard to that compoſition, by their being procured, than by their elements being diſcovered; for when theſe are known, and their quantities are determined, we can, according to the principle from which the actual modes of combination are inferred, whatever this may be, aſſign with equal facility the quantities of the binary compounds they form.

The accuracy with which the proportions of the conſtituent principles of the greater number of the compound ſalts are now determined, enables us alſo to do this with as much preciſion as by obtaining the compounds themſelves; and if any error ſhould exiſt in the eſtimation of their proportions, the proſecution of theſe reſearches could not fail ſoon to diſcover it.

The mode of determining the compoſition of a mineral water, by diſcovering the acids and baſes which it contains, admits in general of greater facility of execution, and more accuracy, than the mode of determining by obtaining inſulated the compound ſalts. Nothing is more difficult than to effect the entire ſeparation of ſalts by cryſtallization, aided even by the uſual methods of the action of alcohol, either as a ſolvent or a precipitant, or by the action of water as a ſolvent at different temperatures: in many caſes, it cannot be completely attained, and the analyſis muſt be deficient in accuracy. No ſuch difficulty is attached to the other method. The principles being diſcovered, and their quantities eſtimated in general from their precipitation in inſoluble compounds, their entire ſeparation is eaſily effected. Nothing is eaſier, for example, than to eſtimate the total quantity of ſulphuric acid by precipitation by barytes, or of lime by precipitation with oxalic acid; and this method has one peculiar advantage with regard to accuracy, that if any error is committed in the eſtimation of any of the principles, it is diſcovered in the ſubſequent ſtep of inferring the binary combinations: ſince, if all the elements do not bear that due proportion to each other, which is neceſſary to produce the ſtate of neutralization, the exceſs or deficiency becomes apparent, and of courſe the error is detected. The indirect method, then, has every advantage over the other, both in accuracy and facility of execution.

Another advantage is derived from theſe views, if they are juſt, that of precluding the diſcuſſion of queſtions, which otherwiſe fall to be conſidered, and which muſt often be of difficult determination, if they are even capable of being determined. From the ſtate of combination being liable to be influenced by evaporation, or any other analytic operation, by which the ſalts exiſting in a mineral water are attempted to be procured, diſcordant reſults will often be obtained, according to the methods employed: the proportions at leaſt will be different, and ſometimes even products will be found by one method, which are not by another. In a water which is of a complicated compoſition, this will more peculiarly be the caſe. The Cheltenham waters, for example, have in different analyſes afforded reſults conſiderably different: and on the ſuppoſition of the ſalts procured being the real ingredients, this diverſity muſt be aſcribed to inaccuracy; and ample room for diſcuſſion with regard to this is introduced. In like manner, it has often been a ſubject of controverſy whether ſea-water contains ſulphate of ſoda with ſulphate of magneſia. All ſuch diſcuſſions, however, are ſuperfluous. The ſalts procured are not neceſſarily the real ingredients, but in part, at leaſt, are products of the operation; liable, therefore, to be obtained or not, or to be obtained in different proportions, according to the

 method

method employed: and all that can be done with precifion is to eftimate the elements, and then to exhibit their binary combinations, according to whatever may be the moft probable view of the real compofition.

The method propofed by Mr. Kirwan, formerly alluded to, confifts in determining, chiefly by tefts, the quantity of the different faline fubftances prefent. But the complicated nature of many of the formulæ, befide the very principle of the method itfelf, being liable to moft of the objections above urged by Dr. Murray againft that in common ufe, render its application difficult, and refults uncertain. Upon the whole, therefore, we have no hefitation in faying, that we confider Dr. Murray's views and methods as by far the beft, and moft likely to lead to correct conclufions, that have yet appeared, and which may be ftated in few words, as follows:

"Determine by precipitants the weight of the acids and bafes prefent in a mineral water. Suppofe them united in fuch a manner that they fhall form the moft foluble falts: thefe falts will conftitute the true faline conftituents of the water under examination."

Dr. Murray illuftrates his method of procedure by fuppofing, as an example, a water found, by the ufual tefts, to contain the carbonates, fulphates, and muriates of lime, magnefia, and foda. The water is to be reduced by evaporation as far as can be done, without occafioning any fenfible precipitation or cryftallization. A faturated folution of muriate of barytes is then directed to be added as long as any precipitate falls, and no longer. This precipitates the whole of the fulphuric and carbonic acids, and the carbonate of barytes is to be feparated from the fulphate by diluted muriatic acid. Add to the refidual liquor a folution of oxalate of ammonia as long as any turbid appearance is produced. By this the whole of the lime is feparated. The oxalate of lime is to be calcined, and converted into fulphate of lime, from which the quantity of pure lime may be readily eftimated. The next ftep is to precipitate the magnefia; and for this purpofe, Dr. Murray recommends a modification of Dr. Wollafton's procefs. This confifts in adding, firft, a folution of neutral carbonate of ammonia, and afterwards a ftrong folution of phofphoric acid, or phofphate of ammonia; taking care to leave an excefs of the carbonate of ammonia. By thefe proceffes, the whole of the magnefia is obtained in the ftate of triple phofphate, and its quantity can be readily eftimated. Muriate of foda now remains in folution, and its quantity can be obtained by evaporation. As a check, however, to the different proceffes, it may be proper to afcertain the quantity of muriatic acid prefent by means of the nitrate of filver.

If alumina, filica, or iron be prefent, they are beft feparated by diftinct proceffes, in the manner formerly defcribed.

Laftly, Dr. Murray recommends that the refults of an analyfis be ftated in three modes: 1ft, The quantities of the acids and bafes; 2dly, The quantities of the binary compounds, as inferred from the principle that the moft foluble compounds are the ingredients; and 3dly, The quantities of the binary compounds, fuch as they are obtained by the ufual modes of analyfis. The refults will be thus prefented in every point of view. As an inftance of this method of ftating the refults of an analyfis, we refer our readers to what we have faid on *fea-water* in the prefent article.

Mineral Waters, artificial Preparation of.—Chemiftry had no fooner developed the compofition of mineral waters, than it fuggefted methods of preparing them artificially. Accordingly, Bergman and others have given many formulæ for this purpofe, fome of which approach the truth, while others are very imperfect. When the compofition of a water is very fimple, nothing more is required to form it artificially than to know the nature and quantity of the faline fubftances prefent, and to diffolve fimilar quantities of the fame faline fubftances in the fame proportion of water. In the earlier periods of chemical inveftigation, before the nature of gafeous fubftances was underftood, no attempts of courfe could be made to imitate the important clafs of waters which derive their chief properties from the prefence of fuch fubftances; but chemifts no fooner became acquainted with the nature of gafes, than they began to devife methods of imitating thefe alfo; and artificial carbonated waters have been long fince prepared as an article of commerce, under the name of *foda water*, fuperior in point of impregnation to any acidulous waters known. See PYRMONT.

It is true that there are fome inftances of natural chemical folution, which art has not even yet been able to imitate. Of this kind is the folution of filex, which occafionally occurs in mineral waters. It is doubtful, however, if this earth is capable of exerting any falutary effects on the animal economy; and, therefore, we have little occafion perhaps to regret our inability to effect its folution. Another defect in the formation of artificial mineral waters is, that many of the more important ones cannot be obtained in large quantities for bathing, &c. without fo great a degree of expence and trouble, as to entirely preclude their ufe.

On the other hand it feems plaufible, in theory at leaft, that we can improve upon the compofition of many mineral waters. Thus, many mineral waters contain ingredients, which, either from the minutenefs of the proportion in which they exift, or from their inert nature, may be deemed as fuperfluous, or in fome inftances as injurious. Again, others contain their active ingredient in fuch fmall quantities, as to require an inconvenient bulk of the water to produce the defired effect: all which defects may be remedied in the artificial preparation, by leaving out the ufelefs or noxious matter, and increafing that in which the proper medicinal virtue refides. Befides thefe advantages alfo, we have it in our power to form new and valuable compounds, which are no where to be met with in a natural ftate.

The firft ftep to the artificial formation of a mineral water is, of courfe, to know the exact compofition of the water we would imitate. Many of the ingredients, however, obtained from mineral waters by the ufual modes of analyfis, are very little foluble in water: fuch, for example, are the fulphate and carbonate of lime, &c. which we fhould attempt in vain to diffolve directly in water. Other modes, therefore, muft be devifed for this purpofe; and Dr. Murray's views of the compofition of mineral waters in general will enable us to effect our object, in moft inftances, very readily and completely, as the following example will fhew.

Suppofe we wifhed to imitate the Seltzer water, an Englifh pint of which, according to Bergman's analyfis, contains, as before mentioned, of

	Cub. Inches.
Carbonic acid	17
	Grains.
Carbonate of lime	3
Carbonate of magnefia	5
Carbonate of foda	4
Muriate of foda	17.5
	29.5

Of

Of theſe ingredients, neither the carbonate of lime nor magneſia are ſoluble in water, nor can be rendered ſo, without a tedious proceſs of impregnating the water, through which they are diffuſed, with carbonic acid gas. But if we adopt Dr. Murray's views, and conſider a pint of this water as actually containing of

	Cub. Inches.	
Carbonic acid gas	17	
	Grains.	
Muriate of lime -	3.3	
Muriate of magneſia	5	
Muriate of ſoda -	7.8	
Carbonate of ſoda	10.3	dry, or 18 cryſtallized.
	26.4	

we can eaſily imitate its compoſition in the following manner:

About 35 grains of muriatic acid, of the ſtrength uſually met with in the ſhops, are to be put into a ſtrong bottle, with a pint of water, the acid being introduced to the bottom of the water by a long funnel. Three grains of pure white marble in coarſe powder are then to be dropped in, and the bottle cloſed. When theſe are diſſolved, five grains of the common carbonate of magneſia in powder are to be added; and after the ſolution of this, 32 grains of cryſtallized carbonate of ſoda, or what is equivalent to this, and preferable, as affording more carbonic acid, 27 grains of bicarbonate of ſoda, are to be put in. The bottle is to be cloſed accurately, ſhaken, and inverted. In a ſhort time a perfect ſolution takes place, and a liquor is obtained tranſparent, which ſparkles when poured out, has a pleaſant taſte, and in its compoſition reſembles the Seltzer water.

It might be ſuppoſed, ſays Dr. Murray, that ſo large a proportion of carbonate of ſoda could not exiſt with the muriates of magneſia and lime, without decompoſing them; but on making the experiment, it was found that the above quantities might be diſſolved in a pint of water, independently of the exceſs of carbonic acid, without any apparent decompoſition; the ſolution remaining tranſparent, even on expoſure to the air.

Upon ſimilar principles may the compoſition of almoſt every other mineral water be readily imitated.

We have an agreeable imitation of acidulous waters, under the term of what is called the *effervеſcing draught.* This conſiſts of two ſolutions, one of an alkaline carbonate, and the other of the citric or ſome other vegetable acid, which are directed to be mixed together, and ſwallowed during the act of effervеſcence. A more portable form of this grateful draught is to be obtained in the ſhops, under the name of *Sodaic powders*, *Seidletz powders*, &c. in which the requiſite proportions of alkali and acid in their dry ſtate are formed into ſeparate little packets, one of each of which is directed to be diſſolved ſeparately in water, and the two ſolutions to be then mixed, and ſwallowed during the act of effervеſcence, as before.

The following, therefore, may be laid down as a general rule for the artificial preparation of mineral waters:—Aſcertain, upon Dr. Murray's principles, the preciſe proportions of the *moſt ſoluble* ſalts that *can* be preſent in any given water; diſſolve ſimilar proportions of the ſame ſalts in an equal quantity of water, and a compound water will be obtained, preciſely ſimilar in its compoſition to the original.

Catalogue of the moſt important mineral Waters.—The following catalogue is intended to compriſe the principal mineral waters of Great Britain, and ſome of the more important ones of other countries. Our readers will recollect that, in the preceding article, we divided natural waters into *potable*, *ſaline*, *chalybeate*, *acidulous*, *ſulphureous*, and *thermal*, and deſcribed the general chemical and medicinal properties of each claſs, as well as of their compounds. To prevent repetition, and to ſave room, therefore, we have attempted to refer the different ſprings, mentioned in the following catalogue, to one or other of the above claſſes: thus, when a ſpring is ſtated to be *ſaline*, its general compoſition and properties are to be underſtood to reſemble the claſs of *ſaline* waters; and ſo of the reſt.

The moderns have very properly exploded the old notion of the myſterious and *ſpecific* operation of particular ſprings. But even if this cogent reaſon for generalization did not exiſt, it would be impoſſible, in a work of the preſent deſcription, to deſcend to all the minutiæ of analyſis, &c. ſuppoſing them to be known, which is far from being the caſe: we have thought proper, however, to give a few of the more intereſting and inſtructive recent analyſes of ſome of the moſt important ſprings.

Thoſe ſprings marked thus *, in the following liſt, are more particularly deſcribed in the preceding article, as examples of the different claſſes.

Abcourt. An acidulous chalybeate ſpring. See Abcourt.

Aberbrothick, or *Arbroath.* An acidulous chalybeate ſpring. See Aberbrothick.

Acton. A ſaline ſpring. See Acton.

Aghaloo, Tyrone, Ireland. A ſulphureous ſpring ſlightly ſaline.

* *Aix-la-Chapelle.* Sulphureous thermal ſprings. See Aix-la-Chapelle.

Alford. A ſaline ſpring. See Alford.

Alkerton, near Glouceſter. A ſaline ſpring.

Anaduff, Leitrim. A weak ſulphureous ſpring ſlightly ſaline.

Aſhwood, Fermanagh. A ſulphureous ſpring ſlightly ſaline.

Aſkeron, Yorkſhire. A ſtrong ſulphureous ſpring ſlightly ſaline.

Aſtrope, Oxfordſhire. An acidulous chalybeate ſpring.

Aſwarby, Lincolnſhire. A ſaline chalybeate ſpring.

Athlone, Weſtmeath. A chalybeate ſpring ſlightly ſaline.

d'Ax-en-foix, France. Sulphureous thermal ſprings, in repute as baths.

Baden. Sulphureous ſprings, formerly in much repute as baths. See Baden.

Bagnigge-Wells. Two ſprings, one ſaline, the other chalybeate. See Pancras.

Baiæ. Thermal ſprings, in much repute among the Romans. See Baiæ.

Balaruc. Saline thermal ſprings. See Balaruc.

Ballycaſtle. Two chalybeate ſprings, one in which the iron is in combination with carbonic acid, the other with ſulphuric acid. See Ballycastle.

Ballynahinch, Downſhire. A ſulphureous ſpring, ſaid to contain iron.

Bagneres, France. Thermal ſprings, in much repute as baths. See Bagneres.

Balſton, North America. A highly acidulous chalybeate ſpring. According to the recent analyſis of a French chemiſt, 25 fluid ounces contain of

	Cub. Inches.
Carbonic acid	75
	Grains.
Muriate of soda	31
Carbonate of lime	22
Muriate of magnesia	12.5
Muriate of lime	5
Carbonate of iron	4
	74.5

Barege. Sulphureous thermal springs, in considerable repute. See BAREGE.

Barnet, Hertfordshire. A weak saline spring. At North-hall, about three miles from Barnet, is another of the same description, but a little stronger.

Bath. Celebrated saline thermal springs, containing likewise a little iron. (See BATH.) One of the most recent and probably correct analyses of these waters is by Mr. Phillips. According to this gentleman, a wine pint contains of

	Cub. Inches.
Carbonic acid	1.2
	Grains.
Sulphate of lime	9
Muriate of soda	3.3
Sulphate of soda	1.5
Carbonate of lime	0.8
Silex	0.2
Oxyd of iron	0.0147
	14.8147

Bilton, Yorkshire. A weak saline sulphureous spring.

Binley, Warwickshire. A saline chalybeate spring.

Borrowdale, Cumberland. A strong saline water. See BORROWDALE.

Borset. Sulphureous thermal springs, in considerable repute. See BORSET.

Brabach, Germany. An acidulous chalybeate spring.

Brandola, Italy. A weak acidulous chalybeate spring.

Brentwood, Essex. A saline spring.

Brighton. A chalybeate spring: sulphate of iron. (See BRIGHTHELMSTON.) According to Dr. Marcet's analysis, a wine pint contains of

	Cub. Inches.
Carbonic acid gas	2.5
	Grains.
Sulphate of iron	1.80
Sulphate of lime	4.09
Muriate of soda	1.53
Muriate of magnesia	0.75
Silex	0.14
Loss	0.19
	8.50

Bristol Hotwells. A simple thermal water. As this spring has not been described in its proper place, we shall insert the following short account of it here. This water is inodorous, perfectly limpid and sparkling, and sends forth air-bubbles when poured into a glass. It is agreeable to the palate, but has no decided taste. Its specific gravity is stated to be 1.00077. Its temperature, upon an average, is about 74°. A wine pint, according to Dr. Carrick's analysis, contains of

	Cub. Inches.
Carbonic acid gas	3.75
Common air	0.375
	4.125
	Grains.
Muriate of magnesia	0.9
Muriate of soda	0.5
Sulphate of soda	1.4
Sulphate of lime	1.47
Carbonate of lime	1.63
	5.9

It was formerly much celebrated in consumption, but its supposed good effects in this disease have been justly called in question by modern writers.

Bromley, Kent. A chalybeate spring. See BROMLEY.

Broughton, Yorkshire. A strong saline sulphureous spring, similar to that of Harrowgate.

Buch, near Carlsbad, in Bohemia. A weak acidulous water.

Buglawton, Cheshire. A saline sulphureous water.

Burlington, or *Bridlington*, Yorkshire. A chalybeate water slightly saline.

Burnley, Lancashire. A chalybeate water slightly saline.

**Buxton*. A simple thermal water. See BUXTON-*Water*.

Cannock, Staffordshire. A chalybeate water.

Cargyrle, near Chester. A weak saline water.

Carlsbad. Celebrated acidulo-chalybeate thermal springs. See CARLSBAD.

Carlton, Nottingham. A chalybeate water.

Castleconnel. A chalybeate water. See CASTLECONNEL.

Castlemain. A sulphureous spring said to contain iron. See CASTLEMAIN.

Cawley, Derbyshire. A sulphureous water slightly saline.

Cawthorp, Lincolnshire. A chalybeate spring slightly saline.

Chedlington, Oxfordshire. A sulphureous water slightly saline.

Chaude Fontaine, near Liege, Germany. Thermal springs celebrated as baths.

**Cheltenham*. Saline and saline chalybeate springs. See CHELTENHAM.

Chippenham, Wiltshire. A chalybeate spring.

Cleves. An acidulous chalybeate spring. See CLEVES.

Clifton, Oxfordshire. A saline spring.

Cobham, Surry. A chalybeate water.

Codsal Wood, Staffordshire. A sulphureous spring.

Colchester, Essex. A saline spring.

Colurian, Cornwall. A chalybeate spring.

Comner, or *Cumner*, Berkshire. A weak saline spring.

Corstorphine, near Edinburgh. A weak sulphureous spring slightly saline.

Coventry. A saline chalybeate spring. See COVENTRY.

Crickle Spa, Lancashire. A strong saline sulphureous water.

Croft, Yorkshire. A sulphureous water slightly saline.

Cross town, Waterford. A sulphureous spring.

Cunley-house, Lancashire. A strong sulphureous spring slightly saline.

Deddington. Saline sulphureous springs. See DEDDINGTON.

Derby. A chalybeate spring.

Derrindaff, Cavan. A fulphureous fpring flightly faline.

Derry-hinch, Fermanagh. A fulphureous fpring.

Dog and Duck, St. George's Fields, Southwark. A faline fpring.

Drig-well, Cumberland. An acidulous chalybeate fpring.

Drumafnave, Leitrim. A ftrong fulphureous fpring flightly faline.

Dublin. Several weak faline fprings.

Dulwich, Kent. Pretty ftrong faline fpring.

Dunblane, Perthfhire. Thefe fprings have been only lately difcovered. They have been accurately analyfed by Dr. Murray. There are two fprings, both of a fimilar nature, that is to fay, faline, with a minute proportion of iron. A wine pint of the *north fpring* was found by Dr. M. to contain of

	Grains.
Muriate of foda - - - -	24.3
Muriate of lime - - - -	18.
Sulphate of lime - - - -	3.1
Carbonate of lime with a trace of iron -	0.5
	45.9

The fame quantity of the *fouth fpring* yielded

	Grains.
Muriate of foda - - - -	22.5
Muriate of lime - - - -	16.
Sulphate of lime - - - -	2.3
Carbonate of lime - - - -	0.3
Oxyd of iron - - - -	.15
	41.25

Dunfe, Scotland. A chalybeate fpring.

Durham. A ftrong fulphureous water flightly faline.

Egra, Bohemia. A celebrated faline chalybeate fpring. See Egra.

Epfom. A celebrated faline fpring. See Epsom.

Felftead, Effex. A chalybeate fpring.

Filah, Yorkfhire. A faline chalybeate fpring.

Francfort on the Maine. Saline fulphureous fprings. See Francfort.

Galway, Ireland. A chalybeate fpring.

Geyfer, Iceland. Remarkable thermal fprings. See Iceland.

Glanmile, Ireland. A chalybeate fpring.

Glaftonbury. A chalybeate fpring flightly faline. See Glastonbury.

Glendy, Angusfhire. A ftrong chalybeate fpring.

Granfhaw, Downfhire. A chalybeate fpring.

Haigh, Lancafhire. A chalybeate fpring: fulphate of iron.

Hampftead. A chalybeate water. See Hampstead. The moft recent analyfis of this water is by Mr. Blifs, according to whom a wine gallon contains of

	Cub. Inches.
Carbonic acid - - - -	10.1
Atmofpheric air - - - -	90.9
	101.

	Grains.
Oxyd of iron - - - -	1.5
Muriate of magnefia - - -	1.75
Sulphate of lime - - - -	2.12
Muriate of foda nearly - - -	1.0
Of filex about - - - -	.38
	6.75

Hanbridge, Lancafhire. A chalybeate water flightly faline.

Hanlys, Shropfhire. Two fprings, one faline the other chalybeate.

**Harrowgate*. Saline fulphureous fprings. See Harrowgate.

Hartfell, Annandale. A chalybeate fpring: fulphate of iron. According to Dr. Garnett's analyfis, a wine pint of this water contains of

	Grains.
Sulphate of iron - - -	10.5
Sulphate of alumina - - -	1.5
Oxyd of iron - - - -	1.875
	13.875

Hartlepool. A chalybeate fpring. See Hartlepool.

Holt, Wiltfhire. A weak faline water.

Holt-nevil, Leicefterfhire. A chalybeate fpring: fulphate of iron. See Holt *Waters*.

Jeffop's Well, near Cobham, Surry. A ftrong faline water flightly chalybeate.

Ilmington, Warwickfhire. A chalybeate fpring.

Inglewhite, Lancafhire. A ftrong chalybeate fpring.

Ifle of Wight. A very ftrong chalybeate: fulphate of iron.

Iflington. A chalybeate fpring. See Islington.

Kanturk, Cork. A chalybeate fpring.

Kattrine Loch, Scotland. On the north fide of this lake is a ftrong chalybeate fpring.

Keddleftone, Derbyfhire. A ftrong fulphureous water moderately faline.

Kenfington. A faline fpring. See Kensington.

Kilbrew, Meath. A chalybeate water: fulphate of iron.

Kilburn, Middlefex. A faline fpring.

Kilroot, Antrim. A faline fpring.

Kiling-fhanvally, Fermanagh. A chalybeate water flightly faline.

Killafher, Fermanagh. A ftrong fulphureous water.

Kinalton, or *Kynolten*, Nottinghamfhire. A weak faline water.

Kincardine. A chalybeate fpring.

King's-cliff, Northamptonfhire. A chalybeate fpring weakly faline.

Kirby or *Kirkby-thower*, Weftmoreland. Two chalybeate fprings.

Knarefborough, the *Dropping-well*, contains lime held in folution by carbonic acid. See Knaresborough.

Knowfley, Lancafhire. A chalybeate fpring.

Korytna, Moravia. A very ftrong fulphureous fpring.

Kuka, Bohemia. A chalybeate acidulous water.

Lancafter. A chalybeate fpring flightly faline.

Latham, Lancafhire. A chalybeate fpring.

Leuk, Valois, Switzerland. Thermal fprings.

Llandrindod, Radnorfhire. Three fprings; one faline, another fulphureous, and the third chalybeate.

Llangybi, Carnarvonfhire. A faline fpring.

Leamington. A faline fpring. See Warwick.

Leez, Effex. A chalybeate fpring.

Lincomb, Bath. A chalybeate fpring flightly faline.

Lifbeak, Fermanagh. Two fulphureous fprings.

Lis-done-varna, Clare. A ftrong chalybeate water.

Loanfbury, Yorkfhire. A fulphureous fpring flightly faline.

Maccroom, near Cork. A chalybeate fpring.

Mahereberg, Kerry. A faline fpring.

Mallow,

Mallow, Cork. A pure thermal ſpring. See MALLOW.

Malton, Yorkſhire. A ſtrong chalybeate ſpring moderately ſaline.

**Malvern*, Worceſterſhire. Very pure ſprings. See MALVERN. One wine gallon of the Malvern Holywell waters, according to Dr. Wilſon, contains of

		Grains.
Carbonate of ſoda	- - -	5.33
Carbonate of lime	- - -	1.6
Carbonate of magneſia	- - -	.919
Carbonate of iron	- - -	.625
Sulphate of ſoda	- - -	2.896
Muriate of ſoda	- - -	1.553
Reſiduum, ſilex	- - -	1.687
		14.610

According to the ſame chemiſt, one gallon of the Malvern St. Ann's well contains of

		Grains.
Carbonate of ſoda	- - -	3.55
Carbonate of lime	- - -	.352
Carbonate of magneſia	- - -	.26
Carbonate of iron	- - -	.328
Sulphate of ſoda	- - -	1.48
Muriate of ſoda	- - -	.955
Reſiduum, ſilex	- - -	.47
		7.395

Markſhall, Eſſex. A chalybeate water.

Matlock, Derbyſhire. Thermal ſprings, temp. about 66°. See MATLOCK.

Maudſley, Lancaſhire. A ſulphureous water moderately ſaline.

Mechan, Fermanagh. Two ſulphureous ſprings.

Millar's Spa. A chalybeate ſpring.

**Moffat*, Annandale. Two ſulphureous ſprings. See MOFFAT.

Moſshouſe, Lancaſhire. A chalybeate ſpring.

Moreton, Shropſhire. A ſaline ſpring.

Mont d'Or, near Clermont, France. Sulphureous thermal ſprings.

Mount Pallas, Cavan. A chalybeate ſpring.

Nevil Holt. See HOLT.

Newnham Regis, Warwickſhire. Three chalybeate ſprings ſlightly ſaline.

Newton Dale, Yorkſhire. An acidulous water holding lime in ſolution.

Newton Stewart, Tyrone. A chalybeate ſpring.

Nezdenice, Germany. An acidulous water.

Nobber, Meath. A chalybeate ſpring: ſulphate of iron.

Normanby, Yorkſhire. A ſulphureous ſpring ſlightly ſaline.

Nottington, Dorſetſhire. A ſtrong ſulphureous water.

Orſton, Nottingham. A chalybeate ſpring.

Oulton, Norfolk. A weak chalybeate ſpring.

Owen Breun, Cavan. A ſulphureous ſpring ſlightly ſaline.

Pancras, Middleſex. A ſaline ſpring.

Paſſy, near Paris. A moderately ſtrong chalybeate ſpring.

Peterhead, Aberdeenſhire. A ſtrong chalybeate ſpring. See PETERHEAD.

Pettygoe, Donegal. A ſtrong ſulphureous water, ſaline.

Pitcaithly, Perthſhire. Theſe ſprings reſemble cloſely thoſe of *Dunblane*, and have been lately analyſed by Dr. Murray, according to whom a wine pint contains of

		Cubic Inches.
Atmoſpheric air	- - -	0.5
Carbonic acid gas	- - -	1.
		1.5
		Grains.
Muriate of ſoda	- - -	13.4
Muriate of lime	- - -	19.5
Sulphate of lime	- - -	.9
Carbonate of lime	- - -	.5
		34.3

Plombiers, France. A thermal ſpring.

Pontgibault, France. A weak acidulous ſpring.

Pyrmont, Weſtphalia. A highly acidulous chalybeate ſpring. See PYRMONT.

Queen's Camel, Somerſetſhire. A ſulphureous ſpring.

Richmond, Surry. A ſaline ſpring.

Road, Wiltſhire. A chalybeate ſpring.

Rougham, Lancaſhire. A ſaline ſpring.

St. Bartholomew's Well, Cork. A chalybeate water ſlightly ſaline.

St. Bernard's Well, Edinburgh. A ſulphureous water ſlightly ſaline.

St. Eraſmus's Well, Staffordſhire. A weak ſaline water.

St. Winifrid's Well, Flint. A very pure ſpring. See HOLYWELL.

Scarborough, Yorkſhire. A ſaline chalybeate ſpring. See SCARBOROUGH.

Schooley's Mountain, United States. A weak chalybeate ſpring.

Scollienſes, Switzerland. An acidulous chalybeate ſpring.

**Sea-water*. See SEA and the former part of this article.

**Sedlitz*. A ſaline water. See SEDLITZ.

**Seltzer*. An highly acidulous water. See SELTZER.

Sene, or *Seend*, Wiltſhire. Two chalybeate ſprings.

**Seydſchutz*, near Sedlitz. A ſaline water. See SEDLITZ.

Shadwell. A ſaline chalybeate ſpring: ſulphate of iron?

Shapmoor, Weſtmoreland. A ſulphureous ſpring ſlightly ſaline.

Shettlewood, Derbyſhire. A ſulphureous ſpring ſlightly ſaline.

Shipton, Yorkſhire. A ſulphureous ſpring moderately ſaline.

Somerſham, Huntingdonſhire. A chalybeate ſpring: ſulphate of iron. See SOMERSHAM.

**Spa*. Highly acidulous chalybeate ſprings. See SPA.

Stanger, Cumberland. A ſaline chalybeate ſpring.

Stenfield, Lincolnſhire. A chalybeate ſpring ſlightly ſaline.

Streatham, Surry. A ſaline ſpring. See STREATHAM.

Suchaloza, Germany. An acidulous ſpring.

Sutton Bog, Oxfordſhire. A ſtrong ſulphureous ſpring ſlightly ſaline.

Swadlingbar, Cavan. A ſulphureous ſpring.

Swanſea, Glamorganſhire. A chalybeate ſpring: ſulphate of iron. See SWANSEA.

Sydenham, Kent. A weak ſaline ſpring.

Tarleton, Lancaſhire. A chalybeate ſpring ſlightly ſaline.

Tewkſbury, Glouceſterſhire. A ſaline ſpring.

Thetford, Norfolk. A chalybeate ſpring ſlightly acidulous.

Thoroton, Nottinghamſhire. A chalybeate ſpring ſlightly ſaline.

Thurſk, Yorkſhire. A ſaline chalybeate ſpring.

Tibſhelf,

Tibſhelf, Derbyſhire. A chalybeate ſpring ſlightly acidulous.

Tilbury, Eſſex. A ſaline ſpring ſlightly chalybeate.

Toberbony, near Dublin. A ſaline ſpring.

Tonſtein, Germany. A ſaline acidulous ſpring in conſiderable repute.

Tralee, Kerry. A chalybeate ſpring.

**Tunbridge Wells*, Kent. A chalybeate ſpring. See TUNBRIDGE *Wells*.

Upminſter, Eſſex. A ſtrong ſaline ſulphureous ſpring.

Vahls, France. A weak acidulous ſpring ſlightly ſaline.

Vichy, France. A highly acidulo-chalybeate thermal ſpring. See VICHY.

Wardrew, Northumberland. A ſaline ſulphureous ſpring.

Warmbrunn, Sileſia. Thermal ſprings.

Weatherſtack, Weſtmoreland. A ſaline chalybeate ſpring.

Wellenbrow, Northamptonſhire. A weak chalybeate ſpring.

Weſt Aſhton, Wiltſhire. A weak chalybeate ſpring.

Weſtwood, Derbyſhire. A chalybeate ſpring : ſulphate of iron.

Wexford, Ireland. A weak chalybeate ſpring.

White Acre, Lancaſhire. A chalybeate ſpring.

Wigan, Lancaſhire. A chalybeate ſpring.

Wiggleſworth, Yorkſhire. A ſulphureous ſpring ſlightly ſaline.

Wildungan, Germany. A weak acidulous water.

Witham, Eſſex. A chalybeate ſpring.

Wirkſworth, Derbyſhire. A ſaline ſulphureous ſpring.

Zahorovice, Germany. A weak ſaline acidulous water.

**Zealand, New*. An acidulous water : muriatic acid.

See the article AQUÆ, where many *thermal* and other ſprings are noticed, which have been omitted in the above catalogue.

Among the older writers on mineral waters, ſee Rutty, Monro, Elliot, and others. One of the beſt modern treatiſes on mineral waters is doubtleſs that of Dr. Saunders, to which we have been particularly indebted. Detached eſſays on particular waters are too numerous to be all noticed. Among the more recent publiſhed in this country may be enumerated thoſe of Phillips on the Bath waters ; Scudamore on the Tunbridge Wells water ; Jones on the Spa waters ; and Brande on the Cheltenham waters.

The chief of the older writers on the analyſis of mineral writers, are Bergman and Kirwan. Latterly, ſome very valuable eſſays have been publiſhed on this ſubject by Dr. Murray of Edinburgh, of which we have availed ourſelves in the above article.

WATER *of Cryſtallization*, in *Chemiſtry*, is a denomination applied to the water attracted by many ſaline bodies during the act of cryſtallization. Some ſalts contain no water of cryſtallization, while others contain a very large proportion. Water always appears to enter into the compoſition of cryſtals in a definite proportion. Water can be commonly ſeparated from ſalts without affecting their ſaline properties, and may be reſtored to them by diſſolving them in water, and ſuffering them to cryſtallize. See CRYSTALLIZATION and SALTS.

WATERS, *Diſtilled* or *Simple*, in *Medicine* and *Pharmacy*, conſiſt chiefly of ſimple water ſlightly impregnated with the eſſential oils of different plants, and are principally uſed as vehicles for more active remedies. They were formerly very numerous, but their numbers have been very properly much reduced by the moderns. See AQUÆ *Diſtillatæ*, where all thoſe in common uſe are enumerated.

WATER, *Spirituous*, *Cordial*, or *Compound*, in *Pharmacy*, &c. was the name formerly given to what are now denominated *ſpirits*, the menſtruum being alcohol, and the impregnating ingredients commonly various. See AQUÆ *Cardiacæ*, and SPIRIT. For the methods of preparing ſuch compounds, ſee alſo DISTILLATION, and OIL, *eſſential*.

WATER, in *Agriculture* and *Rural Economy*, is a fluid of great utility for many different purpoſes. The nature of the compoſition of water, and the great power and capacity which it poſſeſſes of taking up and holding a variety of different matters in the ſtate of diffuſion or ſolution, as well as the circumſtance of its being every where preſent amongſt almoſt all kinds of bodies, renders it particularly uſeful in the growth of plants as crops, and in many other ways. Dr. Woodward, indeed, from finding it to contain the particles of moſt ſorts of extraneous ſubſtances, was led to ſuppoſe that ſome of them were the proper matter of nutrition ; as water is conſtantly found to afford ſo much the leſs nouriſhment, the more it is purified by diſtillation, or other means. So that water, as ſuch merely, did not appear to be the proper nutriment of vegetables, but only the medium or vehicle that contains the nutritious particles or properties, and which conveys them along with it through all the parts of the plant. The more full and complete knowledge of the nature and properties of water which has ſince been acquired, have, however, ſet the matter in a more clear and ſatisfactory point of view. See the article WATER.

Water is ſeldom, if ever, met with in a ſtate of perfect purity, nor often in that even which is ſufficiently ſo for the different operations and uſes to which it may be neceſſary to apply it. Nor have all the trials that have ever been made been yet capable of producing it perhaps perfectly pure. There ſeems indeed to be no ſort of ſtandard by which the weight and purity of water can be readily and eaſily aſcertained. It is, in fact, a very difficult matter, however uſeful and advantageous it might be in many different intentions, as water ſcarcely ever continues for any length of time exactly of the ſame weight, or perhaps purity ; as by reaſon of the air and caloric, or matter of heat contained in it, much variation in reſpect to the former continually takes place. The effects which different degrees of heat have on the gravity of water are well ſhewn by the expanſion of it in boiling. It is this which makes the chief difficulty in fixing the ſpecific gravity of water, in the view of ſettling its degree of purity. The pureſt water that is capable of being obtained is, however, thought by ſome, as Mr. Hawkſbee, who has made many experiments on the ſubject, to be eight hundred and fifty times heavier than air. But others, whoſe trials have not been leſs numerous or correct, have made it not more than about eight hundred, or eight hundred and thirty-ſix times heavier than air. From whence this general proportion may perhaps be deduced, which may be conſidered as a ſort of ſtandard in the buſineſs, that when the barometer is at 30°, and the thermometer at 55°, then water is eight hundred and twenty times heavier than air ; and that in ſuch a ſtate the cubic foot of water weighs one thouſand ounces avoirdupois, and that of air 1.222, or $\frac{2}{9}$ths nearly. (See WATER.) There is not, however, any very exact ſtandard in air, as the more water there is contained in the air, the heavier it muſt of courſe be ; for indeed a conſiderable part of the weight of the atmoſphere appears to ariſe from the water that is contained in it. Conſequently, the nearer any water is found to approach the above ſtandards, the purer it may be concluded to be ; which may ſerve to guide and direct many practical uſes and applications of the fluid.

In regard to the properties and effects of water, it is well known to be extremely volatile and expanſive, being capable of reduction wholly into the ſtate of vapour, and of being diſſipated when expoſed to heat and unconfined. In

this

this ſtate, when properly confined, it is of great uſe and application for a variety of purpoſes. See Steam.

It is found, however, that water, when heated in an open veſſel, acquires no more than a certain determinate proportion or degree of heat, whatſoever may be the intenſity or the length of continuance of the fire to which it is expoſed; which greateſt proportion or degree of it is when it boils in the completeſt manner. The degree of heat, however, which is neceſſary to make water boil perfectly, is variable, according as the purity of the water, and the weight of the atmoſphere, may happen to be. A knowledge of this may be of conſiderable utility and benefit in the application of heat to this fluid, in a number of operations, as tending to ſave time, trouble, and the conſumption of fuel.

The ready penetrability and ſeparability of water from the bodies with which it may have united, as well as its properties and powers of coheſion, ſolution, and coagulation, render it ſtill more extenſively applicable and uſeful on many occaſions.

Water is a fluid which, in popular language, is diſtinguiſhed into many different kinds, according to the qualities of it, and the circumſtances under which it makes its appearance, or is found (ſee the preceding article Water); as *freſh* water, or that which is perfectly inſipid, without any ſaline or other taſte, and inodorous, being that which is the natural and pure ſtate of water: in this ſtate, it is well fitted for moſt ſorts of domeſtic as well as many other uſes: *hard* water, or that in which ſoap does not completely or uniformly diſſolve and diffuſe itſelf, but appears in a ſort of curdled or coagulated ſtate: it is certain from this that the diſſolving power of hard water is leſs than that of ſoft; and that hence it is leſs fit for waſhing, bleaching, dyeing, boiling culinary vegetables, watering plants and trees, and many other purpoſes. It is, for the moſt part, found, that the hardneſs of water proceeds either from ſaline matters, or from the preſence of gas. The hardneſs which ariſes from ſaline matters may moſtly be diſcovered and removed by the addition of ſmall quantities, as a few drops, of a ſolution of fixed alkali; and that which is cauſed by the latter by boiling, or expoſure to the open air for ſome length of time. That the waters of ſprings are hard; but thoſe of rivers ſoft. That hard waters are remarkably indiſpoſed to corrupt; they even preſerve putreſcible ſubſtances for a conſiderable length of time; hence they would ſeem to be beſt fitted for keeping, eſpecially as they are ſo eaſily capable of being ſoftened by a very little of the alkaline ſolution being added to them. *Putrid* water is that which has acquired an offenſive ſmell and taſte by the putreſcence of the animal or vegetable ſubſtances which are contained in it. This ſort of water is of a very pernicious quality, and quite unfit for any purpoſe. Cauſtic lime, when put into water, is uſeful in preſerving it longer in a ſweet ſtate; and even expoſure to the air in broad ſhallow veſſels has the ſame effect. And water in this putrid ſtate may be, in a great meaſure, rendered ſweet by having a current of freſh air paſſed through it, from the bottom to the top. Water in this condition is, of courſe, always to be avoided, except for the purpoſe of manure, for which, in ſome caſes, it is of great uſe. *Rain*-water, or that which may be conſidered as a pure ſort of diſtilled water, but as impregnated during its paſſage through the air with a conſiderable quantity of putreſcent matter, whence, in ſome meaſure, its great ſuperiority to any other in fertilizing the earth or ſoil, as well as in promoting the growth of trees and plants. Whence too its inferiority for ſome domeſtic purpoſes to that of the ſpring or river kind, even where it can be readily and well procured; but, more eſpecially, ſuch as is collected and gotten from ſpouts, trunks, and other contrivances put below the roofs of houſes and other buildings, which are the uſual modes of procuring it in this country, which is obviouſly very impure, and in a ſhort time becomes in the putrid ſtate. From its ſoftneſs, it, however, anſwers well in ſome uſes, after it has become pretty pure by ſtanding. *River*-water, or that which is next in purity to that of ſnow, or the diſtilled kind, and which, for moſt domeſtic and ſome other uſes, is ſuperior to either of them, as having leſs putreſcent matter, and more fixed air, or carbonic acid gas in it. Of this water, that, however, which runs over a clean, rocky, ſtony, or gravelly bottom, is by much the pureſt. River-waters, in general, are found to putrefy ſooner than thoſe of ſprings; and that during their putrefaction they throw off a part of the extraneous matter they contain, and at length become ſweet again, and purer than in their firſt ſtate; after which they will commonly preſerve ſweet a great length of time; this is particularly the caſe with ſome river-water, as that of the Thames. It is this ſort of water that is ſo extenſively uſeful in improving graſs-lands, when thrown over them in a proper manner. See Watering *Land*, and Water *Meadow*.

There are ſome other ſorts of water, as *ſalt* water, or that which contains large portions of ſalt in it, ſo as to be ſenſible to the taſte. This is of moſt uſe in the preparation of that ſubſtance from it, but may perhaps be applicable in ſome other ways. *Sea*-water, or that which is a ſort of an aſſemblage of bodies or ſubſtances, in which this fluid may be ſaid to have barely the principal part: it is, in ſhort, an univerſal collection of moſt of the matters in nature, ſuſtained and kept ſwimming in this fluid as a medium or vehicle: being a diffuſe ſolution of various ſubſtances, as common ſalt, bitter cathartic ſalt, different other ſaline matters, and a compound of muriatic acid with magneſia, mixed and blended together in a variety of proportions. It is capable of being freſhened by ſimple diſtillation, without any addition; and is about three parts in a hundred heavier than common water; the temperature of it at great depths being from thirty to forty degrees; but near the ſurface it follows the temperature of the air more nearly. It is probable, from ſome trials lately made with it, that it may be uſeful when applied to land in ſome caſes. Its greater weight and other properties would ſeem to be favourable for this in ſome intentions. It is the muddy material conveyed in the ſtate of diffuſion in this water, which is found ſo beneficial in the warping of land in ſome caſes and ſituations. (See Warping *of Land*.) *Snow*-water, or that which is the pureſt of all the common waters, when the ſnow has been collected in its pure ſtate, and kept in a dry place, in clean glaſs veſſels, not cloſely ſtopped, but covered from duſt and other ſuch matters; this water becomes in time putrid, although in well-ſtopped bottles it will continue unaltered for ſeveral years; but diſtilled water undergoes no alteration in either circumſtance. Snow-water will be ſeen below to be uſeful in promoting the nutrition of plants. *Spring*-water, or that which is commonly impregnated with ſome ſorts of materials or other, as a ſmall portion of imperfect neutral ſalt extracted and taken up from the different ſtrata through which it paſſes and percolates; great quantities of ſtony matter, which are depoſited as it runs along, and large maſſes of ſtone thus formed, ſometimes too incruſtating different ſubſtances of the animal and vegetable kinds, which it is ſaid to petrify. Spring-water is much uſed for domeſtic purpoſes in many caſes, and on account of its coolneſs and clearneſs forms a ſuitable drink for man and animals; but from its being uſually ſomewhat hard, is inferior in ſome intentions to that which has run a conſiderable diſtance in in an open channel, expofed to the action and influence of the air.

The water of fprings arifes and is caufed by rain, and from mifts and moifture in the atmofphere; which falling upon the hills and higher grounds, as well as other parts, foak in and fink down into the earth, paffing along between the different ftrata, until they find a vent or outlet in the form of a fpring. See DRAINING *of Land*, SPRING, and WALL. Alfo SPRING-*Draining*.

It is only under certain circumftances that fpring-water can be applied over the furface of grafs-land with much benefit; as where it is confiderably impregnated and loaded with particular forts of materials, as thofe of the calcareous, and perhaps fome other kinds.

A late philofophical writer has remarked, that the neceffity of much water in the progrefs of the growth of plants or their vegetation, is fhewn by the great quantity which exifts naturally in all parts of them; infomuch that many roots, as thofe of the fquill and rhubarb, are known to lofe about fix parts out of feven of their original weight, fimply by drying them before the fire; which quantity of moifture neverthelefs does not exhale in the common heat of the atmofphere during the life of the root; as may be feen in the growth of fquills in the fhop of the druggift, and of onions on the floors of the ftore-rooms of the feedfman. And that a fecond neceffity of much water in the economy of their vegetation or growth may be deduced from the great perfpiration of them, which appears from the experiments of Hales and others, who, like Sanctorius, have, it is faid, eftimated the quantity of perfpiration from their daily lofs of weight; which, however, it is fuggefted, is not an accurate conclufion, either in refpect to plants or animals, as they both abforb moifture from the atmofphere, as well as perfpire it. But that this great perfpiration of vegetables, like that from the fkin and lungs of animals, does not appear to confift of excrementitious matter, becaufe it has in general no putrefcent fmell or tafte, but feems to be fecreted firft for the purpofe of keeping the external furface of the leaves from becoming dry, which would prevent the oxygen of the atmofphere from entering into the vegetable blood or juice through them; fince, according to the experiments of Dr. Prieftley on animal membranes, the oxygen will only pafs through them when they are moift. A fecond ufe of this great perfpiration is, it is faid, to keep the bark fupple by its moifture, and thus to prevent its being cracked by the motion of the branches in the wind. And though a great part of this perfpirable matter is probably abforbed, as on the fkins of animals, yet as it exifts on fo large a furface of leaves and twigs, much of it muft neceffarily evaporate on dry and windy days.

And the difcovery of the decompofition of water has, it is faid, led to a third great ufe of water in the vegetable economy, which is probably owing to its ready decompofition by their organs of digeftion, fanguification, or juice-forming, and fecretion. This is evinced, it is thought, firft, by the great quantity of hydrogen which exifts in the compofition of many of their inflammable parts; and fecondly, from the curious circumftance which was firft difcovered by the ingenious Dr. Prieftley, that the water which they perfpire is hyper-oxygenated, and in confequence always ready to part with its fuperabundance of oxygen, when expofed to the fun's light; whence it may be concluded, it is thought, that a part of the hydrogen, which was previoufly an ingredient of this water, has been feparated from it, and ufed in the vegetable economy. And that, from the decompofition of water, when confined in contact with air beneath the foil, the nitrous acid feems to be produced, and ammonia, both of which are believed to be ufeful to vegetation and the growth of plants.

But that, befide thefe peculiar ufes of a great quantity of water, the more common ufes of it both to vegetable and animal life, along with caloric or the matter of heat, are to produce or preferve a due fupplenefs or lubricity of the folids, and a due degree of fluidity of liquids which they contain or circulate; and, laftly, for the purpofe of diffolving or diffufing in it other folid or fluid fubftances, and thus rendering them capable of abforption, circulation, and fecretion.

It is beneficial, too, in the view of promoting the fertility of grafs-lands, by the occafional fuffufion or flowing it over them, by which it not only fupplies fimple moifture for the purpofes above noticed in the drier parts of the feafon, but brings along with it calcareous earth and azotic air from the neighbouring fprings in many inftances, or other manures from the rivers and brooks. Still another beneficial confequence of it is to give a due penetrability to the foil or mould, which otherwife, in moft fituations, becomes fo ftiff and hard, as to ftop the elongation and diftenfion of the tender roots of plants; but neverthelefs, the cohefion of the foil or earthy particles may be too much or too greatly diminifhed or leffened, by great and perpetual moifture, fo as not to give fufficient firmnefs to the roots of trees or plants. It may alfo be injurious in fome cafes, as in very hafty fhowers, by wafhing off and taking away much of the decompofing animal and vegetable recrements, which are foluble or diffufible in it, and carrying them down the rivers and brooks into the fea; and from the fides of hills, injury in this way is produced by fmall fhowers; and the evaporation of water or moifture from the furface of the earth may produce fo much cold as to injure fuch terreftrial plants as are too long covered with it.

The author of the "Elements of Agricultural Chemiftry" has concluded, that water is abfolutely neceffary to the economy of vegetation, both in its elaftic and fluid ftate; and that it is not devoid of ufe, even in its folid form. Snow and ice are, it is faid, bad conductors of heat; and that, confequently, when the ground is covered with fnow, or the furface of the foil or of water is frozen, the roots or bulbs of the plants beneath are protected by the congealed water from the influence of the atmofphere, the temperature of which, in northern winters, is ufually very much below the freezing-point; and this water becomes the firft nourifhment of the plants in early fpring. The expanfion of water too during its congelation, at which time its volume increafes one-twelfth, and its contraction of bulk during a thaw, tend, it is obferved, to pulverize the foil, to feparate the parts of it from each other, and to make it more permeable to the influence of the air, and the fibres of the roots of vegetables.

Water alfo, as conftituting the daily neceffary drink of the different forts of domeftic animals which form the live-ftock of the farmer, is always to be particularly attended to, and to be provided as fully and of as good quality as can poffibly be met with; as fuch ftock conftantly do beft where they have plenty of water. See POND, and LIVE-*Stock*.

Application of water, whether of ponds, brooks, rivers, or other kinds, to the purpofe of fifheries, is likewife a matter of great individual utility and benefit, as well as general national advantage. It is the means of increafing a moft ufeful fort of food in almoft an unlimited manner, at very little coft or expence. It provides much profitable labour and employment to fome of the working claffes of fociety; and from the trifling charge incurred in providing it, and

and the readinefs of its difpofal, muft be a fource of great wealth to the country. It fhould, of courfe, be encouraged as much as poffible, wherever it can be done with convenience and fuccefs, in all parts of the kingdom. See FISH-*Pond*, POND-*Fifheries*, and SALMON-*Fifheries*.

WATER, *Afcent of*, in *Hydraulics*. See ASCENT and CAPILLARY *Tubes*.

WATER, *High* and *Low*. See FLUX, HIGH, and TIDE.

WATER, *Motion of*. The theory of the motion of running water is one of the principal objects of hydraulics, and many eminent mathematicians have applied themfelves to this fubject. But it were to be wifhed that their theories were more confiftent with each other, and with experience. The curious may confult fir Ifaac Newton's Principles, lib. ii. prop. 36. with the comment. Dan. Bernouilli's Hydrodynamica. Jo. Bernouilli, Hydraulica, Oper. tom. iv. p. 389, feq. Dr. Jurin, in the Phil. Tranf. N° 452, and in Dr. Martyn's Abridg. vol. viii. p. 282, feq. S'Gravefande, Phyfic. Elem. Mathemat. lib. iii. par. ii. Polenus, de Caftellis, and others.

Mr. Maclaurin, in his Fluxions, art. 537. feq., has illuftrated fir Ifaac Newton's doctrine on this intricate fubject, which ftill, notwithftanding the labours of all thefe eminent authors, remains in a great meafure obfcure and uncertain. Even the fimple cafe of the motion of running water, which is when it iffues from a hole in the bottom of a veffel kept conftantly full, has never yet been determined, fo as to give univerfal fatisfaction to the learned. We fhall here mention fome of the phenomena of this motion, as ftated by Dr. Jurin from Poleni; referring for other obfervations on this fubject to FLUIDS, and *Hydraulic Laws of* FLUIDS.

1. The depth of the water in the veffel, and the time of flowing out being given, the meafure of the effluent water is nearly in proportion to the hole.

2. The depth of the water, and the hole being given, the meafure of the effluent water is in proportion to the time.

3. The time of flowing out, and the hole being given, the meafure of the effluent water is nearly in a fubduplicate proportion to the height of the water.

4. The meafure of the effluent water is nearly in a ratio compounded of the proportion of the hole, the proportion of the time, and a fubduplicate proportion of the depth of the water.

5. The meafure of the water flowing out in a given time, is much lefs than that which is commonly affigned by mathematical theorems. For the velocity of effluent water is commonly fuppofed to be that which a heavy body would acquire *in vacuo* in falling from the whole height of the water above the hole; and this being fuppofed, if we call the area of the hole F, the height of the water above the hole A, the velocity which a heavy body acquires in falling *in vacuo* from that height V, and the time of falling T; and if the water flows out with this conftant velocity V, in the time T, then the length of the column of water, which flows out in that time, will be 2 A, and the meafure of it will be 2 A F. But if we calculate from Poleni's accurate experiments, we fhall find the quantity of water which flows out in that time to be no more than about $\frac{571}{1000}$ of this meafure 2 A F. Polen. de Caftellis, art. 35. 38, 39. 42, 43.

Poleni alfo found, that the quantity of water flowing out of a veffel through a cylindrical tube far exceeded that which flowed through a circular hole made in a thin lamina, the tube and hole being of equal diameter, and the height of the water above both being alfo equal; and he found it to be fo when the tube was inferted, not into the bottom, which others had obferved before, but into the fide of the veffel.

12

6. Since the meafure of the water running out in the time T, is 2 A F × $\frac{571}{1000}$, the length of the column of water, which runs out in that time, is 2 A × $\frac{571}{1000}$. Therefore if each of the particles of water, which are in the hole in the fame fpace of time, paffes with equal velocity, it is plain that the common velocity of them all is that with which the fpace 2 A × $\frac{571}{1000}$ would be gone over in the time T, or the velocity V × $\frac{571}{1000}$. But this is the velocity with which water could fpring *in vacuo* to near $\frac{1}{3}$d of the height of the water above the hole.

7. But when the motion of water is turned upwards, as in fountains, thefe are feen to rife almoft to the entire height of the water in the ciftern. Therefore the water, or at leaft fome portion of the water, fpouts from the hole with almoft the whole velocity V, and certainly with a much greater velocity than V × $\frac{571}{1000}$.

8. Hence it is evident, that the particles of water, which are in the hole in the fame point of time, do not all burft out with the fame velocity, or have no common velocity; though fome mathematicians have hitherto taken the contrary to be certain.

9. At a fmall diftance from the hole, the diameter of the vein of water is much lefs than that of the hole. For inftance, if the diameter of the hole be 1, the diameter of the vein of water will be $\frac{21}{25}$, or 0.84, according to fir Ifaac Newton's meafure, who firft obferved this phenomenon; and according to Poleni's meafure $\frac{20}{26}$, or $\frac{20\frac{1}{2}}{26}$, that is, taking the mean diameter 0.78, nearly.

As to the manner of accounting for thefe phenomena, we have already obferved that authors are not agreed; and it would be far beyond our defign to ftate their different theories, we muft therefore refer to the originals above quoted.

Neither are authors agreed as to the force with which a vein of water, fpouting from a round hole in the fide of a veffel, preffes upon a plane directly oppofed to the motion of the vein. Moft authors agree that the preffure of this vein, flowing uniformly, is equal to the weight of a cylinder of water, the bafis of which is the hole through which the water flows, and the height of which is equal to the height of the water in the veffel above the hole. The experiments made by Mariotte, and others, feem to countenance this opinion. But Mr. Daniel Bernouilli rejects it, and eftimates this preffure by the weight of a cylinder, the diameter of which is equal to the contracted vein (according to fir Ifaac Newton's obfervation above-mentioned), and the height of which is equal to twice the height of the water above the hole, or, more accurately, to twice the altitude correfponding to the real velocity of the fpouting water; and this preffure is alfo equal to the force of repulfion, arifing from the reaction of the fpouting water upon the veffel. For he fays that he can demonftrate, that this force of repulfion is equal to a preffure exerted by a vein of fpouting water upon a plane directly oppofed to its motion, if the whole vein of water ftrikes perpendicularly againft the plane. From whence it would follow, that the preffure or force of the vein will be greater in proportion, as its contraction is lefs; and this contraction vanifhing, as it does when the water fpouts through a fhort tube, and the vein being at the fame time fuppofed to have the whole velocity it can acquire by theory, the fpouting water will then exert a preffure double to what is commonly fuppofed. But the actual velocity of the water being always fomething lefs than it ought to be by theory, and the vein of water being not uncommonly contracted to almoft one half, experiments

riments have led authors to think, that the preffure, exerted by fpouting water, was equal to the weight of a cylinder of the fame diameter with the vein, and of the height of the water above the hole. The ingenious author remarks that he fpeaks only of fingle veins of water, the whole of which are received by the planes upon which they prefs; for as to the preffures exerted by fluids furrounding the bodies they prefs upon, as the wind, or a river, the cafe is different, though confounded with the former by writers on this fubject. Hydrodynamica, fect. 13. p. 289.

M. Bernouilli endeavours to confirm his theory by a differtation in the eighth volume of the Acta Petropolitana; where he obferves, that the experiments formerly made before the Academy of Sciences at Paris, to eftablifh the quantity of the preffure exerted by a vein of fpouting water, are very far from proving the truth of the rule they are brought to eftablifh. For inftance, in one of thofe experiments, the height of the water in the veffel above the hole from whence the vein fpouted was two feet Paris meafure; the diameter of the circular hole, which was cut in the horizontal bottom of the veffel, was four lines; and the force of the vein of water was obferved to be one ounce and three-quarters. But the weight of a cylinder of water of the diameter of the hole, and of the height of the water in the veffel, is fcarce equal to one ounce and three-eighths. The difference, therefore, is at leaft three-eighths of an ounce, which is about three-elevenths of the whole weight of the before-mentioned cylinder of water. So that it is furprifing, that this difference fhould have been afcribed to the removal of the plane, receiving the impulfe, to fome diftance from the hole; for this caufe, fuppofing the plane removed to the diftance of two inches, could not produce an increafe of one-fixteenth of an ounce. It appears, therefore, that the common opinion is rather overturned than confirmed by experience. Du-Hamel, Hift. Acad. Paris, ann. 1679, fect. 3. cap. 5.

M. Bernouilli, on the other hand, thinks his own theory fufficiently eftablifhed by the experiments he relates; for the particulars of which, we refer to the Acta Petropolitana, vol. cit. p. 122, feq.

This ingenious author thinks that his theory of the quantity of the force of repulfion, exerted by a vein of fpouting water, might be ufefully applied to move fhips by pumping; and he thinks the motion produced by this repulfive force would fall little, if at all, fhort of that produced by rowing. He has given his reafons and computations at length in his Hydrodynamica, p. 293 to 302.

The fcience of the preffures exerted by water, or other fluids in motion, is what M. Bernouilli calls *hydraulico-ftatica*. This fcience differs from hydroftatics, which confiders only the preffure of water and other fluids at reft; but hydraulico-ftatics confiders the preffure of water in motion. Thus the preffure exerted by water, moving through pipes, upon the fides of thofe pipes, is an hydraulico-ftatical confideration, and has been erroneoufly determined by many, who have given no other rules in thefe cafes, but fuch as are applicable only to the preffure of fluids at reft. See Hydrodynam. fect. 12. p. 256. feq.

WATER, *Raifing of*. Machines for this purpofe are fo numerous, that a minute defcription of fuch hydraulic machines as are in common ufe would fill a volume; and a fcientific account of their principles, with the maxims neceffary to be obferved in their conftruction, would form a very complete body of mechanical fcience: this is far beyond the limits of an article like the prefent, in which we can only introduce the moft ftriking machines which have not already been explained in different articles of this work; and for others, we muft refer to the original works in which they are defcribed.

The moft complete collection of hydraulic machines is that of Jacob Leopold, entitled "Theatrum Machinarum Hydraulicarum," publifhed at Leipzic, in 1724 and 1725, in 2 vols. folio; thefe form part of his voluminous "Theatri Machinarum," which may be confidered as containing all that was known in mechanics at that period.

M. Belidor, in his "Architecture Hydraulique," 1737, has defcribed many machines which were invented fince the date of Leopold's work. This eminent engineer was a good mathematician, and his work may be confidered as a ftandard for the theory of the hydraulic machines of which it treats. The "Experimental Philofophy" of Defaguliers contains fome chapters on hydraulic machinery, in which he generally follows Belidor very clofely, but has tranflated the mathematical inveftigations of the former into the ordinary proceffes of arithmetic, to adapt them to the comprehenfion of mechanics; and in this point of view, the works of Defaguliers have been of great ufe. On the other hand, M. Prony publifhed a modern edition of Belidor's work in 1790, in which, in moft cafes, he has tranfcribed the proceffes of the original into the modern modes of analyfis; but on the whole, he has added little to our real knowledge, except his defcriptions and fuperb plates of Mr. Watt's fteam-engine.

We do not recollect any complete collection of machines for raifing water fince Belidor, although the inventions of the laft century are both numerous and important. Much information relative to them may be derived from Gregory's "Mechanics," in 2 vols. 8vo.; Dr. Robifon's Works, and his excellent articles Hydrodynamics, Pump, and Water-works, in the Encyclopædia Britannica; and from various mifcellaneous publications, fuch as the Repertory of Arts, and the Tranfactions of different learned Societies; alfo the collection of Mr. Smeaton's Reports, in 3 vols. 4to. It is much to be regretted, that this excellent engineer never completed a defign which he formed, to publifh a complete collection of practical hydraulic machines founded on his own experience. Among his manufcript papers which have been lent to us by fir Jofeph Banks, we find an outline for this work, of which we have availed ourfelves in this article.

In confidering machines for raifing water, they may be claffed under two heads:

Firft, thofe machines which actuate fome kind of bucket or veffel adapted to contain water, which veffel is raifed up when full of water, and difcharges its contents into an elevated refervoir, then defcends empty in order to repeat its action: of this fpecies are, the buckets for wells, fcoops, Perfian and Chinefe wheels, chaplets or chains of buckets, the Noira, and the fcrew of Archimedes. It is evident from the nature of all this clafs, that they are incapable of raifing water to a greater height than that to which the machine is elevated, or provided with the means of drawing up the buckets or other veffels; and further, that they cannot raife conftant ftreams of water, but that the water muft be given out by a fucceffion of difcharges from the different buckets or veffels.

The fecond clafs comprifes thofe machines which act by means of valves and piftons moving in cylinders, or other equivalent contrivances, and force the water to afcend through pipes or tubes: thefe machines have the advantage of raifing the water to very great heights above the place where the machine is placed. The greater part of thefe machines we have already defcribed under the article PUMP, and

and there remain but few to be confidered in the prefent article; *viz.* the varieties of the hydraulic ram, of the Chremnitz fountain, and of the fyphon machines.

The moft obvious means of raifing water is by the operation called baling, that is, lifting up water in a bucket, or other veffel, by the force of a man's arm. This method is extremely fatiguing, and is only adapted to very fmall elevations, fuch as clearing the water from a boat, &c. The moft ancient hydraulic machine acts on this principle, fuch as the fcoop and troughs, the Fen wheel, Perfian wheel, the Noira, &c.: it is, therefore, with thefe machines we fhall commence.

The *Dutch water-fcoop*, or fhovel, is the beft means of baling out water. The fcoop is a kind of box, made of five pieces of board, with one end and one fide open: this box is fixed at the extremity of a long pole, which the workman holds in his hand, and the weight of the fcoop is borne by a cord tied to the pole near to the box, and fufpended from a tripod, formed of three poles tied together at the top. The man works the machine by fwinging the fcoop backwards and forwards in the direction of the length of the pole; in moving the box forwards, he depreffes the end of the pole, which caufes the box to dip into the water, and take up a quantity which it will throw forwards and rather upwards to a confiderable diftance. In bringing the fcoop back for another ftroke, he depreffes the end of the pole which he holds in his hand, and thus keeps the box out of the water. Of courfe this method is only applicable where the height to which the water is to be raifed, or rather thrown, is very fmall. M. Belidor informs us, that a workman can only remove half a cubic foot in two vibrations, which he will perform in four feconds; this is at the rate of $7\frac{1}{2}$ cubic feet *per* minute, or 450 cubic feet *per* hour: it is rarely applicable, except to throw the water over a bank which forms the boundary of a ditch, or other place of fmall depth, which is to be emptied.

The *laving gun*, which is ufed in falt-works from its fimplicity, comes next. It is a trough of five or fix feet in length, made fmall at one end like a fpout, and gradually increafing to the oppofite end, where it is about a foot or eighteen inches fquare. The fmall end is fupported on pivots upon the bank over which the water is to be raifed, and a lever is applied to it for a man to work it by. The large end of the trough will dip into the water, when it defcends and becomes filled; but when lifted the leaft above the horizontal pofition, the contained water will run along the trough, and be delivered over the bank through the fpout. This machine is much improved by making it double, or with two troughs, on the oppofite fides of the centre; thus when one afcends, the other will defcend fo as to raife up a conftant ftream, which it muft, in this cafe, deliver at a fpout fideways, near to the pivot or centre on which it plays. This double machine will raife a copious ftream of water, but is confined to fmall heights of three or four feet. If the large end of the trough has a valve opening into it to admit the water, it will fill itfelf more readily. A machine which operates on the fame principle as this, is called the fcoop-wheel, or tympanum, which is in fact feveral double laving machines arranged round the centre like a wheel. The advantage of this wheel is, that it always moves in the fame direction, whereas the fimple machine requires a reciprocating motion.

The *tympanum*, or *fcoop-wheel*, mentioned by Vitruvius, is a great hollow wheel formed by a kind of barrel or drum (as its name imports): it is compofed of feveral planks joined together, well caulked and pitched, and having a horizontal axle with pivots at the ends, on which it turns. The interior capacity of this drum is divided into eight equal fpaces, by as many partitions placed in the directions of the radii; each fpace or cell has an orifice of about fix inches in width in the rim of the drum or wheel. Thefe openings are fo fhaped, as to facilitate the admiffion of the water; moreover, there are eight hollow channels running along the axle of the wheel and contiguous to each other, each correfponding to one of the eight large cells; into thefe channels the water paffes out of the cells juft mentioned, and after running along the channels in the axis of the wheel to a convenient diftance, it efcapes through orifices into a refervoir placed juft under the axle. Thus when the wheel is turned round, the water is elevated through a vertical height equal to the radius of the hollow wheel.

When the tympanum is ufed to raife water from a running ftream, it is moved by means of float-boards fixed on the circumference, which are impelled by the ftream; but when it is employed to raife ftagnant waters, there is commonly a fmaller hollow wheel fixed on the fhaft at the fide of the tympanum, which is turned by men walking in it, as in the old walking-crane. The chief defect of this machine is, that it raifes the water in the moft difadvantageous fituation poffible, for the load of water is always towards the extremity of a radius of the wheel, and the length of the effective lever which anfwers to it muft continually increafe as the water is raifed through the whole quadrant, which the water defcribes in paffing from the bottom of the wheel to the altitude of its centre, fo that the power muft act in the fame manner as if it were applied to a winch or crank handle, and cannot act uniformly.

The *horn-wheel* was contrived to remedy this defect: it is fo called, becaufe the fegments which pafs from the circumferences of the large flat cylinder to its centre are not ftraight radii, as in the former inftance, but are curved fpirally. The fcoops, or mouths, by turns, dip into the water, and as they rife up caufe the water to pafs up the horn, or curved fegment, until it is as high as the centre of the wheel, and then it is difcharged into a trough placed under the end of the axis, which is hollow, and has its pivots faftened to a crofs.

M. de la Faye has inveftigated the proper curves for the fcoop fegments of this machine in the following manner:— When we evolve the circumference of a circle by unwrapping a ftring from the circumference, the end of the ftring will defcribe a curve called the involute of the circle, of which all the radii are fo many tangents to the circle, as is fhewn by the ftring in its different pofitions whilft tracing the curve, and likewife all the radii are refpectively perpendicular to the feveral points of the curve defcribed by the end of the ftring.

The greateft radius of this curve is a line equal to the periphery of the circle evolved. The truth of this ftatement is fhewn by geometricians, when treating of the generation of *Evolute* and *Involute Curves*. See thofe articles.

Hence, having an axle, whofe circumference a little exceeds the height to which the water is propofed to be elevated, let the circumference of the axle be evolved, and it will make a curve which will be the involute of the circle, as before mentioned. Now, let a number of pipes, or trunks, be made exactly with this curvature, and then put together around the axle, in form of a wheel, fo that the further extremities of thefe canals will fucceffively enter the water that is to be elevated, whilft the other extremities abut upon the fhaft which is turned. Then, in the courfe of the rotation of the wheel, the water taken in at the extremity of each canal will rife in a vertical line, which is a tangent

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to the ſhaft, becauſe the curves of the ſeveral channels will be at right angles to this vertical line, in the points where the line interſects the curves; and this is true in whatever poſition the wheel may be. Thus the action of the weight continuing always beneath the extremity of the horizontal radius of the axle, will oppoſe the ſame reſiſtance, as though it acted upon the invariable arm of a lever, in the manner of a bucket of water, which is drawn up out of a well by a rope, winding on a roller, and the power required to raiſe the weight will be always the ſame.

If the radius of the wheel, of which theſe hollow canals ſerve as bent ſpokes, be equal to the height through which the water is to be raiſed, and conſequently equal to the circumference of the axle, or ſhaft, the power will be to the load of water reciprocally as the radius of a circle to its circumference, or directly as 1 to $6\frac{1}{4}$ nearly. M. de la Faye recommended the machine to be compoſed of four of theſe canals, but it has often been conſtructed with eight. The wheel is turned by the impulſion of the ſtream upon float-boards fixed on the circumference of the wheel, and the orifices of the curvilineal canals dip one after another into the water which runs into them; and as the wheel revolves, the fluid riſes in the canals, until it is as high as the centre: it then runs out in a ſtream from the holes in the axis, and is received into the trough fixed beneath the axis; from thence it may be conveyed by pipes or troughs to the required ſituation.

By this conſtruction, the weight to be raiſed offers always the ſame reſiſtance, and that is the leaſt poſſible, while the power is applied in the moſt advantageous manner which the circumſtances will admit of. Theſe conditions being both fulfilled at the ſame time, furniſh the moſt deſirable perfection in a machine. This machine raiſes the water by the ſhorteſt way, namely, the perpendicular or vertical line, and in this reſpect is preferable to Archimedes's ſcrew, where the water is carried up a crooked and inclined path; and beſides this each curved channel in this wheel empties all the water it receives in every revolution, while the ſcrew of Archimedes delivers only a ſmall portion of the fluid with which it is charged, being often loaded with twenty times as much water as is diſcharged at one rotation, and thus requiring an increaſe of labour when a large quantity is intended to be raiſed by it. The horn-wheel would be one of the moſt perfect machines for raiſing water, were not its powers confined to ſuch altitudes as the ſemi-diameter of the wheel.

The *flaſh*, or *fen-wheel*, comes next to be deſcribed.— This is a vertical wheel, made exactly like thoſe water-wheels for turning mills which are called breaſt-wheels, and in the ſame manner the wheel is ſurrounded at the lower quadrant by a curved ſweep of maſonry or breaſt, to which the floats of the wheel are fitted with the greateſt accuracy, but do not abſolutely touch. This wheel, being turned round in a direction contrary to that in which a water-wheel turns, will carry water before its floats, and raiſe it up againſt the breaſt until it runs over the ſame. The operation is juſt the reverſe of the water-wheel; and the only difference in the conſtruction of the two machines is, that the flaſh-wheel requires no ſhuttle to be placed at the top of the breaſt, becauſe the water muſt be allowed to run freely away from the top of the breaſt; but the water-wheel requires a ſhuttle or ſluice to regulate the quantity of water which ſhall flow to the wheel.

It is by this kind of machine that the extenſive fens of Holland are drained; and in Lincoln and Cambridgeſhire they are alſo uſed very extenſively. They are, in general, worked by the power of the wind, and are on a very large ſcale.

Mr. Smeaton made a horſe-machine on this plan, which raiſed thirty-three hogſheads *per* minute, to the height of four feet and a half, when it was worked by four horſes; but a ſluice was placed in the channel which admitted the water to the wheel, ſo as to ſupply the water in a greater or leſſer quantity; and by this means, the ſame machine could be adapted to the power of three or two horſes. The crown or top of the breaſt, over which the water was delivered, was not elevated to the full height to which the water was to be raiſed, but it was laid twelve inches beneath the ſurface, and the body of water which the wheel raiſed up was ſufficient to drive this depth of water before it; but to prevent the return of the water when the mill ceaſed working, two pointed doors were placed in the channel leading from the wheel, like the gates of a canal-lock: theſe doors opened freely, to let the water paſs, but would ſhut and ſtop the water from returning. The proportions of this machine were as follows:

Diameter of the track in which the horſes walked - - -	26 feet 8 inches.
Great cog-wheel fixed on the perpendicular axis - - -	72 teeth 9 feet diameter.
Trundle worked by the wheel -	35 teeth $4\frac{1}{2}$ feet diam.
Diameter of the water-wheel on the ſame axis as the trundle -	14 feet.
Breadth of the wheel - - -	2 feet 2 inches.
Number of its floats - - -	42

The floats did not point to the centre of the wheel, but formed tangents to a radius, equal to about half the radius of the wheel. The floats of the wheel were very exactly fitted to the channel or pit in which it worked, ſo as not to touch.

The *bucket-wheel* is a very ancient method of raiſing water; but it cannot lift water to a greater height than its own diameter. The laſt machine was the reverſe of the breaſt water-wheel, and the preſent is the reverſe of the over-ſhot water-wheel, for the circumference of the wheel is ſurrounded by buckets, which dip in the water beneath the wheel, and take up water, which they diſcharge at the top of the wheel into an elevated trough or reſervoir. The wheel is mounted upon an horizontal axis, and turns upon pivots; it is put in motion by the force of a current of water ſtriking the float-boards fixed on the circumference of the wheel; or if there is no current in the water, it may be moved by making the wheel hollow within for a man to walk in it, as is common in ſome kinds of cranes, or the wheel may be turned by horſes. The rim, or circumference of the wheel, is made hollow, and is divided into ſeveral compartments, to form a number of boxes or buckets; each bucket has an opening into it at that end which will be the moſt advanced when the wheel turns; and from this opening, a ſpout or trough projects in a direction parallel to the axis of the wheel. When the wheel revolves, the buckets dip into the ſtream, and become filled with water; but as the mouths or ſpouts are at the upper end when the buckets riſe out of the water, they cannot eſcape, and each bucket carries up its charge of water to the top of the wheel; but the buckets will have then become inverted, and the ſpouts or openings being at the loweſt part, that they diſcharge the water ſideways through the ſpouts into a trough properly placed to receive it, and then the buckets deſcend empty till they dip into the ſtream and are refilled. The objection to this machine is, that the buckets begin to pour out the water

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ſome time before they arrive at the greateſt height of the wheel; and, therefore, the trough is of neceſſity placed lower than the diameter of the wheel, or a conſiderable portion of the water would be loſt, and in any caſe part of the water is raiſed above the level of the trough.

Spaniſh Bucket-Wheel.—Mr. Townſend, in his Travels through Spain, deſcribes a ſimple machine which is uſed at Narbonne for watering of gardens. The water is raiſed by a vertical wheel, which is twenty feet in diameter, on the circumference of which is fixed a number of little boxes or ſquare buckets, for the purpoſe of raiſing water out of the ciſtern communicating with the canal below, and to empty it in a reſervoir above, placed by the ſide of the wheel. The buckets have a lateral orifice to receive and to diſcharge the water. The axis of this wheel is embraced by four ſmall beams, croſſing each other at right angles, and tapering at the extremities ſo as to form eight little arms. This wheel is near the centre of the path in which the mule walks, and contiguous to the vertical axis, into the top of which the horſe-beam is fixed; but near the bottom of this axis it is embraced by four little beams, forming eight arms, ſimilar to thoſe above deſcribed, on the axis of the water-wheel. As the mule which they uſe goes round, theſe horizontal arms, ſupplying the place of cogs, take hold each in ſucceſſion of thoſe arms which are fixed on the axis of the water-wheel, and keep it in rotation. This machine may be made very cheap, and will throw up a great quantity of water, yet undoubtedly it has two defects; the firſt is, that part of the water runs out of the buckets, and falls back into the well after it has been raiſed nearly to the level of the reſervoir; and the ſecond is, that a conſiderable proportion of the water to be diſcharged is raiſed higher than the reſervoir, and falls into it only at the moment when the bucket is at the higheſt point of the circle, and ready to deſcend.

The *Perſian wheel with ſwinging buckets* is free from ſome of the defects of the laſt machine. The buckets are looſe, and each hangs from the circumference of the wheel by a pin, on which it ſwings or turns freely; and as the bucket is ſuſpended by its upper part, it will hang perpendicular, with the mouth upwards, in all poſitions of the wheel. From the time it dips in the water and is filled, until the bucket arrives at the upper part of the wheel, it is carried by the motion of the wheel againſt the edge of the trough, and inclined ſo far as to diſcharge its contents into the trough. (See Persian *Wheel.*) The pins are fixed into the circumference of the wheel, and project ſideways therefrom a ſufficient diſtance to ſupport the buckets, and carry them over the elevated trough. Sometimes the wheel is made with two rims, and each bucket is ſuſpended upon an axis between them: the end of each axis paſſes through the rim of the wheel, and is bent to form a ſhort lever, which is carried by the motion of the wheel againſt a fixed rail, and thus inclines the bucket to diſcharge the contents into a trough which is fixed to the rims of the wheel immediately beneath the bucket, and has a ſpout projecting at the ſide of the wheel, to carry the water ſideways and deliver it into the trough, which is fixed at the ſide of the wheel for its reception.

As the Perſian wheel is a very effective machine in ſituations where the elevation is required to be but ſmall, the following directions, given by M. Belidor for its conſtruction, are worthy of attention: firſt fix the diameter of the wheel ſomething greater than the altitude to which the water is to be raiſed; fix alſo upon an even number of buckets, to be hung at equal diſtances round the periphery of the wheel; and mark the poſition of their centres of motion in ſuch a manner, that they will ſtand in correſponding poſitions in every quarter of the circle. Suppoſe vertical lines drawn through the centre of motion of each bucket in the riſing part of the wheel, and they will interſect the horizontal diameter of the wheel in points, at which, if the buckets were hung, they would make the ſame reſiſtance to the moving force, as they do when hanging at their reſpective places on the rim of the wheel. Thus, ſuppoſing there are eighteen equidiſtant buckets, then while eight hung on each ſide of a vertical diameter of the wheel, there would be eight on the other ſide, and two would coincide with that diameter: in this caſe, the reſiſtance ariſing from all the full buckets would be the ſame as if one bucket hung on the prolongation of the horizontal diameter, at the diſtance of twice the ſine of 20° + twice the ſine of 40° + twice the ſine of 60° + twice the ſine of 80°, theſe being the ſines to the common radius of the wheel.

To know the quantity of water that each one ſhould contain, take four-ninths of the abſolute force of the ſtream, that is, four-ninths of the weight of a priſm of water whoſe baſe is the ſurface of one of the float-boards, and whoſe height is equal to that through which the water muſt fall in order to acquire the velocity with which the ſtream moves. This is the power which ſhould be in equilibrio with the weight of water contained in the buckets of the riſing ſemicircle. Then ſay, as the ſum of the ſines mentioned above is to the radius of the wheel to the centre of the float-board, ſo is the power juſt found to a fourth term, one-half of which will be the weight of water that ought to be contained in each bucket. Laſtly, the velocity of the float-board of the wheel will be to that of the ſtream nearly as one to two and two-fifths, and from this the number of revolutions it will make in any determinate times may be known, and of conſequence the quantity of water the wheel will raiſe in the ſame time, ſince we know the capacity of each bucket, and the number of them which will be diſcharged in every revolution of the wheel. See Persian *Wheel.*

The Chineſe Bucket-Wheel.—Sir George Staunton, in his account of the Embaſſy to China, gives the following deſcription of a bucket-wheel, which is different from any we have met with in the hydraulic collections, and conſtructed with that ſimplicity which diſtinguiſhes the Chineſe inventions. Two hard-wood poſts or uprights are firmly fixed in the bed of the river, in a line perpendicular to its banks. Theſe poſts ſupport the pivots of an axis of about ten feet in length: this is the axis of a large wheel conſiſting of two unequal rims, the diameter of the rim which is neareſt to the bank being about fifteen inches leſs than that of the outer rim; but both rims dip into the ſtream, while the oppoſite points or top of the wheel riſe above the elevated bank over which the water is to be raiſed. This double wheel is framed upon the axis, and is ſupported by ſixteen or eighteen ſpokes, inſerted obliquely into the axis near each extremity, and croſſing each other at about two-thirds of their length. They are there ſtrengthened by a concentric circle, and are faſtened afterwards to the two rims. The ſpokes inſerted in the interior extremity of the axis reach to the outer rim, and thoſe proceeding from the exterior extremity of the axis reach to the inner and ſmaller rim. Between the rims and the croſſings of the ſpokes is a triangular ſpace, which is woven with a kind of cloſe baſket-work, to ſerve as ladle-boards, or floats. Theſe ſucceſſively receiving the current of the ſtream, obey its impulſe, and turn round the wheel.

The buckets which take up the water are ſmall tubes or

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ſpouts of wood attached to the two rims of the wheel, and having an inclination of about twenty-five degrees to the horizon, or to the axis of the wheel. The tubes are cloſed at their outer extremities, which are fixed to the larger rim, and open at the oppoſite end. By this poſition the tubes, which in the motion of the wheel dip into the ſtream, have their mouths or open ends uppermoſt, and fill with water. As that ſegment of the wheel riſes upwards, the mouths of the tubes attached to it will alter their relative inclination, but not ſo much as to let their contents flow out until ſuch ſegment of the wheel arrives at the top. The mouths of theſe tubes are then relatively depreſſed, and they pour the water into a wide trough placed on pivots, from whence it is conveyed, as may be wanted, among the plantations of canes.

The only materials employed in the conſtruction of this water-wheel, except the nave or axis, and the poſts on which it reſts, are afforded by the bamboo. The rims, the ſpokes, the ladle-boards or floats, and the tubes or ſpouts, or even the cords, are made of entire lengths, or ſingle joints, or large pieces, or thin ſlices, of the bamboo. Neither nails, nor pins, nor ſcrews, nor any kind of metal, enter into its conſtruction: the parts are bound together firmly by cordage of ſlit bamboo. Thus, at a very trifling expence, is conſtructed a machine, which, without labour or attendance, will furniſh, from a conſiderable depth, a reſervoir with a conſtant ſupply of water, adequate to every agricultural purpoſe.

Theſe wheels are from twenty to forty feet in diameter, according to the height of the bank, and conſequent elevation to which the water is to be raiſed. A wheel of thirty feet is capable of ſuſtaining with eaſe twenty tubes or ſpouts, of the length of four feet, and diameter of two inches in the clear. The contents of ſuch a tube would be equal to ſix-tenths of a gallon, and the twenty tubes would hold twelve gallons. A ſtream of a moderate velocity would be ſufficient to turn the wheel at the rate of four revolutions in one minute, by which would be lifted forty-eight gallons of water in that ſhort period; or in one hour, two thouſand eight hundred and eighty gallons; and ſixty-nine thouſand one hundred and twenty gallons, or upwards of three hundred tons in a day. This wheel is thought by ſir George to exceed, in moſt reſpects, any machine yet in uſe for ſimilar purpoſes. The Perſian wheel, with looſe buckets ſuſpended to the edge of the rim or fellies of the wheel, ſo common in the ſouth of France, and in the Tyrol, approaches neareſt to the Chineſe wheel, but is vaſtly more expenſive, and leſs ſimple in its conſtruction, as well as leſs ingenious in the contrivance. In the Tyrol there are alſo bucket-wheels for lifting water in a circumference of wood, hollowed into ſcoops; but they are much inferior either to the Perſian or Chineſe wheel.

Chain of Buckets.—This machine conſiſts of a number of buckets attached to a chain or rope, the ends of which are united together. The chain is conducted over a wheel, which is turned by ſome animal or mechanical power; and the chain hangs down from this wheel into the well from which the water is to be drawn. The buckets at the lower part of the chain become filled, and, by the motion of the chain, the buckets attached to one part of the chain will aſcend full of water, whilſt thoſe on the oppoſite ſide are deſcending empty, with their mouths downwards. When the full buckets of water turn over the upper wheel, they diſcharge their contents into a trough fixed near the wheel. The moſt convenient way of diſcharging the water is to make the upper wheel hollow, with diviſions in it like the tympanum; and the buckets, when they turn over, will pour their contents into the hollow ſegments of the wheel, and it will run off through a hollow in the axis made for that purpoſe. The advantage of the chain of buckets over the wheel is, that the chain can be made to deſcend in a well, or ſmall ſpace, where the wheel could not; alſo, that the chain may be uſed for greater depths than would be practicable for a wheel.

The *Spaniſh noira* is a chain of buckets or earthen jars. Mr. Townſend informs us, in his journey through Spain, that the noira conſiſts of an endleſs band or girdle, paſſing over a ſprocket-wheel: the band is long enough to reach eighteen inches or two feet below the ſurface of water in a well. All round this band, at the diſtance of about fifteen inches, are fixed jars of earthen-ware, which, as the band turns, take up water from the well, and pour it into a ciſtern fitted to receive it. A little aſs, going round in a circular walk with eaſe, turns a trundle, which gives motion to a cog-wheel, fixed on the ſame axis with the ſprocket-wheel, on which the band is hung, and with which it turns. This machine produces a conſtant and conſiderable ſupply of water, at a ſmall expence, and with very little friction. As the air would obſtruct the entrance of water into theſe earthen jars or bottles, each jar has a little orifice in its bottom, through which the air eſcapes; but then water runs out alſo, and a certain quantity falls back into the well.

It is true, as the jars riſe in one ſtraight line, the water which runs out of the ſuperior jar is caught by that which is immediately below it, yet ſtill there is a loſs; and, beſides this inconvenience, the whole quantity is raiſed higher than the upper reſervoir, at leaſt by the diameter of the ſprocket-wheel, becauſe it is only in their deſcent that the jars are emptied.

The *ſcrew of Archimedes* is a machine on a principle very cloſely allied to the horn-wheel; but the curved channels are wrapped ſpiralwiſe round an axis, which is placed on an inclined poſition, with the lower end immerſed in the water which is to be raiſed, and the upper end placed over the edge of the reſervoir into which the water is to be delivered. When this cylinder is turned round, it will take water up in its ſpiral channel, and raiſe it gradually to the elevated end, and diſcharge it into the reſervoir. (See Screw.) Although this machine is ſimple in its general manner of operation, its theory is attended with ſome difficulties.

If we conceive that a flexible tube is rolled regularly about a cylinder, from one end to another, this tube or canal will form a ſcrew or ſpiral, of which we ſuppoſe the intervals of the ſpires or threads to be equal to one another. Suppoſe this cylinder placed with its axis in a vertical poſition, if we put in at the upper end of the ſpiral tube a ſmall ball of heavy matter, which may move freely, it is certain that it will follow all the turnings of the ſcrew from the top to the bottom of the cylinder, deſcending always as it would have done, had it fallen in a right line along the axis of the cylinder; only it will occupy more time in running through the ſpiral.

If we ſuppoſe the cylinder placed with its axis horizontally, and we again put the ball into one opening of the canal, it will deſcend, following the direction of the firſt demi-ſpire, until it arrives at the loweſt point in this portion of the tube, and then it will ſtop: for the weight of the ball has no other tendency than to make it deſcend in the demi-ſpire. The oblique poſition of the tube, with reſpect to the horizon, cauſes the ball, in deſcending, to advance from that extremity of the cylinder whence it commenced its motion to the other extremity. When the ball is arrived at the bottom of the firſt demi-ſpire, if we cauſe the cylinder to turn on its axis, without changing the poſition of of that axis, and in ſuch manner that the loweſt point of the demi-ſpire on which the ball preſſes becomes elevated, then the ball falls neceſſarily from this point upon that which ſucceeds, and becomes loweſt; and as this ſecond point is more advanced towards the ſecond extremity of the cylinder than the former one, the ball will be advanced towards that extremity by this new deſcent, and ſo on, that it will at length arrive at the ſecond extremity. Moreover, the ball, by conſtantly following its tendency to deſcend, has advanced through a right line, parallel and equal to the axis of the cylinder; and this diſtance is horizontal, becauſe the ſides of the cylinder were placed horizontally.

But ſuppoſe the cylinder had been placed oblique to the horizon, and turned on its axis continually in the ſame direction, it is eaſy to ſee that the ball will move from the lower end of the ſpiral tube towards the upper end, although it is actuated ſolely by gravity, for this cauſes it to occupy the loweſt point of the firſt demi-ſpire; and when it is abandoned by this point, as it is elevated by the rotation, and will roll by its weight upon that point which has taken its place, this ſucceeding point is further advanced towards the elevated extremity of the cylinder than that which the ball occupied juſt before; conſequently the ball, while following its tendency to deſcend, will be always more and more elevated, by virtue of the rotation of the cylinder. Thus it will, after a certain number of turns, be advanced from the lower extremity to the upper, or through the whole length of the ſpiral; but it will only be raiſed through the vertical height, determined by the obliquity of the poſition of the cylinder.

Inſtead of the ball, let us now conſider water as entering by the lower extremity of the ſpiral canal, when immerſed in a reſervoir. This water deſcends at firſt in the canal ſolely by its gravity; but the cylinder being turned, the water moves on in the canal to occupy the loweſt place, and thus, by the continual rotation, is made to advance further and further in the ſpiral, till at length it is raiſed to the upper extremity of the ſpiral, where it is expelled. There is, however, an eſſential difference between the water and the ball; for the water, by reaſon of its fluidity, will adapt itſelf to the form of the ſpiral, and, after having deſcended by its heavineſs to the loweſt point of the demi-ſpire, will riſe up on the contrary ſide to the original level; on which account, more than half one of the ſpires may be filled with the fluid.

The moſt ſimple method of tracing a ſcrew or a helix upon a cylinder is well known to be this:—Take the height or length of a cylinder for the perpendicular leg of a right-angled triangle, and make the baſe or horizontal leg equal to as many times the circumference of the cylinder as the ſcrew is to make convolutions about the cylinder itſelf; then draw the hypothenuſe to complete the triangle. Suppoſe this triangle to be enveloped about the ſurface of the ſolid cylinder, the perpendicular leg being made to lie parallel to the axis of the cylinder, and the horizontal leg or baſe to fold upon the circumference of the cylinder, even with its baſe; then the hypothenuſe or ſloping ſide of the triangle will form the contour of the ſcrew. If a tube be formed according to the direction of this ſpiral, and a ſmall ball put into it when the cylinder is placed upright, the ball would roll to the bottom with the ſame velocity, and the ſame force, as it would have deſcended upon a plane ſurface, inclined in the ſame degree as the hypothenuſe of the triangle which we have ſuppoſed, when the baſe thereof is horizontal. But ſuppoſe the cylinder be inclined in ſuch degree, that the hypothenuſe of the ſaid triangle would be horizontal inſtead of the baſe, as the angle which the threads of the ſcrew make conſtantly with the baſe of the cylinder is juſt equal to that inclination, the threads at their point of ſmalleſt inclination will be parallel to the horizon; ſo that there being nothing to occaſion the ball to roll towards either end, it will remain immoveable, ſuppoſing the cylinder to be at reſt; but if the cylinder be turned on its axis in one direction, the ball (abſtracting from friction) will move the contrary way, in conformity with the firſt law of motion. The inclination which we have juſt aſſigned is the leaſt we can give, ſo that the ball ſhall not deſcend of itſelf; but if we augment this inclination, then, by turning the cylinder, the ball will always have a deſcent on one ſide, and will in conſequence roll towards the elevated end of the ſame, and will mount by deſcending. The reaſon is very ſimple: the plane which carries it makes it riſe more, in conſequence of the rotatory motion, than it deſcends by virtue of the force of gravity. It is obvious, from what has been remarked, that this ſcrew can never raiſe water, when the angle which the central line of the ſpiral makes with the baſe of the cylinder is larger than the angle which the baſe of the cylinder makes with the horizon.

The ratio of the weight of the ball to the force which is neceſſary to make it riſe by turning the ſcrew, is as the vertical ſpace through which the weight is raiſed to the ſpace paſſed through by the power in moving it. Suppoſe the moving force acts at the circumference of the cylinder, the ſpace paſſed over by that force will be equal to as many times the circumference of the cylinder as the number of convolutions of the helix. Let the diameter of the cylinder be 14 inches, the vertical altitude of the upper end of the cylinder above the lower end 12 feet, or 144 inches, and 12 convolutions of the ſpiral: let the cylinder be ſo placed, that the inclination of the axis is greater than the inclination of the ſpiral to the axis, and let the weight to be raiſed be a 48 lb. ball. The circumference of the cylinder will be nearly 44 inches, and the 12 turns equal to $12 \times 44 = 528$ inches, for the ſpace the power muſt move through. Hence we have 528 inches : 144 inches :: 48 lbs. : $13\frac{1}{11}$ lbs.; the meaſure of the requiſite force to be applied at the ſurface of the cylinder. If the moving force deſcribes a circle whoſe diameter is three times that of the cylinder, or acts at a winch whoſe diſtance from the axis of motion is 21 inches, that force will then be reduced to $\frac{1}{3}$ of $13\frac{1}{11}$ or $4\frac{4}{11}$ lbs. which is leſs than one-tenth of the weight of the ball. In this inveſtigation, no notice is taken of the friction upon the pivots, or of the effects of the air included in the ſpiral: yet if the ſpiral had been folded upon a cone inſtead of a cylinder, or if it had been formed of a flexible tube of varying diameter, theſe effects would have been important: ſome of them are conſidered in our account of the ſpiral pump.

The Archimedes' ſcrew is a machine ſo frequently employed in hydraulic architecture, as to deſerve particular directions for conſtructing it. The ſimple pipe wrapped round a cylinder will not afford any conſiderable ſupply of water, and therefore a hollow barrel muſt be made with one or two ſpiral partitions running in it, like the ſpiral ſtair caſes uſed in church ſteeples.

Vitruvius has given minute directions for the conſtruction of the water-ſcrew, and Mr. Smeaton's directions, which are very ſimilar, are as follow:—For a ſcrew of 18 inches diameter, uſe a ſolid cylinder of ſix inches diameter as an axis, upon the ſurface of which cut a double helix, forming two ſeparate grooves round the axis of about three-quarters of an inch wide and deep, ſo that the grooves in going once round will advance about ſixteen inches, and in conſequence confequence the two grooves will be eight inches apart from middle to middle, meafuring parallel to the length of the cylinder. Into thefe grooves drive and faften pieces of board, fo as to form radii or fectors of a circle of eighteen inches and a half diameter, and fo moulded as to be a little upon the twift, to anfwer the different inclinations of the helix, at the different diftances from the centre. Thefe pieces being jointed together, and to the axis, fo as to fill the whole groove from one end of the axis to the other, form a double fcrew; then apply narrow boards longitudinally, reaching from one end of the fcrew to the other. The boards fhould be about four inches broad, and formed concave withinfide, anfwerable to a circle of eighteen inches diameter. Thefe boards are marked one by one at the places where they touch the fpiral boards, and are then grooved about a quarter of an inch, to admit the ends of the radius pieces which form the fcrew. When all the boards are put together they form a cylinder of eighteen inches diameter, which is hooped on the outfide, in the manner of a tub or cafk; and in order that the hoops may properly drive on the outfide, at the fame time that the infide forms a complete cylinder, the longitudinal pieces are made rather thicker in the middle than at the ends.

Archimedes' fcrew may be ufed for other purpofes than raifing of water. It might be adapted with advantage in raifing cannon-balls from a fhip to a wharf, and with the addition of a bevel-wheel or two and their pinions, might be worked either by men or horfes. Sometimes Archimedes' fcrew inftead of being worked by men at a winch, is turned by means of float-boards fixed on the circumference of a wheel placed at its lower end, upon which a ftream of water acts. If the water has a moderate fall, it will have fufficient efficacy to turn two fcrews, one above another. The top of the lower fcrew and the bottom of the upper fcrew may act one upon the other, by means of a wheel upon each, with an equal number of teeth taking into each other. In this cafe the upper fcrew will turn in a contrary direction from the lower, and confequently the fpiral tube muft be wound about the cylinder in an oppofite direction. A folid wheel, or a light wheel with a heavy rim, turning upon the middle of the fcrew as an axis, will operate like a fly, and in fome cafes be very ufeful.

Mr. Smeaton made a machine to raife water by an Archimedes' fcrew for the royal gardens at Kew, which was on a large fcale. The fcrew was twenty-four feet long, two feet fix inches in diameter, and raifed the water perpendicularly fourteen feet nine inches. The central cylinder, or fhaft of the fcrew, was ten inches diameter; the diftance between the threads, including the thicknefs of the helix, was twelve inches and a half; and as there were two fpiral paffages, each fpiral advanced twenty-five inches along the cylinder at every turn; each fpiral contained twenty-feven quarts at every turn, the fcrew therefore gave out fifty-four quarts at every turn which it made.

This fcrew was turned by means of a trundle or pinion from a horfe-wheel, with the intervention of two moveable joints, to change the direction of the axis from the horizontal to the direction of the axis of the fcrew, which was inclined at an angle of about thirty-eight degrees to the horizon. The diameter of the horfe-track was twenty-five feet, half of which was the length of the effective lever upon which the horfes acted. The great cog-wheel on the axis of the levers was fourteen feet diameter, with 144 cogs, and the trundle which it turned twenty-three cogs, fo that the fcrew made about fix turns for one of the horfe-wheel.

This machine was worked by two light horfes, with very great eafe, and they made three turns *per* minute; but if at all urged, could make the fcrew turn twenty turns *per* minute, and at that rate of working raifed 300 hogfheads *per* hour.

The *Water-fcrew*, defcribed in our article Screw, does not differ from the fcrew of Archimedes in its principle, but as the fcrew turns round within a fixed barrel, the water is liable to leak back in part.

Drawing Water by Buckets.—The methods which we have hitherto defcribed are only adapted to raife water to fmall elevations; but by means of buckets, water may be drawn from very great depths. The moft fimple cafe is that of a man with a bucket or other veffel in his hand, ftooping down to lower the empty bucket into a pond, as low as he can reach, and drawing it up full of water.

The firft improvement which would occur would be to fufpend the bucket by a rope, and draw it up by means of a long lever, or otherwife, if the depth was greater, by continuing the rope over a pulley, fo that the man could eafily draw the end of it; and this would be farther improved when two buckets were fufpended at the oppofite ends of the rope or chain, fo that one being drawn up full of water, an empty one would be let down at the fame time. This method is applicable to the deepeft well, and is very effective. The addition of a windlafs and crank would be a fucceffive improvement, and could be made to act either fingly, to draw up one bucket, or double, to let down an empty bucket at the fame time it drew up another loaded with water.

The drawing up of a bucket by a rope and pulley is fo fimple and obvious as to need no explanation. The bucket fhould be of fuch a fize that it will not weigh above twenty-fix pounds, and will therefore contain nearly half a cubic foot of water. For although a man could with eafe raife a much greater weight, yet he would be unable to draw it up fo quickly, or to work at it throughout the day; and what he would gain by the increafed quantity of water, he would lofe in the time which it would require to draw up the bucket, and in the time he would require to reft himfelf from his fatigue. If the rope is conducted horizontally, and the man takes it over his fhoulder and walks along the ground, his force will be applied in a much more effective manner than by fimply hauling the rope over a pulley; and a horfe may be applied in the fame manner with a larger bucket, and there is perhaps no better mode of applying the force of a horfe for a deep well. The bucket fhould not in this cafe weigh above a hundred and twenty pounds, or it muft not contain above two cubic feet to enable the horfe to draw it with that velocity which is moft natural to him.

When a windlafs is employed to wind up the rope, the winch or crank, which is applied to the axis of it, can be made much larger than the radius of the windlafs, and in confequence the power may be increafed fo much that a larger bucket may be drawn, which is fome advantage, becaufe lefs time will be loft in ftopping to fill and empty the bucket, otherwife nothing is gained in drawing up a large bucket, becaufe it muft move flower in proportion to its increafed weight; but in all cafes the length of the handle fhould be about fourteen or fixteen inches, to enable a man to turn it with eafe, and the weight of the bucket muft be fo adapted to the fize of the windlafs, that the power required at the handle will not be above thirty pounds or even twenty-five pounds, if a man is to work continually for fix or eight hours in a day. For example, fuppofe the bucket is about forty-fix pounds weight, and the handle fixteen inches long, then as 46 is to 25, fo is 16 to $8\frac{3}{4}$ nearly; from which

which deduct half the thickness of the rope, and it leaves the proper radius for the roller or windlass. A rope of the proper size for this purpose will be about two inches and a half in circumference, or rather more than three-quarters of an inch in diameter; hence the diameter of the barrel will be 16⅝. If a fly-wheel is applied to the axis, it will be an advantage to equalize the force which the man applies, because some positions of a crank or handle are less favourable than others for the exertion of a man's strength. It is most advantageous to employ two buckets, and as the rope for one unwinds whilst the other winds up, the weight of the two buckets balance each other, and the man has only the weight of the water to draw up.

Bucket-Machines for deep Wells.—When a machine to draw water by buckets is made on a larger scale, the windlass is placed perpendicularly, and levers applied to it at the lower end, which may be actuated either by men, or by horses walking round in a circle on the ground, and drawing or pushing the end of the lever; in this way a powerful machine may be made, and if the depth is very considerable, it is a very good method. Many methods have been proposed to make the buckets fill themselves when at the bottom of the well, and empty when at the top: the best is to suspend the bucket in an iron loop or bow, like the handle of a pail, but this should be made so long, that the pins on which the cask or bucket hangs, shall be but little above the centre of gravity of the bucket when loaded with water; in consequence, when the bucket is drawn up to the top, one edge of it is caught by a hook fixed on the edge of the cistern into which the water is to be delivered, and the bucket still continuing to be drawn up whilst the hook detains one edge, the bucket is thereby overturned, and its contents discharged into the reservoir. It is requisite for this plan, that the bucket be made, by some contrivance, to present itself always in the same direction to the hook, so that it will be seized and overturned thereby: one method is to fix upright pieces of wood or iron in the well on each side of the bucket, and the pivots on which the bucket is poised project on each side beyond the iron loop on which the bucket hangs, and enter into grooves formed in these pieces, so as to be guided in the ascent and descent of the bucket. Another method is to make the rope of the bucket double for some feet immediately above the bucket, that is, the rope divides into two ends, each of which is made fast to the opposite side of the iron loop in which the bucket is suspended: the rope is made to pass through a narrow opening in a piece of plank, which will admit the double rope to pass freely, provided the bucket comes up in the required position; but if it does not, then the forked rope will be acted upon by the sides of this narrow opening in such manner, as to turn the bucket round to the required position.

To make the bucket fill readily at the bottom of the well, a simple valve is made in the bottom, which opens upwards and admits the water, but shuts when the bucket is drawn up out of the water. In the Transactions of the Society of Arts, vol. xii. is a description of a machine by Mr. Russel, in which the bucket, when it is drawn up to the top of the well, acts upon a lever, and causes a moveable trough to run across the well beneath the bucket; and then as the bucket rises higher, a trigger, which belongs to the valve in the bottom of the bucket, is intercepted by a fixed piece of wood, so as to open the valve, and the water runs out of the bucket into the moveable trough which conveys it into the reservoir: when the bucket begins to descend, it allows the levers to return, and the moveable trough retreats from beneath the bucket, and allows it to descend again into the well to bring up a fresh charge. The moveable trough is made to run backwards or forwards over the mouth of the well, by means of wheels or rollers, on which it is supported, and these wheels run upon pieces of wood laid across the well.

Indian Method of drawing Water by a leathern Bucket.—Dr. Roxburgh of Calcutta has given us a description of a method of raising a large quantity of water from a deep well by means of one or two buffaloes or bullocks, which is in common use in many parts of Hindoostan, where the wells are too deep for the lever. A pulley is erected over the well to receive a rope, which the animals draw by walking along an horizontal path in order to elevate a large bucket, and they return towards the well to lower it down: the bucket is made of leather, like a long funnel, extended at the top or mouth by a square frame of wood, or by a hoop, and the lower end terminates in a small open tube, which is flexible, and can be turned up; in which case, if the orifice of the tube is kept as high or higher than the mouth of the bucket, no water can escape through the tube, it is in this condition that the bucket is drawn up full of water: the end of the tube has a cord fastened to it, which is conducted over a roller fixed on the edge of the trough into which it is desired to deliver the water, and which trough must be at least the length of the bucket beneath the great pulley that is fixed over the well. The opposite end of the cord is tied to the great rope near the point where the buffaloes draw, and the cord is of such length as to hold the orifice of the tube rather above the mouth of the bucket, until the tube is drawn up to the roller. When the cord draws the tube over the roller, and leads its end into the trough as the bucket continues to be drawn up, it is raised above the level of the trough, by which means the whole of the water will make its escape through the orifice of the tube into the trough: when the bucket is let down again, the flexible tube returns over the roller, and the cord holds up its orifice above the top of the bucket.

Desaguliers, in the second volume of Experimental Philosophy, describes a very simple contrivance to raise water by a bucket; which is this, to one end of a rope is fixed a large bucket, having a valve in its bottom opening upwards; to the other end of the same rope is fastened a square board, something like the scale-board of a balance, but large enough for a man to stand upright in it; the cord is made to pass over two pulleys, each of about fifteen inches diameter, and fixed in such manner, that as the bucket descends, the scale ascends with equal velocity, and *vice versâ*. The scale is made to run freely between four vertical guide rods, passing through holes at its four corners, and when the bucket is lowered down into the lower water-cistern in order to fill with water, the scale stands nearly level with the horizontal plane of the upper reservoir to which the water is to be raised. When the bucket is full, a man steps into the scale, and his weight, together with that of the frame, exceeding the weight of the vessel and its contained water, will give an ascending motion to the bucket, and causes the valve in its bottom to close. When the bucket is raised to the proper height, a hook which is fixed at the edge of the upper reservoir catches into a hasp at the side of the bucket, and turns it over, to cause it to empty its water into the upper cistern, or into a trough, which conveys it where it is required: at this time the man and the scale have arrived at a platform, which prevents their further descent, and the man must remain in the scale till he finds the bucket above is empty, when he steps from the scale, and runs up a flight of stairs to the place from which he descended: the bucket in the mean while, being somewhat heavier than the scale, descends again to the water, and raises the frame to its original position; thus the work is is continued, the man being at reft during its defcent, and labouring in the afcent.

Defaguliers employed in this kind of work a tavern-drawer, who had been ufed to run up and down ftairs; he weighed 160 pounds, and was defired to go up and down 39 fteps of $6\frac{1}{2}$ inches each (in all about 21 feet) at the fame rate he would go up and down all day. He went up and down twice in a minute, fo that allowing the bucket, with a quarter of a hogfhead of water in it, to weigh 140 pounds, he is able to raife it up through 21 feet twice in a minute, which is equivalent to the whole hogfhead raifed $10\frac{1}{2}$ feet in a minute, and rather exceeds what Defaguliers affigned as a maximum of human exertion; from experiments made with a mercurial pump. He recommends that the man in the fcale fhould weigh one-fifth or one-fixth more than the weight of the water in the bucket, in order to give him a preponderance to bring up the bucket with a proper velocity.

Balance Buckets.—This is an ingenious contrivance for raifing water by the power of a fmall fall of water: fuppofe a wooden lever twenty feet long, poifed upon a centre at five feet from one end, one arm will then be five feet long, and the other fifteen, or three times. At the extremity of the long arm a fmall bucket is fixed, and at the extremity of the fhort arm another bucket, which is rather more than three times as great in capacity: the lever is fo poifed, that it will place itfelf in an horizontal pofition when both the buckets are empty; but fuppofe that in this fituation a fmall fpout of water runs into each bucket, when they become both filled, the larger bucket at the end of the fhort arm will overweigh the fmaller one, becaufe it holds more than three times as much water; in confequence, the larger bucket will defcend and move the lever into a perpendicular fituation, by which means the fmall bucket is raifed fifteen feet above the level of the fpout at which it received the water, whilft the great bucket has defcended five feet beneath its fource of fupply. Both the buckets are fufpended to the ends of the lever on pivots, fo that they can readily be turned over to difcharge their contents; this takes place when the lever arrives near its vertical pofition: the fmall bucket is caught by a hook, and overturned into the elevated trough which is to receive the water, and immediately the lower bucket is emptied by fimilar means. The long end of the lever is now the heavieft, and in confequence the lever returns to its horizontal pofition, in which it remains until the buckets are both full, and then it makes another ftroke. A fimple contrivance is applied to ftop the running of the fpout of water during the time that the lever is in motion, to prevent wafte of the water.

The *lofing and gaining Buckets* is a fimilar machine to the preceding, but admits of raifing the water to a greater height, becaufe chains and wheel-work are employed inftead of a lever. This machine will raife water fufficient to ferve a gentleman's feat, with an overplus for fountains, fifh-ponds, &c. A machine of this kind can be erected wherever there is a fpring affording a fmall fupply of water, and having even fo fmall a fall as ten feet. It is poffible, by this invention, with the lofs of part of the water, to raife the reft, to fupply a houfe, or any place where it is required; but, of courfe, it muft be in a lefs quantity than the fall of water which is to actuate the machine, nearly in the fame proportion as the place to which the water is to be raifed is higher than the fall of the fpring. For example, the fall of one hogfhead through ten feet will raife about one-fixth of a hogfhead to the height of forty feet. This machine had been conceived by Schottus a great many years ago, and he gave a draught of it. It is defcribed in Leopold's Theatrum Machinarum Hydraulicarum, 1720; but it was never put in execution to any good purpofe in England, till Mr. George Greaves, a carpenter, erected an engine upon this principle, about 1730, for fir John Chefter, baronet, at his feat at Chickley, in Buckinghamfhire; a fketch of which is given at *fig.* 13, *Plate Water-Works.* A fmall fpring of water, fupplying four gallons *per* minute, is conveyed feventy-two yards, by a gutter, into a ciftern N, containing about twelve gallons. This water has a defcent to the other ciftern at R, ten feet below X; from the latter, the wafte is conveyed off along H, by a drain or fewer. The defcent of part of the water through this ten feet is the motive force to work the machine. A, B, are two copper pans, or buckets, of unequal weights and fizes, fufpended by chains, which alternately wind off, and on the two multiplying-wheels Y and Z, whereof the wheel Y is fmaller in diameter, and Z larger, in proportion to the different lifts each bucket is defigned to perform. A houfe is built over the well or ciftern, with three floors, for the conveniency of fixing the parts of the engine. On the uppermoft floor is fixed a frame of timber 2 2, in which the moving parts are fupported, as is fhewn, (part being broken off in the figure, to explain the work): acrofs this frame lies an horizontal axis G, three feet and a half long, moving on two gudgeons in braffes. Upon this axis are framed three wheels; firft, the fmall wheel Y, which is two feet diameter, and fhrouded, or made with a raifed rim at each fide: the edge of the wheel is five inches broad, and fhod with iron. Upon the wheel Y is fixed a chain, made very flat and flexible, which, after it has wrapped once round the wheel, is then made double, that it may lie on each fide of the edge part, the double parts having a fufficient opening between them to admit the fingle part, and this prevents fretting or galling, and keeps the chain exactly perpendicular: from the extremity of the double part is hung a long rod of iron, at the bottom of which the great bucket A is fixed. The largeft wheel Z on the axis is fix feet diameter, and one inch and a half broad on the face, which is alfo fhrouded: this wheel is not circular, but fpiraled two inches, both in the fole and in the fhrouds; fo that its radius at the leaft part is two inches lefs than three feet. Upon the large wheel Z is fixed a fmaller chain, to fufpend the bucket B: it is made like the former, and fo arranged, that when the wheel Z has made one revolution from left to right, the fpiral fole will take up a certain length of the chain. After this length, the lower or remaining part of the chain has crofs-bars fixed to it, at equal diftances, which fall upon the edges of the fhrouds into notches plated with iron: by this means, and by the help of the fpiral, this part of the chain is not only prevented from riding upon the other, but helps to equiponderate the increafe of weight of the other chain of the bucket A. A third wheel *r*, three feet ten inches diameter, is fixed on the axis G, between the other two wheels: it is fhrouded like the others, and is fpiraled three-fourths of an inch; it receives a rope, the lower end of which goes about a wheel *d*, of two feet diameter, to which that end is fixed, and on the axis, *d*, of this wheel is another, *t*, one foot diameter, and to this is faftened a rope, which goes down upon the quadrant *a b*, which carries a fliding weight in a box at the extremity of the arm Q; the quadrant *a* moves on the axis *b*, and the rope defcending from the wheel *t*, is guided between iron plates, upon the circumference of the quadrant. The box, at the end of the arm Q, contains a fliding lead weight, to counter-balance the weight of the chains, by keeping an exact equilibrium in every pofition of the machine. Befides the action of the quadrant, the motion is regulated by wheel-work, like that of a jack; thus, upon

 one

one end of the axis G, is a ſtrong iron wheel M, giving motion to a pinion *m*, and by means of a wheel and worm *n* and *o*, to a fly P, which regulates the motion of the engine, and prevents any improper acceleration from the unwinding of the chains. The ſmall bucket B is made of copper, about five gallons in capacity; it has a valve in the bottom, by which the bucket will be filled when it deſcends into the water of the ciſtern N. The bucket is ſuſpended in an iron link, or handle, upon two pivots, ſo that it can be very eaſily turned over upon them. This happens when it is drawn up to F, the edge of the bucket catching a hook which overturns it, and diſcharges the contents into the trough W, at an elevation of thirty feet above X, and whence it is conveyed by pipes wherever it is wanted. The great bucket A is likewiſe made of copper, and contains about fifteen gallons when drawn up to the poſition A: it is filled with water from a valve, or ſluice, in the ſide of the ciſtern N, which is then opened by a bent lever, whereof the end projects, ſo that the bucket will lift it up. In the bottom of the bucket is a ſpindle-valve, which is opened when the bucket has deſcended to R, by the end of its ſpindle reſting on the bottom of the well. Iron rods are fixed vertically to guide both the buckets, which have ears with braſs rollers in them, and incloſe three ſides of each, which is ſquare, and they are thus cauſed to aſcend and deſcend in a perpendicular line, and no other.

The operation of the machine is as follows:—When the buckets are empty, they are ſtopped, as ſhewn in the figure on a level with the ſpring at X, whence they are both filled with water at the ſame time, in the manner juſt deſcribed.

The greater of the two A, being the heavier, when full preponderates, and deſcends ten feet from C and D, and the leſſer B, depending from the ſame axis, is at the ſame time weighed up or raiſed from B to F thirty feet.

Here, by catching the hook F, the ſmall bucket diſcharges its water into the trough W, and thus ſuddenly loſing weight, it lets the great bucket down an inch lower, and the valve in the bottom is opened, ſo as to let out its water, which runs waſte by the drain below at H. The bucket B being then empty, is ſo adjuſted as to overweigh, and deſcending ſteadily as it roſe, betwixt the guiding-rods, it brings or weighs up A to its former level at X, where both being again repleniſhed from the ſpring, they thence proceed as before. And thus will they continue conſtantly moving, (merely by the circumſtantial difference of water and weight, and without any other aſſiſtance than that of ſometimes giving the iron-work a little oil,) ſo long as the materials ſhall laſt, or the ſpring ſupply water.

The ſteadineſs of the motion is, in part, regulated by the fly P, which not only keeps the engine to an equal velocity, but by its running forwards, after the buckets are quite up or down, holds them ſteady till they are completely filled or emptied, and prevents them recoiling back too ſoon. In order to counterbalance the weight of the chains in every poſition, the wheels *r*, *d*, and *t*, are ſo calculated, that during the whole performance up and down, they let the quadrant *a* move no more than one-fourth of a circle; by which contrivance, as more or leſs of the chains which ſuſpend the buckets come to be wound off their reſpective wheels Y and Z, this weight gradually increaſes its action as a counterbalance, and ſo continues the motion equable and eaſy in all its parts. The ſpiraling of the wheels Y and Z help, in ſome meaſure, to regulate the weight of the chains in every poſition, as they act in winding on and off the wheels; but the quadrant *a b*, and lever with the weight Q, complete the equilibrium, by acting with the greateſt force, becauſe the lever is in the horizontal poſition when the chain of the great bucket A is all down, and weighing upon the wheel, the weight Q then acts with its whole weight upon the wheel *t*, as that chain is drawn up, its acting weight is thereby diminiſhed, and the lever of the weight Q is moving down towards its perpendicular, whereby the weight Q diminiſhes equally in its influence on the motion of the wheel *r*, until it hangs perpendicular, and its weight ceaſes to act; but the ſliding-weight then runs down in its box, to keep the rope tight, the ſliding-weight being attached to the end of the rope, and not to the lever. At the firſt return, or re-aſcent of the great bucket, the weight Q is drawn up to a ſhoulder, before any motion is given to the lever of the quadrant; but whilſt the long chain of the ſmall bucket evolves from its wheel Z, the acting-weight of the quadrant is continually increaſing, and at the ſame time the other chain of the great bucket wrapping itſelf upon the wheel Y, its acting weight is decreaſing. The lever of the quadrant riſing higher, brings the line of direction of the weight Q farther from the centre of the quadrant, and ſo lays a greater force or obſtruction to retard the wheel *r*, and continually keeps a counterbalance.

This engine, at a ſlow motion, carries up one bucket full in five minutes; but if the ſpring ran double the quantity, it would go up twice in the ſame time, and an engine of this kind may be made to raiſe one hogſhead *per* minute, or more, if required, the conſumption of water is leſs than what is ſpent by a water-wheel to raiſe an equal quantity of water to the ſame height.

The Endleſs Rope to raiſe Water.—This is a moſt ſimple contrivance, and will raiſe up a ſmall quantity of water from a very conſiderable depth. A ſoft hemp or hair-rope, with the ends ſpliced together, is ſuſpended over a large wheel, which is turned by a handle; the rope muſt hang down into the well, and reach ſome depth into the water, and a ſimilar wheel may be placed beneath the ſurface of the water for the rope to paſs under; but this is not neceſſary when the length of the rope is ſuch, that its own weight will make it apply cloſe to the upper wheel. The upper part of the rope muſt deſcend through a tube, which is fixed in the bottom of the ciſtern, or reſervoir, to prevent the water running down with the rope; the tube is of ſuch ſize as to fit the rope very nearly, but not to cauſe any conſiderable friction. The rope is put in motion by turning the handle of the wheel, and the motion muſt be in ſuch a direction, that the rope where it paſſes through the tube in the ciſtern ſhall deſcend.

The conſequence is, that the water in the well adheres to the rope, and ſurrounds it like a film, or covering of water; but when the rope paſſes over the wheel, ſome of the water is thrown off by the centrifugal force, and falls into the reſervoir, and that part of the water which eſcapes the action of the wheel is ſeparated from the rope by the tube through which the rope paſſes; for it is to be obſerved, that the film of water which ſurrounds the rope is put in motion, whilſt it is in the well, by the lateral adherence of the water to the rope, which motion being continually kept up, is ſufficient to overcome the gravity of the water; but if any body is preſented to the rope, ſo as to reſiſt the motion of the water, without obſtructing the motion of the rope, the water will fly off, and, loſing its motion, will obey the action of gravity, and fall down.

The velocity with which the rope requires to be moved, will depend upon the depth from which the water is to be raiſed. The length of that part of the rope which is immerſed in the water is alſo of ſome conſequence, for it muſt be ſuch, that the rope will act upon the ſtill water which

which immediately furrounds it, until it has put that water in motion with nearly the fame rapidity as the rope, and then fuch portion of water will accompany the rope; but this cannot take place without communicating a flower motion to a much larger quantity of water, which will alfo accompany the rope with a flower motion; but being too far removed from the rope to have its motion accelerated, or even maintained, its velocity will continually decreafe, until it ceafes to afcend, and then it will begin to run back. But this is to be underftood only of that part of the water which is too far diftant from the rope to have its motion fully maintained by the lateral action of that water which is nearer to the rope, and which moves with nearly the fame velocity as the rope. If the rope is examined at the point where it rifes above the furface of the water, it will be found to be furrounded by a column of water which is of a confiderable fize at the bafe, but diminifhes as it rifes upwards, fomewhat in the form of a trumpet, fo that at a few feet in height it is but little larger than the rope. This column of water is compofed of feveral laminæ, each moving with a different velocity: for inftance, the interior part moves nearly as quick as the rope, the water which is more diftant from the rope moves flower, until there muft be a part in which the water remains immoveable, and all the water which is beyond this, and on the outfide of the column, runs downwards, and falls back into the well. On this account, the machine lofes a confiderable part of the power which is applied to it without producing an adequate effect.

This machine was invented by the Seur Vera, in France. A machine was made by him with a wheel three feet diameter, and a hair-rope of half an inch diameter, the well was ninety-five feet deep. A man could turn the wheel fixty times *per* minute, which gives a velocity of five hundred and fixty-five feet *per* minute for the rope. It brought up fix gallons *per* minute, but was fevere labour for one man. When the wheel made fifty turns, and the rope moved four hundred and feventy-one feet *per* minute, the machine ftill raifed a confiderable quantity of water; but if the motion was reduced to thirty turns, or two hundred and eighty-two feet *per* minute, it brought up fcarcely any water. A rope of hair is preferable to hemp, becaufe it is lefs fubject to decay; and when a hemp-rope begins to rot, it communicates a taint to the water.

The *Sucking-Pump* has a valve at the bottom of the barrel, and alfo another valve in the pifton, which is called a bucket, becaufe it brings up the water before it. This pump does not raife water when the bucket is let down, but only when it is drawn up, which is in fome cafes an inconvenience; and another objection is, that it cannot raife water to a greater height than the place where the power is applied, becaufe there muft be an opening for the pump-rod to come out at, and the water would flow out at the fame opening, if it was raifed as high. This inconvenience is remedied by

The *Lift-Pump*, which has a valve in the bucket, the fame as the fucking-pump, but it differs from it in the manner of communicating the force to the pifton or bucket: one way of effecting this is to make the barrel open at the lower end, and the rod from the bucket, inftead of being fixed to the upper fide of the bucket, is fixed to the lower fide, and comes out beneath the furface of the water in which the barrel is immerfed. Rods are jointed to this, and rife up parallel to the barrel, in order to be attached to the lever by which the pump is to be worked: the fixed valve is placed at the top of the barrel above the bucket: this is the old-fafhioned lift-pump.

The *Lift-Pump with a Stuffing-box*, called fometimes a jack-head pump, is exactly the fame as the fucking-pump, except that the top of the barrel is covered by a lid, which has a hole in the centre for the rod to pafs through: the rod is made very fmooth and true, and the hole is fo formed as to contain collars of leather, which fit clofe round the rod, and prevent the efcape of any water by the fide of the rod. The water mounts up a pipe which communicates fideways with the upper part of the barrel.

Another form of lift-pump has been recently introduced, in which the pifton is folid, having no valve in it, and the rod paffes through a ftuffing-box or collar of leather in the top of the barrel, the bottom of the barrel being open. Two pipes are made to communicate fideways with the barrel at the upper part, one of which brings water from the well into the pump when the pifton defcends, and has a valve in it to prevent the return of the water; the other pipe conveys the water away from the barrel when the pifton is drawn upwards, and this is likewife furnifhed with a valve to prevent the return of the water.

One advantage of this kind of pump is, that both valves are fituated in boxes near the top of the barrel, and can be examined and repaired at any time by taking off the doors or covers of the boxes; but in pumps where there is a valve at the bottom of the barrel, it fometimes happens that the valve fails, and requires to be repaired, when the water in the well ftands higher than the cover or door of entry to the valve: in this cafe, fome other means muft be ufed to reduce the water in the well, or elfe the pump muft be drawn up out of its place, which, in large works, is very difficult. Another advantage is, that the apertures of the valves may be made of any required dimenfions to let the water pafs freely through them; but when the water muft come up through a valve in the bucket or pifton, the paffage through the valve muft neceffarily be much fmaller than the barrel, to allow a proper lodgment all round for the valve and alfo for the leathers.

The Force-Pump.—This is made with a folid pifton, like the laft, but the barrel is open at the top, where the pifton-rod comes out. There is a valve at the bottom of the barrel to admit the water into it, and a pipe, which turns fideways out of the barrel at bottom, and has a valve to prevent the water returning into the barrel, to convey the water to whatever place it is to be forced to. The force-pump raifes water only when the pifton is preffed down, whereas the lift-pumps and fucking-pumps raife the water when the buckets are drawn up.

The Lift and Force-Pump of M. De la Hire.—This is the union of the two laft pumps in one, for both thefe pumps work with a folid pifton, and the barrel of the force-pump is open at top, and the barrel of the lift-pump is open at bottom; hence the fame barrel and pifton may be made to ferve for both. This pump throws up water equally when the pifton-rod is drawn up or when it is forced down, and is moft proper for the double-acting fteam-engine. It has the advantage of raifing twice the quantity of water that any of the other pumps will raife, and with the friction of only one pifton; alfo the valves admit of being made of fufficient fize to allow the paffage of the water without any unneceffary refiftance.

Force-Pump with a folid Plunger.—This was invented by fir Samuel Morland, and does not differ from the force-pump laft defcribed, except in the manner of fitting the pifton to the barrel. Inftead of the barrel being bored truly cylindrical withinfide, and the pifton fitted into it fo as to flide up and down, and provided with leathers to make a clofe fitting, the pifton is made of a cylindrical form, and very nearly as large as the hollow barrel into which it defcends, but it does not touch the infide of the barrel. To make the clofe fitting, the outfide furface of the cylindrical pifton, or plunger, as it is called, is made very true and fmooth; and it is furrounded by a collar of leathers fixed at the top of the barrel, fo that no water can leak out of the barrel between the plunger and the leather collars; at the fame time that the plunger can freely move up and down through the collars, and will thereby increafe or diminifh the capacity of the barrel, to produce the fame effect as if the pifton fitted clofe into the barrel.

The principal circumftance to be attended to in this pump is the conftruction of the collar of leathers. To retain thefe leathers in their places, the top of the barrel muft be made with a flaunch, and pierced with holes to receive fcrew-bolts. Upon this flaunch two rings of metal are applied one over the other, with fimilar holes: the internal opening in the loweft ring is exactly the fize of the plunger, and that of the upper one a little larger. Two rings of foft leather are cut out to correfpond with the metal rings, except that the central holes are rather fmaller than the plunger: to prepare the leather, it is foaked in a mixture of oil and tallow for fome hours. One of thefe leather rings is laid on the pump-flaunch, and one of the metal rings placed above it; the plunger is then thruft down through the leather, which turns the inner edge of the leather ring downwards; the other leather ring is then flipped on at the top of the plunger, and the fecond metal ring is put over it, and then the whole are flid down to the metal ring; by this the inner edge of the laft leather ring is turned upwards.

The metal rings and leathers are now fixed on the flaunch by the fcrew-bolts; and thus the leathern rings are ftrongly compreffed between them, and make a clofe joint with the top of the barrel; and as the holes through the leathers are fmaller than the plunger, they grafp the plunger fo clofely that no preffure can force the water through between them. The lower metal ring juft allows the plunger to pafs through it, but without any play, fo that the turned-down edges of the lower leathern ring cannot come up between the plunger and the lower metal ring, but are lodged in a conical enlargement, which is made round the inner edge of the upper part of the barrel; and in like manner the turned-up edges of the upper leather are received in the hole of the upper metal ring, which hole is made larger than the plunger, to leave a fpace all round for thefe edges: it is on thefe trifling circumftances that the great tightnefs of the collar depends. To prevent the leathers from fhrinking by drought, there is ufually a little ciftern formed round the head of the pump, and kept full of water.

This kind of pump is preferable to any other, where the preffure to be overcome is very confiderable. The hydroftatic preffes are conftructed on this principle. See Press.

Piftons or Buckets for Pumps.—A good pifton fhould be as tight as poffible, and fhould have as little friction as is confiftent with this indifpenfible quality. The bucket of the common fucking-pump, when carefully executed, poffeffes thefe properties in a high degree, and is the model for other kinds of pump-buckets, or piftons, in which leather can be employed. This bucket is in the form of a truncated cone, with a hollow through the centre of it, which is half as large as the outfide, at the largeft part; it is generally made of wood not liable to fplit, fuch as elm or beech, but in the beft kind of pumps is made of metal. The fmall or upper end of it is cut away at the fides, fo as to open into the hole through the centre of it, and form an arch, by which it is faftened to the iron rod or fpear of the pump, and within the arch the valve or clack is fituated. The lower end of the conical part may be covered with a hoop of brafs, which fits the barrel of the pump very exactly; the bucket is alfo furrounded with a ring or band of ftrong leather, faftened to the wood with nails, and firmly retained by the brafs hoop which is driven down on the bucket from the upper or the fmaller end of the cone, and binds the leather faft on the wood; but the leather being wider than the brafs, the edge of the leather rifes upwards and furrounds the wood: this part of the leather is made to turn outwards, like a cup or hollow cone, which, at the upper end, is rather larger than the barrel, fo as to fpring againft the infide of the barrel when the bucket is put into it. The leather muft be of uniform thicknefs all round, fo as to fuffer equal compreffion between the wood of the bucket and the working barrel, but this compreffion is very flight, becaufe it is the upper edge of the cup which applies moft clofely to the barrel. The feam or joint of the two ends of the band of leather muft be tapered, and made to overlap and lie very clofe, without increafing the thicknefs, but not fewed or ftitched together, as that would occafion bumps or inequalities, which would fpoil its tightnefs; and no harm can refult from the want of fewing, becaufe the two edges will be fqueezed clofe together by the compreffion in the barrel; nor is it by any means neceffary that this compreffion be great, for it occafions friction, and caufes the leather to wear through very foon at the edge of the bucket, and it alfo wears the infide of the working barrel, which foon becomes enlarged in that part which is continually paffed over by the pifton, while the mouth remains of its original diameter, and then it is impoffible to thruft in a pifton which fhall completely fill the worn part. A very moderate preffure is fufficient for rendering the pump perfectly tight, becaufe the preffure of the water makes the leather cup apply itfelf clofe to the barrel all round, and even adjuft itfelf to all its inequalities. Suppofe it to touch the barrel in a ring of an inch broad all round, this is a trifle, and the friction occafioned by it not worth regarding; yet this fmall furface is fufficient to make the paffage perfectly impervious, even by the preffure of a very high column of incumbent water: for let this preffure be ever fo great, the preffure by which the leather is forced againft the infide of the barrel will always exceed it, becaufe, in addition to the preffure of the water, the leather will always prefs againft the barrel by its own elafticity, the top of the cup of leather being made rather larger than the interior of the barrel.

This method of applying leather piftons is found to be preferable to any other, becaufe if the leather is preffed againft the barrel by any other means than the force of the column of water, the preffure will always be too great or too little.

Pumps which are to raife hot water cannot be leathered, becaufe the leather would fhrivel up; in this cafe, ftrong canvas cloth is fometimes ufed inftead of leather; but as this will not hold water perfectly, fuch pumps are generally packed with hemp, in the fame manner as the pifton of fteam-engines.

Pump without Friction.—When the height to which the water is to be raifed is fmall, a pump may be conftructed in which the pifton does not require to be fitted clofely into the barrel, nor are any leathers required. The barrel of this pump muft be as long as the whole height to which the water is to be raifed, and as much more as the length of the ftroke of the pifton. The pifton is a folid piece of wood, fitted to the barrel as clofely as it can be without actually touching the infide, and may be either fquare or round, but a fquare trunk and a fquare beam of wood are beft, if the pump is made of wood. The pifton muft be as long as the barrel,

barrel, fo that when it is let down it will occupy the whole interior fpace of the barrel, except that fmall fpace which is left between the infide of the barrel and the pifton, to avoid actual contact. The bottom of the barrel has a valve in it which opens upwards, and a pipe proceeds from the lower part to convey away the water to the refervoir into which it is to be raifed by the pump. This pipe is provided with a valve, to prevent the return of any water which has paffed through it, but the greateft elevation of the water in the refervoir muft not be quite fo great as the top of the barrel. When this pump is fixed for work, the lower end of the barrel muft be immerfed in the water of the well at leaft as much as the whole length of the ftroke, fo that the lower end of the pifton will never rife above the furface of the water in the well, and upon this circumftance the action of the pump depends; for when the pifton is drawn up, the water flows through the valve in the bottom by its gravity, and fills the fpace which is left by the drawing up of the pifton; when the pifton defcends, it difplaces from the barrel all this water, and forces it up the fide-pipe into the refervoir. It is true that a fmall portion of water rifes in the fpace between the barrel and the pifton, but this fmall quantity cannot efcape, becaufe the top of the barrel rifes higher than the furface of the water in the refervoir.

Dr. Robinfon, who we believe firft defcribed this pump, obferves that it is free from all the difficulties which are experienced in common pumps, from want of being air-tight. Another is, that the quantity of water raifed is very nearly equal to the power expended; for if there is any want of accuracy in the work, which occafions a diminution of the quantity of water difcharged, it alfo makes an equal diminution in the force which is neceffary for pufhing down the plunger. The doctor mentions a machine, confifting of two fuch pumps, the piftons of which were fufpended from the arms of a long beam or lever, the upper fide of which was formed into a walk, with a rail on each fide. A man ftood on one fide of the centre of the lever, until the pifton of the pump at that end funk to the bottom of its barrel, and of courfe the pifton of the pump on the oppofite fide of the centre was drawn up; he then walked flowly up to the other end of the walk upon the beam or lever, the inclination being about twenty-five degrees at firft, but gradually diminifhed as he went along, and paffed on the oppofite fide of the centre of motion, fo as to change the load of the beam. By this means he made the pifton at the other end go to the bottom of its barrel, and fo on alternately, with the eafieft of all exertions, and what a man is moft fitted for by his ftructure. With this machine a feeble old man, weighing 110 pounds, raifed 7 cubic feet of water $11\frac{1}{2}$ feet high every minute, and continued working eight or ten hours every day. A ftout young man, weighing nearly 135 pounds, raifed $8\frac{1}{3}$ cubic feet to the fame height; and when he carried 30 pounds conveniently flung about him, he raifed $9\frac{1}{4}$ feet to this height, working ten hours a day, without greatly fatiguing himfelf. This exceeds Defaguliers' maximum of a hogfhead of water ten feet high in a minute, in the proportion of 9 to 7 nearly. This pump is limited to very moderate heights, and in fuch fituations it is very effectual.

The *mercurial pump* is a fpecies of lift-pump, in which mercury is employed to make a clofe fitting between the pifton and the barrel, and thus avoid the friction of leathers, and prevent lofs of water.

This pump was originally invented by Mr. Jofhua Hafkins, and was improved by Defaguliers, who defcribed it in the Philofophical Tranfactions for 1722, N° 370. p. 5; and he has alfo given every detail of the conftruction in his Experimental Philofophy, vol. ii. p. 491.

In this pump the barrel is inverted, that is, it is open at the bottom, like the firft lift-pump which we have mentioned; and it has alfo two pipes communicating with the upper end of the barrel, one to bring up the water from the well, and the other to carry it up to the refervoir: each pipe is provided with its valve, to prevent the return of the water. The barrel muft be made of iron, and as thin as is confiftent with the ftrength of the metal. The pifton is a cylindrical plug of wood, fitted to the barrel fo as to fill it, but not to touch the fides. This pifton is fixed perpendicularly in the centre of a hollow cylinder of iron, which is rather larger within than the outfide of the pump-barrel, fo that an annular fpace is left all round between the folid pifton or plug and the infide of the cylinder, into which fpace the pump-barrel can enter, and will fill it very nearly. The annular fpace is then filled with mercury. This compound piece, confifting of the hollow cylinder, with the fmaller folid cylinder within it, forms the pifton; and to this the power which is to work the pump is applied by means of chains, which fufpend it from the fhort arms, fo that if the lever is moved, the pifton will rife up and down. When the pifton is applied in its place, and the inverted pump-barrel is received into the annular fpace between the folid and hollow cylinders, the mercury therein will make a clofe fitting between the folid pifton and the infide of the barrel, fo as to prevent any water paffing between them; and the afcent and defcent of the pifton will produce an alternate contraction and dilatation of the internal capacity of the working barrel, in the fame manner as a folid pifton would do, if it was clofely fitted to the infide of the barrel with leather all round.

As the water exerts a preffure on the mercury, to force it out of the annular fpace in which it is lodged, the depth of the annular fpace and length of the barrel which defcends into it muft be adapted to the height to which the water is intended to be elevated; fo that the column of mercury which it will contain, without raifing the mercury fo high as to run over the edge of the external cylinder, fhall always exceed one-thirteenth part of the height to which the water is to be elevated; the weight of mercury being more than thirteen times the weight of an equal quantity of water.

That there may be lefs mercury ufed, the pump-barrel fhould be made of plate-iron, turned on the outfide, and bored within; the outer cylinder of the pifton fhould be bored, and the inner one turned; and if the work be well performed, eight or ten pounds of mercury will be fufficient, though the bore of the barrel, or diameter of the column of water which is raifed, is fix inches. Lefs than fix pounds of mercury would fuffice, if there were two barrels, in order to keep a conftant ftream. This will very much leffen the expence of mercury, which would otherwife be an objection againft this pump; and by making the inner and outer cylinder of hard wood, as box, or *lignum vitæ*, the expence may ftill be reduced. But if the engine be very large, caft-iron bored will be proper for the outer cylinder, and caft-iron turned on the outfide for the inner cylinder or plug, and hammered iron bored and turned for the middle cylinder.

There is an objection, which feems at firft to take off the intended advantage of this engine, *viz.* that inftead of the friction of the leather of a pifton, when we lift up the pifton to make a ftroke, the refiftance neceffary to make the mercury to rife on the outfide of the barrel in the outer cylinder of of the piston is at least as great as the friction we avoid. Desaguliers says, that resistance is never greater than the weight of a concave cylinder of mercury, whose height is the greatest to which the mercury rises in the said outer cylinder, and the base is the area of the barrel itself. This weight in a pump of 6 inches bore is equal to $57\frac{1}{2}$ pounds, and, therefore, it would appear to be greater than the resistance arising from the friction of a piston. But if it be considered, that in the descent of the piston for sucking, the mercury shifts immediately into the inside of the barrel, rising to the same height therein, and still keeping the same base, the weight of $57\frac{1}{2}$ pounds helps to press down the piston, and facilitates the overcoming of the force of the atmosphere, or suction of the pump; consequently, the weight of the mercury being balanced is no hindrance, whether the pump works with a double or with a single barrel.

There remains only then the hindrance by loss of time, whilst the mercury changes from the outside to the inside of the barrel, at the beginning of any stroke. Desaguliers states this to be one-fifty-second part of the stroke, and that he found the best pumps then in use generally lost near one-fifth of the water that they ought to have given, according to their number of strokes.

Notwithstanding the high terms in which this author and others have spoken of the mercurial pump, it can only be considered as an ingenious suggestion, for the expence of mercury would be too great for the actual application of any such machine in practice; and in respect to friction, it would have a considerable share of resistance in plunging the piston into the mercury, although there would be no actual rubbing of hard substances together. This resistance would arise in the rapid running of the mercury from the inside of the barrel to the outside, and back again, at the beginning of each stroke.

The machine is exceedingly ingenious and refined, and there is no doubt but that its performance will exceed that of any other pump which raises the water to the same height, because there can be no want of tightness in the piston, and friction is in a great measure avoided. But these advantages are but trifling. The expence would be enormous; for with whatever care the cylinders are made, the interval between the inner and outer cylinders must contain a very great quantity of mercury. The middle cylinder must be made of iron-plate, and without any seam, for mercury dissolves every kind of solder. For such reasons, it has never come into use. But although we have professed to describe only the machines in actual use, it would have been unpardonable to have omitted the description of an invention, which is so original and ingenious; and there are some occasions where it may be of use, such as nice experiments for illustrating the theory of hydraulics: it would be the best piston for measuring the pressures of water in pipes, being in fact the same principle as the barometer.

Sector pumps are those in which the piston is made to move upon a centre, like a door upon its hinges. The piston is inclosed within a vessel shaped like the sector of a circle, which forms the body of the pump, and which is divided by the piston into two compartments. The piston is fitted, so that it can move backwards and forwards on its centre of motion, without suffering any water to pass by it; and by this motion it will alternately enlarge or contract the capacities of the two compartments, so as to draw in water through pipes and valves properly situated, and force it out again at other pipes. These kinds of pumps are difficult to construct, and have no advantages over the pumps with straight barrels, except for the engines for extinguishing fire. See that article for a description and figure of Mr. Rowntree's, which is one of the best of this kind.

Rotative Pumps.—As most of the first movers for hydraulic machinery act with a rotative motion, it would be very desirable to have a pump which would at once employ the rotative force to the purpose of raising water. Many schemes have been proposed, and much ingenuity displayed in these inventions; but hitherto no one has been brought to such perfection as to be equal to the pumps with straight barrels. In Ramelli's work, published in 1588, several rotative pumps are described; and Leopold has made a collection of them in his "Theatrum Machinarum Hydraulicarum," vol. i. They are all upon one common principle, *viz.* a hollow cylinder or drum closed on all sides; within this another smaller cylinder is inclosed, and the interior cylinder is placed out of the centre of the hollow cylinder, so that the interior cylinder touches the hollow one at one point of the circumference; but at all other points there is a considerable space between the two. The interior cylinder is provided with four or six valves or leaves, which are united to it by hinges, and, when folded close up to the cylinder, will form a smooth and circular circumference; but if the leaves are opened out, they will reach to the interior surface of the hollow cylinder. When the interior cylinder is turned round by a handle applied to the axis, the valves sweep round within the hollow cylinder, and in this motion perform the office of pistons, because they close up to the internal cylinder, in proportion as they approach towards the point where the internal cylinder touches the hollow cylinder; and the same vanes open out again, after they have passed that point. In this way the spaces between the valves form a number of cavities, which alternately expand and contract in their capacity, and in consequence they will draw up water through a pipe which is inserted into the hollow cylinder, and force it out at another pipe, so as to raise up a continual stream.

The machine is sometimes varied, by making the hollow cylinder of an elliptical form: in other cases, the valves, instead of moving upon hinges, are made to slide in straight lines from the centre of the revolving cylinder; but in either case, the action is the same. The common defect of all these rotatory pumps is, that it is very difficult to pack them so as to be tight, and they have more friction than any other kind of pump.

The *centrifugal pump*, invented by Mr. Erskine, may be called a rotative pump, but it is on a different principle from all other pumps. A perpendicular pipe has another joined to it, in form of the letter T: the lower end of this pipe being immersed in water, and the whole filled with water, it is turned round on the perpendicular stem as an axis; the water contained in the horizontal arms will, by its centrifugal force, fly out, and draw a constant stream of water up through the perpendicular pipe. See *Centrifugal* Pump.

Spiral pump, or *Zurich machine*, is a hollow drum or cylinder turning on a horizontal axis, and partly plunged in a cistern of water, like a very large grind-stone. The interior space of this cylinder or drum is formed into a spiral canal, by a plate coiled up within it, like the main-spring of a watch in its box, only that the spires are situated at a given distance from each other, so as to form a spiral passage of uniform width. (See *fig.* 11. *Plate Water-Works.*) This spiral partition is well joined to the two circular ends of the cylinder, and no water can escape between them. The inner end or central part of the ſpiral paſſage communicates with the axis, which is hollow at one end, and communicates with the vertical pipe which is to convey the water to the elevated reſervoir. The outermoſt turn of the ſpiral paſſage begins to widen at about three-fourths of a circumference from the open end, and this gradual enlargement continues for nearly a ſemicircle; this part being called the horn. The paſſage then widens ſuddenly in form of a ſcoop or ſhovel. The cylinder is ſo ſupported, that this ſcoop may, in the courſe of a rotation, dip ſeveral inches into the water, and take up a certain quantity of water before it emerges again. This quantity is ſufficient to fill the enlarged part called the horn, and is alſo nearly equal in capacity to one turn of the outermoſt uniform ſpiral. The vertical pipe is connected with the axis by a turning joint, ſo as to admit of the rotation of the axis, at the ſame time that it will not allow of the eſcape of any water.

When this cylinder is turned round by a handle applied to the extremity of the axis, a portion of water which the ſcoop takes up at every turn, will continually advance in the ſpiral, until it arrives at the centre; it will then paſs through the hollow in the end of the axle, and will riſe upwards in the vertical pipe; and in the intervals between the periods when the ſcoop dips into the water, the horn will become filled with air, and the ſucceeding portion of water which is taken in will carry the air before it, ſo that the water riſes in the vertical pipe mixed with air. See SCREW.

Dr. Robinſon, in his account of this machine, recommends the riſing pipe to be of ſmall bore; for if the pipe is ſo large as to allow the air to eſcape freely upwards through the water, the machine will raiſe the water to a certain height, proportioned to the number of turns of the ſpiral, and to their diameter; but if the pipe be narrow, ſo that the air cannot riſe freely, it will riſe in the pipe almoſt as ſlowly as the water. By this circumſtance, the water mixed with the air becomes of a leſs ſpecific gravity, as it were, and can be raiſed to a much greater height than it could be raiſed by the mere preſſure of the columns of water and air in the different turns of the ſpiral. This is effected with hardly any augmentation of the power, but if the air, after being compreſſed, is ſuffered to eſcape, all the force exerted to compreſs it will be loſt. The entrance into the riſing pipe ſhould be no wider than the laſt part of the ſpiral; and it would be adviſeable to divide it into four channels by a thin partition, and then to make the riſing pipe very wide, and to put into it a number of ſlender rods, which would divide it into ſeveral ſlender channels, that would ſerve completely to entangle the air among the water. This procedure will greatly increaſe the height to which the heterogeneous column may be carried.

Another Form of the Spiral Pump.—When the main pipe is very high, the former conſtruction will require either an enormous diameter of the drum, or many ſpiral turns of a very narrow pipe. In ſuch caſes, it will be much better to make the ſpiral in the form of a cork-ſcrew, than of a flat form like a watch-ſpring; or, the pipe which forms the ſpiral may be wrapped round the fruſtum of a cone.

We regret that we have had no opportunity of making experiments upon a machine of this kind, as its principles of action, though treated of by many authors, are not deſcribed in a ſatisfactory manner in any works which we have read.

The *chain pump* is an effective means of raiſing water, and with the advantage of a continuous motion. It is generally made with a ſquare or round barrel, placed in a perpendicular poſition. The chain is furniſhed with ſeveral piſtons of the ſame figure as the barrel, which are fixed at ſmall diſtances aſunder upon the links of the chain. The ends of the chain are united together, and it is extended between two wheels, one fixed at the upper end of the barrel, and the other at the lower end; but ſometimes only the wheel at the top is uſed. Theſe wheels have forks fixed on the circumference, which are ſo contrived as to receive one half of each of the flat piſtons in the intervals between the forks, whilſt the forks take hold of the links of the chain, and draw them up, when the wheel is turned round by means of a handle applied to the axis. The piſtons on the chain are made accurately to fill the ſection of the barrel, at the lower part near the water, and alſo for a few feet upwards; but above this, the barrel is made larger, ſo that the piſtons riſe up free: indeed, the upper part of the barrel is only to contain the water which is brought up by the piſtons, and may, therefore, be ſquare, or of any other figure. The lower end of the barrel is immerſed in water, and the chain being cauſed to circulate by turning the wheel, each piſton, as it enters into the lower or bored part of the barrel, will bring up water before it in the barrel; which water will riſe in the upper part of the barrel, till it runs over the top; and as the piſtons ſucceed each other in a regular ſucceſſion, they produce a conſtant ſtream. Chain pumps are chiefly uſed in ſhips, where they are worked by the force of men turning winches. (See PUMP.) In other ſituations they are moved by horſes, and ſometimes by the impulſe of a ſtream of water. They are ſo contrived, that by the continual folding in of the piſtons, when they enter into the bottom of the barrel, ſtones, dirt, or whatever comes in the way, may be cleared off. On this account they are often uſed to drain ponds and ſewers, or to remove foul water, when no other pump could be employed.

The greateſt diſadvantage in the chain pump is the friction of the chain, and of the piſtons, which is greater than in other pumps; becauſe ſeveral piſtons are moving in the barrel at the ſame time, and alſo becauſe the piſtons do not admit of the application of the cup-leathers, which we have deſcribed. The edges of the cups would fold up when they enter into the barrel, and get between the edge of the piſton and the barrel. The piſtons are, therefore, made with a thick piece of leather, which is placed between two round plates, which form the piſton or ſaucer, as it is called; the leather is cut round to the ſize of the barrel, ſo that the edge of the leather may be applied to the inſide of the barrel. In this way, its tightneſs muſt depend wholly upon the force with which the leather is ſqueezed into the barrel, and it occaſions great friction to make the piſtons ſufficiently tight.

Another variety of the chain pump is an endleſs rope, with ſtuffed cuſhions faſtened upon it at regular intervals. By means of two wheels or drums, the rope is made to circulate, and the cuſhions are drawn up in ſucceſſion through the barrel, and each one carries ſome water before it.

The chain pump is found to raiſe a greater quantity of water to the ſame height, when the barrel is placed in an inclined poſition, than when vertical. M. Belidor recommends the barrel to be placed at an angle of 24 degrees with the horizon, and the diſtance between the piſtons to be equal to their diameter. The reaſon of this advantage is, that an inclined pump acts with leſs friction, becauſe the piſtons need not be ſo exactly fitted, but they will, by their weight alone, apply cloſely to the bottom or loweſt ſide of the inclined barrel; whereas the piſtons of the vertical pump muſt exactly fill the barrel, or the water will leak down from one to the next in a conſtant ſtream.

Bellows-Pump.—A pair of leathern bellows may be employed as a pump, if a ſuction-pipe is applied to the lower valve, and another pipe to the nozzle, with a valve to prevent

prevent the water returning into the bellows after it has been driven out by clofing the bellows. This kind of pump has been frequently propofed, and the advantages of difpenfing with barrels and piftons loudly infifted upon; but the refiftance of the leather in folding, and the lofs of water by leakage, and above all the want of durability, will always prevent the adoption of fuch pumps.

The Pump with a Diaphragm of Leather, which does not flide in the Barrel.—This is very nearly allied to the bellows-pump. The beft form for conftructing it is fully defcribed in our article SHIP'*s Pump*, where the invention is attributed to Benjamin Martin; but we find the fame thing was long before applied by Meffrs. Goffet and De la Deuille, in France. (See Belidor's Arch. Hydraulique, vol. ii. p. 120.) This is a good pump, but is not durable, becaufe the conftant ftrain on the leather will caufe it to crack.

Sucking-Pump, which gives out a continual Stream.—Mr. Smeaton applied the following fimple and effectual expedient to make a fingle fucking-pump deliver the water equally in the defcent of the bucket as in its afcent. The pump-rod was enlarged, by furrounding it with a cylinder of wood at the part where it rofe above the furface of the water contained in the ciftern at the top of the pump. This cylinder of wood was of fuch diameter, that its fection was equal to half the area of the pump-barrel at the place where the bucket worked. When the bucket was drawn up, and raifed water into the ciftern at top of the pump, the wood cylinder, which was attached to the pump-rod, rofe up out of the water in the ciftern, and thereby made place in the ciftern for one-half of the water which was brought up by the bucket, and in confequence only one-half of the water ran out at the fpout of the ciftern; but when the bucket moved downwards, in order to fetch another ftroke, this cylinder of wood difplaced from the ciftern half as much water as the pump brought up in the former inftance, and confequently an equal quantity of water was given out at the fpout in either cafe.

If the pump is worked by the force of a man working a fimple lever, then he will make the down-ftroke of the bucket in lefs time than the up-ftroke, and in this cafe the area of the cylinder fhould be made lefs than half the area of the barrel of the pump. It muft be obferved, that this contrivance is only a remedy for the unequal efflux of water from the fucking-pump, and that the power required to work the pump is ftill left unequal in the up-ftroke and down-ftroke, becaufe it is only in raifing up the bucket that the water is drawn from the well below; and that water which runs out at the fpout when the bucket defcends, is drawn from the ciftern at the top of the pump, and not from the well. When the pump is worked by a man with a lever, this inequality of the refiftance is advantageous, becaufe a man can exert his force moft conveniently when he depreffes the end of the lever to draw up the bucket; alfo, in a fingle-acting fteam-engine, the principal power is exerted to draw up the bucket.

In machines worked by wind, water, or horfes, the moving force is uniform, and the refiftance muft, by fome means, be made uniform alfo, or the machine will move by fudden ftarts. A fufficient weight may be applied to the oppofite end of the lever to counterbalance one-half of the force neceffary to draw up the bucket; this weight will tend to diminifh the force of drawing up the bucket, and when the bucket defcends, and the machine would otherwife have nothing to do, it will have to raife up the weight ready to aid it in the fucceeding ftroke. Or a fly-wheel may be applied: but a ftill better method is to employ two pumps to act alternately, by which means the refiftance is continual, and the efflux of water alfo. When two fucking-pumps are employed, they may be combined together, by making them both draw from a common fuction-pipe, and both may be made to lift the water into the fame ciftern. Or two or three force-pumps may be combined together, as is defcribed in the article PUMP, in order to produce a continuous ftream.

Air-Veffel for equalizing the Difcharge of Water from Pumps.—This is the moft perfect contrivance for effecting that purpofe. It is a clofe veffel of any figure, which will contain air, and is made to communicate with the pipe which conveys the water away from the pump. This communication muft be made at the lower part of the air-veffel, fo that the water will have free ingrefs and egrefs from it. The air in this veffel will be compreffed into a fmaller fpace, in proportion to the column of water which the pump has to raife; and by its elafticity endeavouring continually to regain its former fpace, it will act as a fpring to equalize all fudden motions of the water through the pipe; for in any pump which acts by a barrel and pifton, the water will be propelled by ftarts; and even if two or three barrels are combined together fo as to produce a continual efflux of water, fuch efflux will not be perfectly equal during all the periods of the motion.

The evil of this may appear trifling and fo it would be merely with refpect to the difcharge of the water; but it muft be confidered that the mafs of water contained in a long pipe is very great, and that it requires a very confiderable force to put this mafs in motion with that velocity with which it muft flow through the pipe. Now if the operation of a pump is by ftarts, the mafs of water in the main-pipe will remain at reft, preffing on the valve during the time that the pifton is withdrawn from the bottom of the working barrel. In this cafe, the force neceffary to put the water in motion muft be expended at every ftroke, becaufe if the column comes to reft only for an inftant, it muft be put in motion again before the operation can be refumed: this is a heavy additional load upon the firft mover, and has another more ferious evil in ftraining the pipe and all parts of the machinery; becaufe the column of water in the pipe, after it ftops, runs back for a fmall fpace until the valve fhuts; and it makes juft as great a concuffion or fhock when its motion is fuddenly ftopped by the fhutting of the valve, as any other folid body would do which was of the fame weight, and moved with the fame velocity. In large fteam-engines, the fhock occafioned by the fhutting of the valve is exceedingly violent, unlefs an air-veffel is applied. In that cafe, if the pump urges the water with a fudden motion, the air in the veffel will yield, and admit the water into the veffel in far lefs time than the whole column of water could be urged into motion; but as the air will become compreffed by more force than the column of water in the pipe, the elafticity of the air will force the water from the veffel and up the pipe with a regular motion, and this will continue until the air has regained fo much fpace that its elafticity is only juft fufficient to balance the column of water in the pipe.

The air-veffel fhould be placed as near the pump as poffible, that it may produce an equable motion of the water in the whole length of pipe. The air-veffel is of confiderable advantage when a column of water of great length is to be raifed by a fingle-acting pump. If the pifton of the pump at one end of the pipe is put at once into motion, even with a moderate velocity, the ftrain on the pipe would be very great before the column of water could be put in motion. But the air-veffel tends to make the motion along the main-pipe lefs defultory, and therefore diminifhes thofe ftrains which would really take place in the pipe. It acts like the ſprings of a travelling carriage, whoſe jolts are incomparably leſs than thoſe of a cart, and by this means really enables a given force to propel a greater quantity of water in the ſame time.

The ſtream produced by the aſſiſtance of an air-veſſel is almoſt perfectly equable, and as much water runs out during the returning of the piſton as during its active ſtroke; but it muſt not be imagined that it therefore doubles the quantity of water. No more water can run out than what is ſent forwards by the piſton during its effective ſtroke. The continued ſtream is produced only by retaining part of this water in the air-veſſel during the ſtroke of the piſton, and by providing a propelling force to act during the piſton's return; but it cannot enable the moving force of the piſton to produce an increaſed effect: for the compreſſion which is produced in the air-veſſel, more than what is neceſſary for merely balancing the quieſcent column of water, reacts on the piſton to reſiſt its compreſſion juſt as much as the addition of a column of water would do, the height of ſuch column being ſufficient to produce the required velocity of the efflux.

Machines for working Pumps.—The beſt method of working pumps from a firſt mover which acts with a rotative motion, is by means of cranks; and if two or more pumps are to be actuated by the ſame machine, the cranks for them ſhould be placed at regular intervals round the centre, ſo as to produce a continual action.

It has been obſerved, in our article STEAM-*Engine*, that the reciprocating motion obtained by a crank is very unequal, even when the rotative motion of the crank is quite uniform. This renders the motion of the piſton in the barrel of the pump irregular, for at the top and bottom of the barrel the motion of the piſton is very ſlow, but when the piſton is at the middle of the barrel the piſton moves quickly. This property is a great advantage in working pumps, becauſe it puts the column of water in motion with a leſs ſudden ſhock; but it has been very generally miſtaken and conſidered as a defect, and many ingenious contrivances have been propoſed, by means of racks and pinions, to give an uniform motion to the piſton-rods of pumps. Theſe have never ſucceeded in practice, and have always been laid aſide.

The attempts of mechanicians to correct this unequal motion of the piſton-rod are miſplaced; for if it could be done it would greatly injure the performance of the pump. As this is a favourite ſpeculation, and new attempts to perfect it are conſtantly making, we think it right to ſhew the reaſon of their failure.

Suppoſe the firſt mover to move uniformly with a rotatory motion, and that the machinery is ſo conſtructed, that the piſton-rod will be moved up and down with a regular motion, or that the velocity of the piſton ſhall be at all times the ſame, whether it is at the top or bottom, or in the middle of its courſe. In this caſe, at every reciprocation, the column of water in the main pipe muſt be ſuddenly urged into motion from a ſtate of reſt, and the machine could not perform one ſtroke, if the velocity of the firſt mover did not ſlacken a little, or if the different parts of the machine did not yield by bending or compreſſion. Theſe ſtrains would be ſo ſudden and violent, that no ſtrength of materials could withſtand the violence of the ſhocks at every reciprocation of the motion. This would be chiefly experienced in great works which are put in motion by a water-wheel, or ſome other equal power, exerted on a large maſs of matter, of which the machine conſiſts. The water-wheel, being of great weight, moves with ſteadineſs or uniformity; and when an additional reſiſtance is oppoſed to it by the beginning of a new ſtroke of the piſton, its quantity of motion is but little affected by this addition, and it proceeds with very little loſs of motion. The machine muſt therefore yield a little by bending and compreſſion, or it muſt break to pieces, which is the common event.

A crank is free from this inconvenience, becauſe it accelerates the piſton gradually, and brings it gradually to reſt, while the water-wheel moves round with almoſt perfect uniformity. It has been ſtated as an inconvenience of this ſlow motion of the piſton at the beginning of its ſtroke, that the valves do not ſhut with rapidity, ſo that ſome water gets back through them; but this is a miſtake, becauſe the valves always fall by their own weight as ſoon as the water ceaſes to flow upwards through them. Now when the piſton begins to move with its ſlow motion towards the end of the ſtroke, leſs water is cauſed to flow through the valves, and in conſequence they cloſe gradually, and will be fully ſhut by the time that the piſton becomes motionleſs, and before it begins to return. This is ſhewn in the large machines, ſuch as that of London-bridge, where the pumps are worked by cranks, and the valves cloſe imperceptibly; but in a ſteam-engine of the ſame power, the ſhock occaſioned by the ſhutting of the valves is exceedingly violent. In ſhort, by a judicious application of the crank and a fly-wheel, or an air-veſſel, and by employing two or three barrels to the pump, the evils of the reciprocating motion of pumps may be completely remedied, and on this account we conſider, that if a rotatory pump could be brought to perfection, it would have no ſuperiority over an accurate pump with a ſtraight barrel.

Mr. Smeaton's proportions for a two-horſe pump machine for raiſing water are as follow: horſe-track thirty feet diameter; great cog-wheel nineteen feet diameter, with 144 cogs; this gave motion to a trundle of ſeventeen ſtaves, fixed upon an horizontal axis, which carried a caſt-iron fly-wheel of ten feet diameter, and the rim three inches by three inches. On the extremity of the horizontal axis was a crank of a foot and a half in length, which, by means of a connecting-rod, gave motion to one end of a working beam or lever of ſeventeen feet long, which was poiſed on a centre in the middle of its length, and at the oppoſite end was an arched ſector for the chain, by which the pump-rod was ſuſpended. The pump was a ſucking-pump, ſix inches diameter in the barrel, and the length of the ſtroke was three feet. A weight was applied to the end of the beam over the crank, which was ſufficient to balance one-half of the column of water in the pump. In this machine, when the horſes walked two miles and a half *per* hour, they made two turns and one-third *per* minute. The trundle and fly-wheel made twenty turns *per* minute; the pump made the ſame number of effective ſtrokes, and raiſed upwards of a hundred barrels ale meaſure *per* hour. By the counter balance and the fly-wheel, the reſiſtance to the horſes was rendered perfectly uniform.

The *Pump Machine at Blenheim*, which was erected by Mr. Alderſea for the duke of Marlborough, is thus deſcribed by Mr. Ferguſon in his lectures. The water-wheel is underſhot, and is turned by the fall of the water running down an inclined plane, and ſtriking the floats of the wheel. The extremity of the pivot or gudgeon is formed into any number of cranks; for inſtance ſix, that is, three at each end of the axis, more or leſs, according to the force of the fall of water, and the height to which the water is intended to be raiſed by the engine. As the water-wheel turns round, theſe cranks move as many levers up and down, by the iron connecting-rods. Theſe levers alternately raiſe and depreſs the piſtons of the forcing-pumps by other iron rods, which are attached to the oppoſite ends of the levers, and as one is raiſed the oppoſite piſton is depreſſed. Pipes go from all theſe pumps, to convey the water which they draw up (to a ſmall height) into a cloſe ciſtern or box, from which

the

the main-pipe proceeds, the water is forced into this ciftern by the defcent of the piftons. And each pipe, going from its refpective pump into the ciftern, has a valve to cover its end in the ciftern, which valves will hinder the return of the water by the pipes; and, therefore, when the ciftern is once full, each pifton upon its defcent will force the water (conveyed into the ciftern by a former ftroke) up the main-pipe, to the height to which the engine is intended to raife it; which height depends upon the quantity to be raifed and the power that turns the wheel. When the power upon the wheel is leffened by any defect of the quantity of water turning it, a proportionable number of the pumps may be laid afide, by difengaging their rods from the vibrating levers.

When fuch a machine is placed in a ftream that runs upon a fmall declivity, the motion of the levers, and action of the pumps, will be but flow; fince the wheel muft go once round for each ftroke of the pumps. But when there is a large body of flow running water, a cog or fpur-wheel may be placed upon each fide of the water-wheel, upon its axis, to turn a trundle upon each fide; the cranks being formed upon the axis of the trundle. And by proportioning the cog-wheels to the trundles, the motion of the pumps may be made quicker, according to the quantity and ftrength of the water upon the firft wheel; which may be as great as the workman pleafes, according to the length and breadth of the float-boards of the wheel. In this manner the engine for raifing water at London-bridge is conftructed; which we fhall now proceed to defcribe.

The original engine at London-bridge was put up by Mr. Sorocold towards the beginning of the laft century: it deferves notice on account of a contrivance for raifing and falling the water-wheel, to accommodate it to the different heights of the water: this was the invention of Mr. Hadley, who put up the firft of that kind at Worcefter, for which he obtained a patent.

Mr. Beighton has thus defcribed this machine in the Philofophical Tranfactions. The wheels of the London-bridge water-works are placed under the arches of the bridge, and moved by the common ftream of the tide-water of the river. The following are the particulars of the largeft wheel.

The axle-tree of the water-wheel is nineteen feet long, and three feet in diameter, in which are four fets of arms, eight in each fet; thefe arms fupport four circular rings or felloes, twenty feet in diameter, to which are attached the float-boards, fourteen feet long and eighteen inches deep, being about twenty-fix in number. The wheel lies with its two gudgeons, or centre-pins, upon braffes in two great levers, which are placed in an horizontal pofition, and therefore fupport the weight of the wheel. The wheel is, by thefe levers, made to rife and fall with the tide in the following manner. The levers are fixteen feet long; thus, from the fulcrum of each lever, to where the gudgeon of the water-wheel bears on it, fix feet; and from thence to the extremity ten feet. At the extremity is a fector or arch of a circle defcribed from the fulcrum of the lever, and to the bottom of this arch is fixed a ftrong triple chain, made after the fafhion of a watch-chain; but the links are arched to a circle of one foot diameter, having notches, or teeth, to take hold of the leaves of a pinion of caft-iron, ten inches diameter, with eight teeth in it moving on an axis, which is fixed up over the arch at a confiderable height, and the chain goes up to the pinion and turns over it. The other loofe end of this chain has a large weight hanging at it, to help to counterpoife the great weight of the water-wheel, and prevent the chain from fliding on the pinion. On the fame axis as the pinion is fixed a cog-wheel, fix feet diameter, with forty-eight cogs. To this is applied a trundle, or pinion, of fix rounds, or teeth; and upon the fame axis is fixed a fecond cog-wheel, of fifty-one cogs; laftly, this is turned by a trundle of fix rounds, on whofe axis is a winch or windlafs. The other lever is provided with a fimilar chain and wheel-work, and the axis of the laft-mentioned trundle is prolonged until the two winches nearly meet, fo that one man, with the two windlaffes, raifes or lets down the wheel, as there is occafion to dip always equally into the water.

By means of this machine, the ftrength of an ordinary man will raife about fifty ton weight, which much exceeds the weight of the water-wheel.

Near each end of the great axis of the water-wheel, a cog-wheel is fixed, eight feet diameter, and forty-four cogs, working into a trundle, of four feet and a half diameter, and twenty rounds, whofe axis or fpindle is of caft-iron four inches in diameter, lying in braffes at each end, fupported by ftrong timber framing.

And becaufe the fulcrums of the levers above defcribed are in the line of the axis of the trundle, in what fituation foever the water-wheel is raifed or let down, the great cog-wheel is always equidiftant from the trundle, and works or geers truly therewith.

A quadruple crank of caft-iron is attached to the end of the axis of the trundle, the metal being fix inches fquare, each of the necks being diftant one foot from the centre of motion; the gudgeons of the cranks are fuftained in braffes at each end in two headftocks faftened down by caps. One end of this crank is placed clofe abutting to the end of the axis of the trundle, which at that end is fix inches diameter, and having a flit in the end, the end of the crank terminates in the fame manner, and an iron wedge is put, one half into the flit in the end of the axis, and the other half into the flit in the end of the crank, by means of which the axis turns the crank about with it.

The four necks of the crank have each an iron fpear, or rod, jointed to them, and alfo jointed at the upper end to the refpective libra, or lever, within nine feet of the centre of the lever. Thefe levers are twenty-four feet long, moving on centres in the middle of their length, and fupported by the frame; at each end of each lever is jointed a rod, which defcends into the pump-barrel, and has the forcer faftened to it. Each end of the four levers works a quadruple forcing-pump, confifting of four caft-iron barrels or cylinders four feet three-quarters long, feven inches bore above, and nine inches below, where the valves lie; the four barrels are faftened by fcrewed flanches over four holes in a hollow trunk of caft-iron, having four valves in it juft over thefe holes, at the joining on of the bottom of the barrels, and at one end of the hollow trunk is a fucking-pipe and grate, going into the water, which fupplies all the four pumps alternately, when they fuck or draw up water.

To carry away the water which they force out, there proceeds from the lower part of each pump-barrel, a neck turning upward arch-wife, whofe upper part is caft with a flanch to fcrew up to the under fide of another fquare trunk, which receives the necks of all the four barrels; which necks have bores of feven inches diameter, and over the holes in the trunk, communicating with them, are placed four valves at the joinings or flanches. The fquare forcing-trunk is caft with four boffes, or protuberances, ftanding out againft the valves, to give room for their opening and fhutting; and on the upper fide of the trunk are four holes ftopped with plugs, to take out on occafion, to cleanfe the valves. One end of this trunk is ftopped by a large plug, and to the other the iron-pipes are joined by flanches, through

through which the water is forced up a hundred and twenty feet, or to any height or place required.

See a drawing of a triple forcing-pump of this fame kind, in our article PUMP.

Befides this four-barrelled pump, there is fuch another placed at the other ends of the libræ, or levers; but to avoid confufion, we fpoke only of one quadruple pump, as the other is juft the fame; but its rods and forcers being at the oppofite ends of the levers, the barrels draw and force alternately.

At the other end of the water-wheel is placed all the fame fort of work as at the end already defcribed; *viz.* the great cog-wheel and the trundle, fixed upon the fpindle or axis, which is united, as before-mentioned, with the axis of the quadruple crank.

Alfo the four rods from thefe cranks, to work the four horizontal levers, each of which has a forcer at both ends, to ferve the four barrels of a quadruple pump at each end of the levers; fo that one fingle wheel works fixteen pumps, *viz.* two quadruple engines at each end of the axis.

Mr. Beighton, who has defcribed the ftructure and operation of this engine, (fee Phil. Tranf. abr. vol. vi. p. 358.) has thus calculated the quantity of water raifed by it in a given time.

In the firft arch next the city there is one wheel with double work of fixteen forcers. In the third arch, one wheel with double work at one end, and fingle at the other, having twelve forcers. A fecond wheel in the middle having eight forcers. A third wheel with fixteen; fo that there are in all fifty-two forcers. One revolution of a wheel produces in every forcer $2\frac{1}{5}$ ftrokes; fo that one turn of the four wheels makes 114 ftrokes, taking all the barrels into account. When the river acts with moft advantage, the wheels go fix times round in a minute, and but $4\frac{1}{2}$ at middle tide; hence the number of ftrokes in a minute is 684; and as the ftroke is two feet and a half in a feven-inch bore, it raifes four ale gallons; and all raife *per* minute 2736 ale gallons; *i. e.* 164160 gallons or 3420 hogfheads *per* hour, ale meafure, to the height of 120 feet. Such is the utmoft quantity they can raife, fuppofing that there were no imperfections or lofs at all; but Mr. Beighton infers, from experiments performed on engines whofe parts were large and excellently conftructed, that they will lofe one-fifth and fometimes one-fourth of the calculated quantity.

Mr. Beighton obferves, that, though thefe water-works may juftly be efteemed as good as any in Europe, yet fome things might be altered much for the better. If, he fays, inftead of fixteen forcers, they worked only eight, the ftroke might be five feet in each forcer, which would draw much more water with the fame power in the wheel; becaufe much water is loft by the too frequent opening and fhutting of the valves; and that the bores that carry off the water from the forcers are too fmall; and that they fhould be near nine inches in diameter. This objection Dr. Defaguliers fays is of no force, unlefs the velocity of the piftons was very great; but here the velocity of the water paffing through the bores is much lefs than two feet in a fecond. This laft writer obferves, that a triple crank diftributes the power better than a quadruple one. He adds, that forcers made with thin leather tanned, of about the thicknefs of the upper leather of a countryman's fhoe, would be much better than thofe of the ftiff leather commonly ufed.

In order to calculate the power which the above water-wheel exerts, we muft find the weight which it raifes, and the fpace through which it is raifed in any given time.

The weight of the column of water, in any one of the pumps, is found thus: Diameter feven inches fquared = 49 circular inches area. Now one cylindrical inch, a foot high, weighs .34 pounds avoirdupois, and therefore 49 fuch cylinders muft weigh $16\frac{2}{3}$ pounds; but the column is 120 feet high, and therefore $120 \times 16\frac{2}{3} = 1999$ pounds weight. This column of water is raifed $2\frac{1}{2}$ feet at every ftroke, now each pump makes $2\frac{1}{5}$ effective ftrokes for every turn of the wheel, or taking the wheel at fix turns *per* minute, each pump makes 13.2 ftrokes *per* minute. Multiply this by $2\frac{1}{2}$ feet, and we find the motion given to each column of water is near 33 feet in a minute, and the weight of it 1999 pounds.

But the wheel which we have defcribed actuates 16 fuch columns, and therefore the total weight will be 31984 lbs. raifed 33 feet in a minute. This is equal to 1055571 lbs. raifed one foot high *per* minute.

What is called a horfe-power, in fteam-engines, is 33000 pounds raifed one foot high *per* minute, and we find this contained near thirty-two times in the above quantity, fo that this fingle machine exerts thirty-two horfe-power. But as the above horfe-power is $1\frac{1}{2}$ times what horfes can do for conftant work, it would take forty-nine horfes to do as much work as this wheel, and they would not be able to work more than eight hours every day, but the water-wheel works five or fix hours each tide.

We fhall afterwards give a fimilar calculation of the machine at Marly, in France, in the fame terms, fo as to admit of a direct comparifon, and from this it will appear, that the old machine at London-bridge, which was erected not long after the machine at Marly, is three times as powerful as any one of the water-wheels at Marly.

The above ftatement of the wheel making fix turns *per* minute is taken from Mr. Beighton's account, who alfo ftates the velocity of the water at 685 feet *per* minute, and the velocity of the wheel 310 feet *per* minute, or as 1 to 2.2.

In 1763 Mr. Smeaton found, by an average of the fix years preceding, that the engine above defcribed had made 3025 ftrokes in each pump at every tide, taking an average of all the circumftances of high and low tides. This is only 1375 turns for the water-wheel, or 4033 ale hogfheads every twelve hours; and hence the produce falls very fhort of the calculation of fix turns *per* minute; but this does not affect the power of the machine during the fhort time when it is working at that rate.

In 1762, when the two middle arches of London-bridge were thrown into one by the removal of the pier, the water way of the river was fo much increafed, that the water-wheels did not perform fo much as they did before, the daily produce being reduced to 2716 hogfheads. In confequence, the city granted to the Water-works Company the ufe of the fifth arch, for which Mr. Smeaton planned a larger machine than any of the others: it was erected in 1767, and which we fhall now defcribe.

We fuppofe it underftood, that London-bridge is not built with ftone down the bottom of the river, but according to an ancient method of driving piles into the bottom of the river, and cutting off the tops level with the loweft water line, upon thefe the ftone-piers of the bridge are erected; but as the original piles were fubject to decay, and admitted of no renewal, it became neceffary to furround them with gravel and chalk; and to retain the chalk, cafings of piles, called ftarlings, are driven in all round the piers. Thefe diminifh the fpace between the arches, fo as to occafion a very rapid current of the water in running through them, becaufe the water-paffage bears only a fmall proportion of the artificial folids, thus placed in the way of the current, and this reduces nearly all the arches to fluices as it were. Of the twenty arches in this bridge, fix are devoted

devoted to the water-machines, that is, five on the London ſide, and one on the Southwark ſide.

Mr. Smeaton's great Engine at the fifth Arch of London Bridge.—This machine is repreſented in perſpective, in *Plate* II. WATER-WORKS, *Machines for raiſing Water.* The view being taken from beneath the arch of the bridge, B B repreſents the ſtarling of the fourth pier of the bridge, compoſed of a vaſt body of piles driven into the bed of the river, and the interſtices filled up with chalk and gravel. Upon the heads of theſe piles, a ſet of horizontal beams are laid in the manner of joiſts, and all is made level by chalk and gravel.

The fifth pier C C is made in the ſame manner. The water-wheel F F G G is made of ſuch a breadth as to fill the ſpace between the two ſtarlings as exactly as poſſible, without touching; and the bearings for the gudgeons of its axis are ſupported upon head-ſtocks E E, which reſt upon the ſtarlings. The water-wheel has four circular rings F F F F, each ſuſtained by ſix arms mortiſed into the axis; each ring has twenty-four ſtarts mortiſed into it, and to theſe are nailed the float-boards *f f*, upon which the water acts to turn the wheel round.

Upon each end of the main axis is fixed a large wooden wheel H H, round which caſt-iron rings of cogs are fixed in ſegments. Theſe cog-wheels turn two trundles, which give motion to the forcing-pumps, which are ſix in number, *viz.* one three-barrelled pump on each ſide of the water-wheel; but only one of the engines or triple pumps is ſhewn in the figure, for as the other is exactly the ſame, it is ſufficient to deſcribe one. The axis on which the trundle I is fixed is of caſt-iron; it is connected with a triple crank, one arm of which is marked *b*, and two others are hidden behind the frame: *g h i* are ſtrong iron rods, joined to the cranks at their lower ends, and to the ends of the great levers or regulators K L M at the upper ends.

The regulators are poiſed on centres in the middle of their length, and have arches *k l m* at the other ends, which are ſtruck from the centres of motion, upon which arches the chains are laid, to give motion to the piſton-rods of the pumps N.

By the motion of the water ſtriking the float-boards, the water-wheel is made to revolve on its axis, and the large cog-wheel H with it. This turns the trundle I and the triple cranks *b c*, which, being arranged round the axis at equal intervals, elevate and depreſs the crank-rods *g h i* and regulators K L M ſucceſſively, and give to the pump-rods and piſtons a vertical motion.

The joints of the crank-rods *g h i* are made to ſcrew together round the crank-neck with braſs between; by this means they work very pleaſantly, and when worn can be ſcrewed up tight again that they may have no ſhake. The crank-rods are each made in two lengths, each of which has a flanch at the end, and they join at *n* in the middle of the rod: the flanches are held together by three ſcrews, ſo as they may be taken apart occaſionally without difficulty, when the pump-forcers are to be drawn out of the barrels to new leather them.

The joints at the end of the beam or levers are made with braſſes, and ſcrews to adjuſt them; and ſo are the centres or fulcrums of the levers.

The levers or regulators are admirably well deſigned to be ſtrong, with but little timber; they are formed of two pieces of timber, between which the caſt-iron axis on which they turn are placed; and then the ends of theſe pieces are bent to touch, and are kept together by hoops and ſcrew-bolts, ſo as to make cloſe joints. At the ends, ſeveral ſmall ſquare pieces of wood are interpoſed croſs ways in theſe joints at the ends of the lever, being let into both timbers; by theſe, when they are firmly bound together, the two pieces of timber are prevented from ſliding end ways upon each other, ſo as they form an excellent truſs-beam, for it cannot bend or yield without ſtretching one timber and compreſſing the other.

The pump-rods are attached to the arches at the ends of the beams by four iron chains each, as is ſhewn in *fig.* 2. The rod has a croſs-piece *p* fixed on the top of it, to which the two outſide chains are attached, and the lower ends of the ſame chains are faſtened at the lower end of the arch.

Theſe chains act to pull down the piſton-rods; the other two chains which return or raiſe the rods are faſtened to the top of the arch, and to the rods at the lower ends, as ſhewn in the figure.

The pumps are forcing-pumps, and raiſe the water when the piſtons are depreſſed: the lower piece of the triple pump is a ſquare iron-pipe or trunk, ſcrewed faſt down upon the groundſells of the engine-frame; this is called the ſuction-piece: it has a flanch at each end, to one of which a lid is ſcrewed, and the other joins it to the ſuction-pipe R, which brings up the water from the river. On the top of the trunk, the three barrels N are ſcrewed, each having a valve in the joint, which allows water to enter into the barrel, but prevents its return. From the bottom part of each barrel proceeds a crooked pipe *q*, which communicates with another ſquare trunk S, called the forcing-piece, having valves at the joint, to prevent any water from getting back into the barrels. On the top of the trunk over each valve is a round hole, over which a lid is ſcrewed, but can be removed to clean or repair the valves when neceſſary. Similar lids are ſcrewed on over openings into the ſuction-trunk, at the back towards the cranks. At the ends of the forcing-trunk S are flanches, one of which receives a lid like the lower trunk, and the other flanch joins to the pipe *s*, which conveys the water away from the pumps.

The piſtons or buckets of the pumps are ſolid, that is, without valves in them; and their action is as follows:

When the piſton of any of the barrels is drawn up, it makes a vacuum in that barrel; and the preſſure of the atmoſphere on the ſurface of the water from which the ſuction-pipe R draws, raiſes the valve at the bottom of that barrel, and fills it with water. At the deſcent of the piſton, the lower valve ſhuts, and the water contained in the barrel can find no paſſage but through the valve in the forcing-trunk S; and when the piſton is drawn up again this valve cloſes, and the lower one opens to give a freſh ſupply of water to the barrel. By the poſition of the triple cranks, it always happens that one or other of the barrels is forcing the water into the force-pipes; and as the ſtrokes of the other ſet of pumps at the other end of the water-wheel are contrived to be intermediate or alternating to theſe, a conſtant ſucceſſion is kept up.

The main-pipe *s* is continued to the ſhore, to convey the water into the ſtreets. A wooden ciſtern T is placed over the pumps to hold water, and keep a conſtant ſupply of it above the piſtons to prevent leakage. The whole engine is ſurrounded by a ſtrong timber fence, which guards it from the injuries it might receive from veſſels or floating ice, ſtriking it at high water, when the water riſes above the level of the ſtarlings nearly to the axis of the water-wheel. On the tops of theſe piles, a large ſtage is built, to ſerve as a road from the ſhore to the engine, and the underſide of it ſupports the main-pipes, which convey the water aſhore. There are alſo other ſtages in different parts of the machine, to ſupport workmen when repairing it; theſe prevent the whole engine from being ſeen from the bridge at one view, and for

for this reafon they are omitted in the drawing, which is in fome degree imaginary, as it reprefents the engine detached.

This machine is more fimple than the preceding, as it performs more work by fix pumps of ten inches bore and $4\frac{1}{2}$ feet ftroke than the other by fixteen pumps of feven inches bore and $2\frac{1}{2}$ feet ftroke, and therefore with much lefs lofs of power by friction; and as the cranks only work in one direction, they work much more pleafantly than when there are pumps at both ends of each lever, becaufe in that cafe the ftrain on the cranks, connecting-rods, and the fulcrums of the levers, in fact on all the joints, is alternately in different directions, and if there is any fhake or loofenefs in the joints, it produces jerks and irregularities. By ufing three barrels and triple cranks, the fupply of water, forced into the main-pipe, is more equable than when four are ufed, though not perfectly fo. The perpendicular motion produced by the arches and chains, is a great advantage in making the barrels wear equally.

In order to enable this engine to work as long as poffible in each tide, and after the velocity of the motive water is abated, it is contrived to adjuft the refiftance to the diminifhed power. This is done in the moft fimple manner by a fmall cock and pipe in the chamber of each pump-barrel; juft above the fuction-valve from this cock, a rod of communication rifes up to the ftage to turn it by, and this cock being opened will admit air into the barrel when the pifton is drawn up, fo that the water of the river will not be drawn up into that barrel; and in confequence, it will become inactive, and the wheel will be relieved from the load of working it. In this way, the load of the engine is adapted to the power of the tide at its different periods; but when all the three barrels are thus relieved by opening the air-cocks, the motion of that engine becomes a ufelefs loud friction of the piftons and movements; and to relieve this, the fhaft or axis of connection between the axis of the trundle and the triple crank, is provided with the means of difuniting or uniting them whilft in motion, fo that one engine will ftand ftill whilft the other is at work.

The principal dimenfions of this machine are as follow: —The water-wheel is thirty-two feet diameter, meafuring to the outfide of the float-boards; the length of the float-boards fifteen feet and a half, and their breadth four feet and a half; the number of float-boards twenty-four. At each end of the axis is fixed a cog-wheel, fourteen feet diameter, with eighty cogs: each of thefe turns a trundle of twenty-three ftaves, fixed on the axis of the cranks, which are triple; that is, three cranks are formed fide by fide on the fame axis, and bent in different directions, fo as to produce a continual action. Each crank actuates a lever or working beam eighteen feet long, which is poifed on a fulcrum in the middle, and gives motion to the pump-rods by an arch-head and iron chains. The pump-barrels are ten inches diameter, and the piftons make ftrokes of four feet and a half long; they are forcing-pumps, and three barrels are combined together, to throw the water into one main pipe, which conveys the water into the town; the higheft elevation to which the water is ever lifted is a hundred and twenty feet. The cranks, beams, and pumps, at each fide of the wheel, are exactly fimilar, fo that the wheel actuates fix pumps.

This machine was erected, under Mr. Smeaton's directions, in 1767, and worked conftantly for fifty years, when the timber-work becoming decayed, it was rebuilt in 1817, with caft-iron inftead of wood, and has been lately fet to work. The principal proportions of Mr. Smeaton's defign have been preferved, but the great levers have been fuppreffed, and the cranks are placed over the fame pumps as the former.

Mr. Smeaton's Pump Machine at Stratford Water-works.—This is fo like the laft, that we fhall only give the principal dimenfions, as an example of the beft proportions for a machine with a breaft-wheel, the laft being underfhot. The water-wheel was fixteen feet diameter and eight feet wide; upon its axis was a cog-wheel of eleven feet and a half diameter, with feventy-eight cogs, which turned a cog-wheel of five feet one inch diameter, with thirty-five cogs. This was fixed upon the axis of the cranks, which were three in number, and by means of three beams gave motion to three forcing-pumps nine inches diameter and two feet and a half length of ftroke, lift of the water 84 feet. In addition to the pair of cog-wheels juft mentioned, there was another pair, of different proportions, fixed clofe to the fides of the others, and by a fimple contrivance either pair could be brought into action, and the other pair would then be difengaged. The fecond wheel, which was fixed in the axis of the water-wheel, was nine feet eight inches diameter, with fixty-fix cogs, and the wheel on the axis of the cranks which belonged to it had forty-feven cogs. The intention of thefe two fets of wheels was to adapt the water-wheel to work equally well when it was flooded and impeded in its motion, as when the water was low; for when the quick motion was in ufe, the cranks made 15.6 revolutions *per* minute, whilft the water-wheel made feven revolutions. But when the flow motion was in ufe, the cranks would make $15.\frac{1}{2}$ revolutions *per* minute, whilft the water-wheel made eleven. This machine is feven horfes' power.

The *Pump Machine at Marly*, near Paris, being fo much celebrated on account of its magnitude and the multiplicity of its parts, we fhall be expected here to give fome account of it, which we have taken from Belidor, and we fhall fubjoin a few remarks upon its conftruction, from which it will appear we do not recommend it as a model.

This machine is fituated between Marly and the village La Chauffée. In that place the river Seine is penned up partly by the machine and partly by a dam, which keeps up the water; but in order that the navigation may not be interrupted, a canal has been cut, two leagues above Marly, for the paffage of boats and barges. There has been erected, about thirty-five fathoms from the machine, a contrivance, called an *ice-breaker*, to prevent floating pieces of ice or timber, which come down the ftream, from damaging the machine, and the better to fecure the pen-ftocks, and the channels in which the water-wheels move. There is a grate of timber to ftop whatever may come through the ice-breaker.

The water is raifed to its deftined height by the force of fourteen underfhot water-wheels, which work the pumps at three different ftages: firft, one fet of pumps to lift the water from the river, to a refervoir placed up the hill two hundred and thirteen yards from the river, and at the elevation of a hundred and fixty Englifh feet above the level of the Seine. The power of the wheels is conveyed alfo to this place by chains, in order to work a fecond fet of pumps, which force the water to the fecond refervoir, a hundred and eighty-fix feet higher, and therefore three hundred and forty-fix feet above the river, and fix hundred and ninety yards diftant. At this fpot is a third fet of pumps, to throw up the water from the latter to the fummit of a tower a hundred and eighty-nine feet higher, and at a diftance of one thoufand three hundred and thirty yards from the river up the mountain. The whole elevation is rather more than five hundred and thirty-five feet above the river. From the ciftern in the tower the water is conveyed, by an immenfe aqueduct, to the gardens of Marly.

The breadth of the machine comprehends fourteen water-courfes,

courfes, each fhut by a fluice or pen-ftock, which can be raifed and depreffed by racks, and in each of thefe courfes an underfhot wheel is placed. The fourteen wheels are difpofed in three lines acrofs the river. In the firft line, which is up the ftream, there are feven wheels, in the fecond line fix, and only one in the third.

The wheels are thirty feet diameter, and five feet wide, and they are all nearly the fame as follow: the ends of the axle of each wheel go beyond their bearing pieces, and are bent into cranks, which make levers of two feet; the crank which is towards the mountain gives motion to a beam or lever, which carries four piftons or forcers at each end, to work in the barrels of as many forcing-pumps, which as the wheel works alternately fuck up the water of the river, and drive it up into the firft ciftern. The other crank at the oppofite end of the axle gives motion to the chains, which go up the hill, to work the pumps in the two elevated cifterns.

Each of the fix wheels on the firft line is conftructed in this manner, to give motion by one of its cranks to an engine, confifting of eight forcing-pumps combined together. The engine is actuated by a lever or beam, from each end of which a fquare piece of wood is fufpended, that carries and directs four piftons of forcing-pumps; the beam of the engine is put in motion from the crank of the wheel by a beam or leader, which is connected with the crank of the wheel at one end, and with one arm of a regulator or bent lever, whilft the other arm of this regulator is united by another leader to the extremity of the beam of the engine, which beam is thus made to vibrate up and down and work the pumps.

Of the fix wheels we have juft mentioned, there are five which, by their oppofite cranks, give motion to the pumps in the elevated ciftern of the firft lift. This is effected by means of one vertical beam or lever, and two horizontal levers, which are bent, and actuate the chains that communicate the motion; the three levers are only to change the direction of the motion of the crank into a proper direction to go up the hill. The fixth wheel, which is the firft towards the dam, gives motion to a long chain that goes up the hill to work the pumps of the upper ciftern. The feventh wheel of the firft line is exclufively applied to move a chain, which goes to the firft ciftern, by both its cranks.

The fix wheels of the fecond line are like the five wheels in the firft row, *i. e.* one of the cranks of each works an engine of eight pumps, and the other a chain that goes to the upper ciftern.

Laftly, the fingle water-wheel, which is on the third line by each of its cranks, works an engine of eight forcing-pumps fixed in the river, and of itfelf fupplies one conduit-pipe of eight inches and a half bore.

There are then eight engines in the river, and reckoning all the chains which go up the hill, they are thirteen in number, including the chains that come from the fixth and feventh wheels of the firft line: thefe thirteen chains afcend the hill all together, and are fufpended at regular intervals of twenty feet by levers, to bear them up from touching the ground, which by moving on their centre admit of the working of the chains. Each chain is double, that is, there is a fecond chain, which is connected to the oppofite ends of the fufpending levers, and each chain ferves to draw the other chain back again after it has made its ftroke. Five of thefe double chains are employed to actuate levers, which work thirty inverted lift-pumps fituated in a ciftern at the firft lift, and which drive the water through two pipes of eight and a half inches bore up to the upper lift. The other eight double chains go ftraight on to the upper ciftern.

The feven chains of the wheels of the firft line, in going along, work alfo eight fucking-pumps, placed a little below the ciftern of the firft lift, becaufe in that place the water of a confiderable fpring is brought by an aqueduct, and thefe fame chains take up that water a fecond time by forty-nine pumps, which are fituated in a feparate ciftern, at the firft lift, on a level with the firft ciftern, and force it into the upper refervoir, through two conduit-pipes of eight and a half inches diameter, and three others of fix and a half inches diameter.

The water raifed by the feventy-nine pumps in thefe two cifterns at the firft lift, difcharges itfelf into a great refervoir at the fecond lift, and thence by two conduit-pipes of a foot diameter each, it runs into refervoirs of communication, and is diftributed into the feveral wells or little pump-cifterns of the upper ciftern, which all together contain eighty-two inverted lift-pumps; thefe force the water through fix conduit-pipes of eight inches and a half diameter up into the ciftern, in the tower which anfwers to the aqueduct. Thefe eighty-two lift-pumps are worked by the eight great chains before mentioned, that go ftraight to the upper ciftern, without moving any pumps by the way; and the fame chains work fixteen fucking-pumps behind the upper ciftern, to bring back into the refervoir of the fame ciftern the water which leaks out of the fix iron pipes that go to the tower.

To fum up all the pumps of this intricate machine:

1. The eight engines in the river contain fixty-four pumps, which fuck and force the water 160 feet up five iron pipes of eight and a half inches bore, and 213 yards long, up to the firft lift.

2. The two cifterns at the firft lift contain feventy-nine lifting-pumps, which raife the water 186 feet, through four pipes of eight and a half inches bore, and three pipes of fix and a half bore, and 477 yards up to the fecond lift.

3. The cifterns at the fecond lift contain eighty-two lifting-pumps, which raife the water 189 feet through fix pipes of eight and a half inches bore, diftance 640 yards: In all 225 forcing-pumps, which lift 535 feet and 1330 yards diftance. To this muft be added eight fucking-pumps in the river called feeders, which raife water into the cifterns at the top of the forcing-pumps, to keep water in the pumps, and prevent leakage; alfo the eight others which are below the midway ciftern; and laftly, the fixteen fucking-pumps, which we mentioned as placed behind the upper ciftern, fo that the machine has in all 257 pumps.

The bafin of the tower, which receives the water raifed from the river, and fupplies the aqueduct, is 1330 yards diftant from the river, and 535 feet above the level: the water having run along a ftone aqueduct, which is raifed upon thirty-fix arches, is feparated into different conduits, which lead it to immenfe refervoirs at Marly, and formerly conveyed it alfo to Verfailles and Trianon.

Such is the mechanifm of the machine of Marly. Its mean produce in Belidor's time was from 3000 to 4000 Englifh cubic feet of water *per* hour: he fays mean produce, becaufe under certain favourable circumftances it has formerly raifed more than 8484 cubic feet *per* hour. But during inundations, or when the Seine is frozen, when the water is very low, or when any repairs are making, the machine ftops in a great meafure, if not entirely.

The annual expences of the machine have been ftated formerly at 3300*l.* fterling, or 9*l. per* day, including the falaries of thofe who fuperintend it, and the wages of the workmen employed, together with repairs, neceffary articles, &c. This makes about one farthing for every eleven cubic

cubic feet. Or, taking into the account the intereſt of 333,000*l.*, the original expenſe of erection, which is five times as great as the annual expenſe, 11 cubic feet, which is 67 gallons, will coſt three half-pence, or at the rate of a farthing for 11 gallons.

This is the account of it given by Belidor in his ſecond volume.

Rannequin, the inventor, was an ingenious practical mechanic, but no mathematician or philoſopher. In ſeveral poſitions, the moving forces act unneceſſarily obliquely, which occaſions a great loſs of power, and renders the machine leſs effectual. A great proportion of the whole moving power of ſome of the water-wheels is employed in giving a reciprocating motion to the ſets of rods and chains, which extend from the wheels to the ciſtern, nearly two-fifths of a mile diſtant, where they work a ſet of pumps.

As this machine is continually quoted as the moſt powerful of all machines, we will compare its power with ſome of the large ſteam-engines in England. The quantity of water is $(8484 \div 60 =)$ 141 cubic feet *per* minute $\times$ by 535 feet, the height to which it is raiſed, $=$ 75649 cubic feet *per* minute lifted one foot high. Divide this by 528 cubic feet, which is the quantity that can be lifted one foot *per* minute, by what is called a horſe-power in ſteam-engines $=$ 143 horſe-power; but as the machine acts by 14 water-wheels, each one will be ſcarcely $10\frac{1}{7}$ horſe-power. The horſe-power is one-third greater than the average of horſes, and we therefore eſtimate that 215 horſes working together, would do as much work as this machine ever did, or 15 horſes to each wheel; but as the horſes could only work eight hours *per* day, three ſets muſt be kept to continue conſtantly.

M. Montgolfier informs us that the ſupply of water to the wheels is 138000 cubic feet *per* minute, and the fall is $4\frac{1}{2}$ feet; this gives a power $8\frac{3}{4}$ times as great as the effect produced. Montgolfier found $22\frac{1}{3}$ times when he tried it.

The whole work is now in a very ruinous ſtate, and many projects have been formed for a reſtoration of the machine on better principles.

It is probable Rannequin thought his moving force would not be ſufficient to raiſe the water to the height of 535 feet at once; and this is agreeable to the practice of more modern engineers.

If the machinery was conſtructed in caſt iron, in the ſame manner as ſteam-engines are now made, the force of one crank would be more than ſufficient to raiſe a cylinder of water of that altitude, and above eight inches in diameter, without any complication; but the pipes would require very great ſtrength. This is proved by a machine that has been lately erected at Marly, in place of one of the old water-wheels.

Even according to the original conſtruction, the water might be raiſed in one jet to the ſecond reſervoir. This appears from two experiments, one made in 1738, and the other in 1775. In the firſt, M. Camus endeavoured to make the water riſe in one jet to the tower; his attempt was not attended with ſucceſs, but he made the water riſe to the foot of the tower, which is conſiderably higher than the ſecond reſervoir. During this experiment the machine was ſo much ſtrained, that it was found neceſſary to ſecure ſome parts of it with chains.

The object of the ſecond trial, made in 1775, was to raiſe the water at once to the ſecond lift, 346 feet. It did aſcend thither at different times, and in great plenty, but the pipes were exceedingly ſtrained at the bottom, ſo that ſeveral of them burſt, and it was neceſſary to ſuſpend and recommence the experiment ſeveral times. This aroſe from a fault which might eaſily have been remedied; *viz.* from the age of the tubes and their want of ſtrength; therefore it reſults from this trial, that the chains which proceed from the river to the firſt lift might be ſuppreſſed, together with the firſt well itſelf: and this perhaps is all that is to be expected without a complete change in the machinery.

Rules for calculating the Dimenſions of Pumps.—The quantity of water delivered by any pump will be in the joint proportion of the ſurface or baſe of the piſton and its velocity; for this meaſures the capacity of that part of the working barrel which the piſton paſſes through; and the ſame is true of ſector pumps, or rotative pumps: but as pumps with ſtraight cylindrical barrels are the only kind in general uſe, it will be ſufficient to give the rule for calculating the content of a cylinder, which is ſimply to multiply the area of the baſe by the length; thus, take the diameter of the barrel in inches, and the length of the ſtroke in feet.

Square the diameter in inches, and divide by 183.3: multiply this by the length of the ſtroke in feet, and it gives the content of the cylinder in cubic feet.

Example.—How many cubic feet of water will be raiſed in an hour by a pump $8\frac{1}{2}$ inches diameter, and $3\frac{1}{2}$ feet ſtroke, which makes 18 ſtrokes *per* minute?

Diameter 8.5 inches $\times$ 8.5 $=$ 72.25 circular inches: divide it by 183.3, which is the number of circular inches in a ſquare foot, and it gives .394 ſquare feet for the area of the barrel $\times$ 3.5 feet in length $=$ 1.379 cubic feet; the content of the barrel $\times$ 18 ſtrokes *per* minute $=$ 24.822 cubic feet of water raiſed *per* minute $\times$ 60 minutes $=$ 1489 cubic feet *per* hour.

If it is required to know the quantity which a pump will raiſe in ale gallons, it is obtained by the following rule: take the diameter of the barrel in inches, and the length of the ſtroke in feet.

Square the diameter in inches; multiply by the length in feet, and divide by 30.

This ſhould give the content of the barrel in ale gallons of 282 cubic inches each; but the rule is not perfectly correct, for it aſſumes the gallon to be $282\frac{3}{4}$.

Example of the ſame Pump as above.—The ſquare of the diameter is 72.25 $\times$ 3.5 feet in length $=$ 252.875 $\div$ 30 $=$ 8.429 ale gallons for the content of the barrel. The true meaſure in this caſe is 8.45 gallons, which is very near.

To find the force requiſite to work any pump, take the diameter of the barrel in inches, and the perpendicular height of the column of water in feet.

Square the diameter in inches; multiply by .34 decimal, and multiply by the height of the column in feet.

This gives the force in pounds avoirdupois. It is uſual to add one-fifth to this weight, on account of friction and reſiſtance.

Example.—Suppoſe the above pump lifts the water 64 feet in the whole, what force will it take to draw up the piſton?

The ſquare of the diameter is 72.25 $\times$ .34lbs. $=$ 24.565 lbs., which is the weight of one foot high of the column $\times$ 64 feet $=$ 1572 lbs., the weight of the whole column. Add $\frac{1}{5}$th of this, *viz.* 314 lbs. $=$ 1886 lbs. the weight required to draw up the piſton and give it a proper velocity.

In conſtructing pumps, care muſt be taken to avoid all unneceſſary contractions in the valves or pipes which convey the water. If the water-way is too ſmall, the water will be be greatly resisted in its passage through such contractions; and this is called by the workmen wire-drawing the water.

The velocity of the water in the conduit-pipe, and in its passage through every valve, will be greater or less than the velocity of the piston, in the same proportion that the area of the piston or working barrel is greater or less than the area of the passage of the valve. For whatever quantity of water passes through any section of the working barrel in a second, the same quantity must go through any one of the passages: this enables us to modify the velocity of the water as we please, and we can increase it to any degree at the place of delivery, by diminishing the aperture through which it passes, provided we apply sufficient force to the piston. This is the case in the engine for extinguishing fires; but no such increase of velocity must be suffered in pumps which are required to raise the greatest quantity of water with a given power; because the power required to force the water with a great velocity is very considerable, and the velocity so obtained adds nothing to the mechanical effect which is produced. The resistance arises from a two-fold cause; *viz.* the friction of the water against the sides of the passage, and still more from the resistance which water opposes to any sudden change of figure; for though water is a perfect fluid, and will readily accommodate itself to any change of figure by its own gravity, yet, it requires some time to make such change; and if we force it to change its figure in less time than it naturally would, it requires mechanical power to do so, just the same as to compress a mass of clay, or other soft and non-elastic body.

In practice, the velocity with which the piston of the pump moves, determines the size of the smallest passage through which the water can pass without unnecessary resistance. Few pumps move with a greater velocity than 80 or 100 feet *per* minute; and we think the area of the narrowest passages and pipes should bear such a proportion to the area of the barrel, that the water will never be urged with a greater velocity than three feet *per* second, or 180 feet *per* minute, if the power required to move the pump is an object. In general, this will be accomplished by making the area of the smallest opening equal to half the area of the barrel; or if the diameter of the barrel is divided into 10 parts, the diameter of the least opening should be 7 of those parts. If the pump moves slower, then the passages may bear a smaller proportion. The pumps which have solid pistons are preferable, because the valves can be made of any size which is desired; but when a valve is made in the piston, its size is necessarily limited to less than we have recommended.

Estimate of the Strength of Men to raise Water.—Various authors have stated the mean force of a man so widely different, that the student is perplexed which to choose. The following table contains several of these statements, which we have reduced to one common denomination; *viz.* the number of pounds avoirdupois, or the number of cubic feet of water which a man can raise up in one minute to the height of one foot.

Authors.	Pounds Avoirdupois raised one Foot *per* Minute.	Cubic Feet of Water raised one Foot *per* Minute.	Duration of the Work.
Hachette - - - -	1343	21.5	Working 10 hours *per* day.
Amontons - - - -	1530	24.48	
Euler - - - -	3000	48.	
Smeaton - - - -	3668	58.7	Working during 8 hours in 24.
	3750	60.	
	3859	61.7	
Bernouilli - - - -	4144	66.3	For 8 hours.
Schulze - - - -	4410	70.5	
Desaguliers - - - -	5500	89.6	
Emerson - - - -	6300	100.8	For 10 hours.
Dr. Robinson - - -	5031	80.5	A feeble old man, working 8 or 10 hours *per* day, a pump without friction.
	6648	106.4	A young man weighing 135 lbs.: 10 hours *per* day.
Average of all these - - -	4098	65.5	
True standard - - -	3750	60.	Working 10 hours *per* day.

It is not difficult to account for these great differences, when we consider how the muscular force varies in different individuals, and also the power of enduring fatigue. The only means of ascertaining the mean force of a man is to take the sum total of the work executed by a number of men acting for a great length of time. This was repeatedly done by Mr. Smeaton, on a very large scale, and with so very little variation, that we can very confidently recommend engineers to calculate a man's force at 60 cubic feet, or 3750 lbs., raised one foot *per* minute: as this is just one cubic foot *per* second, it will easily be fixed in the memory. Desaguliers' estimate of one hogshead raised ten feet high *per* minute, is very frequently used, and is 5500 lbs. raised one foot *per* minute, but it is too great for a mean; and Desaguliers himself called it the maximum, which no machine can exceed.

When a machine is to be turned by the force of a man turning a winch or handle, the handle ought not to be longer than from 12 to 16 inches; nor should it be calculated to make more than 30 turns *per* minute; and when moving with this velocity, it should not require a greater force than $16\frac{3}{4}$ lbs. pressure upon the handle; or a man will not be able to move it without greater fatigue than he can endure for a day's work. If the handle is required to move slower, flower, for inftance 20 turns *per* minute, then the load may be increafed in proportion; *viz.* to 25½ lbs., and this will be lefs fatiguing.

The Force of Horfes to raife Water.—This we find as varioufly ftated by different authors as the force of men.

Authors.	Pounds Avoirdupois raifed one Foot *per* Minute.	Cubic Feet of Water raifed one Foot *per* Minute.	Duration of the Work.
Hachette's eftimate that a horfe is equal to 7 men	9406	150.5	Working 9 hours *per* day.
Fenwick	13200	211.2	
Gregory	18480	295.6	
More	21120	337.9	
Watt	20000	320.0	
Smeaton's 2 horfe machine, with an Archimedes' fcrew	20104	321.6	Working 9 hours *per* day, light work.
Smeaton's 4 horfe machine to work a flafh-wheel	20418	326.7	Working 8 hours *per* day.
Smeaton's ftandard	22916	366.6	
Defaguliers' eftimate that a horfe is equal to 5 men	27500	440.0	
Smeaton's experiment on drawing coals with 2 horfes	27720	443.0	Working 4½ hours *per* day, 4 horfes were kept in order to work for 9 hours *per* day.
Meffrs. Boulton and Watt's horfe-power in fteam-engines	32000 33000	512.0 528.0	The ftrongeft horfes, fuch as are ufed in London, cannot work at this rate throughout the day.
True ftandard	22000	352	Working 8 hours *per* day, nearly equal to 6 men.

In this, as in the former inftance, we feel inclined to give the preference to Mr. Smeaton's eftimate, both from his fuperior experience and accuracy, and alfo becaufe by his MS. papers, we are informed of the particulars of his experiments. He found, from examining the accounts of a colliery, that each horfe drew 27720 pounds one foot *per* minute; but as they could only continue to work at that rate for 4½ hours *per* day, Mr. Smeaton fixed his ftandard at 250 hogfheads *per* hour raifed ten feet, which is equal to 22,916 pounds, raifed one foot high. Still we find in two of his machines, of which we have already given the particulars, the performance fell rather fhort: we have, therefore, chofen to recommend 352 cubic feet of water, or 22,000 pounds *per* minute raifed one foot high, as a ftandard for a horfe's force, when he works 8 hours *per* day, and moves with a velocity of 2½ miles *per* hour. This is fettled by univerfal confent as the moft proper pace for a horfe to walk; and he will in that cafe draw juft 100 pounds, which is an eafy number to remember.

The eftimate of Defaguliers we confider as the maximum of a horfe's power; for the horfe-power of Meffrs. Boulton and Watt is only ufed as a meafure of the force of their *fteam-engines*. See that article.

In applying horfes to work machines, the circular tract in which they walk fhould be as large as poffible, that the horfes may turn round in the circle with little inconvenience. Few cafes will admit of a walk of more than 30 feet diameter; and in proportion as this is diminifhed, the horfe lofes fome of his power. No horfe-walk fhould be made of lefs than 20 feet diameter, if he is required to act with any confiderable force. When this fize cannot be obtained, we are of opinion that the horfe would work to a greater advantage by walking within a large perpendicular wheel, like thofe wheels ufed for cranes.

It muft be remembered, that the horfe fhould always move with a velocity of 2½ miles *per* hour, or 220 feet *per* minute; and, therefore, the number of turns which he will make in a minute muft be proportioned to the fize of the track in which he works.

Diameter of the Horfe's Track.	Circumference.	Number of Turns *per* Minute, when the Horfe walks 2½ Miles *per* Hour.
30 feet.	94 feet.	2.34
28	88	2.5
26	81.5	2.7
24	75.2	2.9
22	69	3.17
20	62.6	3.5

The machine which is to raife the water fhould be fo connected with the principal wheel which the horfe turns, that it will move with the proper velocity, when the horfe-wheel turns at the rate above fpecified. The velocity proper for moft machines is mentioned in the defcription of each.

Water-Wheels applied to raife Water.—The circumference of a water-wheel will work to the greateft advantage, when it moves with a velocity of from 3 to 4 feet *per* fecond, or from 180 to 240 feet *per* minute. A very proper velocity for a water-wheel is to make it the fame as the horfes, by the above table; and we have, therefore, added the velocities for fmaller diameters.

Diameter.	Circumference.	Turns *per* Minute.
18 feet.	56.4 feet.	3.9
16	50	4.4
14	44	5
12	37.5	5.86
10	31.4	7

Few machines, with pumps worked by a water-wheel, will raiſe more water to a given height in any timo, than amounts to one-third the mechanical effect of the quantity of water employed to work it; that is, conſidering the differences of the heights to which the water is raiſed, and the height of the fall, and reducing them both to an equality, the quantity of water raiſed will never exceed half of the quantity which falls. The other half is loſt in friction and leakage, and in overcoming the *inertiæ* of the parts of the machine.

Preſſure engines are thoſe machines which give motion to the piſton of a pump, by the force of a column of water acting in a cylinder or barrel, ſimilar to that of the pump. (See the article PRESSURE-*Engine*.) It was omitted in that article, that M. Belidor invented a machine, which may be conſidered as the firſt which was perfect, and was indeed the model for that made by Mr. Smeaton. See Architecture Hydraulique, vol. ii. p. 240.

M. Baillet made obſervations upon ſeveral machines of this kind in the mines of Hungary, from which it appears that the mechanical effect produced, is only four-tenths of the mechanical effect of the firſt power.

Height of the Fall of Water to work the Machine.	Diameter of the Piſtons.	Quantity of Water expended in 24 Hours.	Height to which the Water is raiſed.	Quantity of Water raiſed in 24 Hours.	Ratio of the Effect, and the Cauſe.
French Metres.	Metres.	Cubic Metres.	Metres.	Cubic Metres.	
85.757	0.352	1900.328	89.656	817.036	0.45
89.656	0.325	2467.965	214.39	479.879	0.46
79.910	do.	685.55	46.777	394.185	0.33
79.910	do.	582.711	28.585	589.566	0.36
89.656	do.	2467.965	66.267	1336.815	0.40
					0.4 mean.

The French metre is equal to 3.281 Engliſh feet, and the cubic metre is 35.3198 cubic feet Engliſh.

Power of the largeſt Steam-Engines to raiſe Water.—The moſt powerful machine in exiſtence is the ſteam-engine, on Mr. Watt's principle, called Stoddart's engine, at the United Mine in Cornwall. Three other engines of equal dimenſions are employed to drain the mine, but only this one is loaded ſo as to exert its utmoſt force. The ſteam cylinder is 63 inches diameter, and acts double; that is, it operates to raiſe water equally in the aſcent or deſcent of the piſton. The weight of water in the pumps is 82,000 pounds, and with this load it makes $6\frac{1}{2}$ double ſtrokes *per* minute of $7\frac{3}{4}$ feet each; or, it gives to the load $100\frac{3}{4}$ feet motion *per* minute.

Multiply 82,000 pounds by $100\frac{3}{4}$ feet, and it gives 8,261,500 pounds *per* minute lifted one foot high: divide this by 33,000 pounds, which is called the horſe-power, and it gives $250\frac{1}{3}$ horſe-power for the acting force of the engine. Again, divide 8,261,500 pounds by $62\frac{1}{2}$ pounds, the weight of a cubic foot of water, and we find this engine is capable of raiſing 132,184 cubic feet of water *per* minute to a height of one foot. This is not one of the beſt engines with reſpect to fuel, and it burns $31\frac{1}{2}$ pounds of coal to raiſe this quantity.

The whole power employed to drain the United Mine is as follows:

		Horſe-Power.
Stoddart's engine, 63 inch cylinder, double acting		$250\frac{1}{3}$
William's engine, 65 inch cylinder,	do.	200
Sim's engine, 63 inch cylinder,	do.	185
Poldorey's engine, 63 inch cylinder,	do.	196
Total	-	$831\frac{1}{3}$

Here we have a ſingle machine of nearly double the power of the famous machine at Marly, which is in fact compoſed of fourteen machines, working in concert for a common object; and ſo do the four engines in the mine, which amount to $831\frac{1}{3}$ horſe-power, without reckoning the engines employed to draw up the ore.

The engines at ſeveral other mines in Cornwall are of immenſe power. We will ſtate two.

The mine called Wheal Alfred has four engines: a 63 inch double engine, which is lightly loaded, and only exerts 80 horſe-power; a ſingle acting engine of 66 inch, and 60 horſe-power; and two others of 64 and 60 inch, equal to 51 and 54 horſe-power:—in the whole, 245 horſe-power to drain one mine.

The Dolcoath mine has three engines: a double engine of 63 inch cylinder, and 132 horſe-power; a ſingle engine of 63 inch, and 45 horſe-power; and a ſmaller ſingle engine of 20 horſe-power:—in all, 197 horſe-power to drain the mine.

It will be obſerved above, that the power of the different engines is not in proportion to the dimenſions of the cylinders: this is becauſe the preſſure upon each ſquare inch of the piſton varies in different engines from 7 to 20 pounds. But cuſtom has eſtabliſhed, that certain ſizes of cylinders will be equal to a certain number of horſes' power, as is ſhewn by the following table.

The ſteam in the boiler is ſuppoſed to be kept within the limits of from 2 to 4 lbs. preſſure on each ſquare inch more than the atmoſphere; and in that caſe the cylinders of the diameters marked in the Table will have very nearly the powers aſſigned to them.

A TABLE of the Dimenſions of the Cylinders of Mr. Watt's Steam-Engines, either Double or Single, ſhewing their different Powers, either to raiſe Water by Pumps, or to turn Machinery by Cranks and Fly-Wheels.

Nominal Horſe-Power.		Dimenſions of the Piſton.			Effective Preſſure or Load on the Piſton.		Velocity of the Motion with which the Load is raiſed.				Mechanical Effect expreſſed by the Weight which can be raiſed in a Minute to a Height of one Foot.		Conſumption of Coals in an Hour in Pounds Weight.		
									Velocity of the Piſton per Minute, in Feet.				Double Engines.		
Double Engine.	Single Engine.	Diameter in Inches.	Area in ſquare Inches.	Number of ſquare Inches for each Horſe-Power.	Preſſure on each ſquare Inch in Pounds.	Load on the Piſton in Pounds.	Length of the Stroke in Feet.	Number of Strokes per Minute.	Double Engine.	Single Engine.	Cubic Feet of Water.	Pounds Avoirdupois.	By Each Horſe-Power.	Total.	Single Engines.
1	½	6.0	28	28.0	7.	199	1⅔	50	166⅔	83⅓	528	33,000	20.7	20	10
2	1	8.3	54	27.4	7.2	392	2	42	168	84	1,056	66,000	15.6	27	13½
4	2	11.6	106	26.5	7.3	777	2½	34	170	85	2,112	132,000	13.8	55	27½
6	3	13.9	152	25.4	7.0	1070	3	31	185	92½	3,168	198,000	12.2	73	36½
8	4	15.9	199	24.9	6.9	1389	3½	27	190	95	4,224	264,000	10.5	84	42
10	5	17.7	245	24.5	7.	1718	4	24	192	96	5,280	330,000	10.0	100	50
12	6	19.2	288	24.0	7.1	2062	4	24	192	96	6,336	396,000	9.8	117	58½
14	7	20.6	332	23.7	7.1	2357	4½	22	196	98	7,392	462,000	9.0	126	63
16	8	21.75	373	23.3	7.1	2666	4½	22	198	99	8,448	528,000	8.7	140	70
18	9	23.0	412	22.9	7.2	3000	4½	22	198	99	9,504	594,000	8.5	153	76½
20	10	24.0	452	22.6	7.3	3300	5	20	200	100	10,560	660,000	8.3	166	83
22	11	25.1	493	22.4	7.35	3630	5	20	200	100	11,616	726,000	8.0	176	88
24	12	26.1	532	22.2	7.4	3960	5½	18	200	100	12,672	792,000	7.8	187	93½
26	13	26.9	569	21.9	7.5	4290	5½	18	200	100	13,728	858,000	7.6	197	98½
28	14	27.8	605	21.6	7.6	4620	5½	18	200	100	14,784	924,000	7.4	207	103½
30	15	28.7	645	21.5	7.6	4897	6	17	204	102	15,840	999,000	7.2	216	108
32	16	29.5	682	21.3	7.59	5176	6	17	204	102	16,896	1,056,000	7.1	227	113½
34	17	30.3	721	21.2	7.49	5500	6	17	204	102	17,952	1,122,000	7.0	238	119
36	18	31.	756	21.0	7.7	5823	6	17	204	102	19,008	1,188,000	6.9	249	124½
38	19	31.8	794	20.9	7.6	6028	6½	16	208	104	20,064	1,254,000	6.8	258	129
40	20	32.6	832	20.8	7.6	6346	6½	16	208	104	21,120	1,320,000	6.7	268	134
42	21	33.3	869	20.7	7.65	6663	6½	16	208	104	22,176	1,386,000	6.6	279	139½
44	22	34.	906	20.6	7.7	6980	6½	16	208	104	23,232	1,452,000	6.5	286	143
46	23	34.7	943	20.5	7.7	7298	6½	16	208	104	24,288	1,518,000	6.4	294	147
48	24	35.3	979	20.4	7.7	7543	7	15	210	105	25,344	1,584,000	6.3	302	151
50	25	36.	1020	20.4	7.7	7857	7	15	210	105	26,400	1,650,000	6.2	310	155
52	26	36.6	1055	20.3	7.75	8171	7	15	210	105	27,456	1,716,000	6.1	317	158½
54	27	37.3	1091	20.3	7.77	8485	7	15	210	105	28,512	1,782,000	6.1	329	164½
56	28	38.	1136	20.3	7.79	8800	7	15	210	105	29,568	1,848,000	6.0	336	168
58	29	38.8	1172	20.2	7.79	9114	7½	14	210	105	30,624	1,914,000	6.0	348	174

TABLE *continued*.—

Nominal Horse-Power.		Dimensions of the Piston.			Effective Pressure or Load on the Piston.		Velocity of the Motion with which the Load is raised.				Mechanical Effect expressed by the Weight which can be raised in a Minute to a Height of one Foot.		Consumption of Coals in an Hour in Pounds Weight.		
									Velocity of the Piston *per* Minute, in Feet.				Double Engines.		
Double Engine.	Single Engine.	Diameter in Inches.	Area in square Inches.	Number of square Inches for each Horse-Power.	Pressure on each square Inch in Pounds.	Load on the Piston in Pounds.	Length of the Stroke in Feet.	Number of Strokes *per* Minute.	Double Engine.	Single Engine.	Cubic Feet of Water.	Pounds Avoirdupois.	By each Horse-Power.	Total.	Single Engines.
60	30	39.2	1206	20.1	7.8	9,428	7½	14	210	105	31,680	1,980,000	5.9	354	177
62	31	39.8	1246	20.1	7.8	9,742	7½	14	210	105	32,736	2,046,000	5.9	366	183
64	32	40.4	1280	20.0	7.85	10,057	7½	14	210	105	33,792	2,112,000	5.9	378	189
66	33	41.	1320	20.0	7.9	10,371	7½	14	210	105	34,848	2,178,000	5.8	382	191
68	34	41.6	1360	20.0	7.9	10,686	7½	14	210	105	35,904	2,244,000	5.8	394	197
70	35	42.	1386	19.9	8.0	11,106	8	13	208	104	36,960	2,310,000	5.8	406	203
72	36	42.7	1433	19.9	8.0	11,423	8	13	208	104	38,016	2,376,000	5.7	410	205
74	37	43.3	1472	19.9	8.0	11,740	8	13	208	104	39,072	2,442,000	5.7	422	211
76	38	43.7	1505	19.8	8.0	12,058	8	13	208	104	40,128	2,508,000	5.7	433	216½
78	39	44.4	1544	19.8	8.0	12,375	8	13	208	104	41,184	2,574,000	5.6	437	218½
80	40	45.	1590	19.8	8.0	12,692	8	13	208	104	42,240	2,604,000	5.6	448	224
85	42½	46.2	1674	19.7	8.2	13,750	8½	12	204	102	44,880	2,805,000	5.6	476	238
90	45	47.5	1773	19.7	8.2	14,558	8½	12	204	102	47,520	2,970,000	5.6	504	252
95	47½	48.7	1862	19.6	8.2	15,367	8½	12	204	102	50,160	3,135,000	5.5	522	261
100	50	50.	1963	19.6	8.2	16,176	8½	12	204	102	52,800	3,300,000	5.5	555	277½
105	52½	51.	2043	19.5	8.2	16,995	9	11	198	99	55,440	3,365,000	5.5	577	288½
110	55	52.2	2145	19.5	8.5	18,333	9	11	198	99	58,080	3,630,000	5.5	605	302½
115	57½	53.4	2242	19.5	8.5	19,166	9	11	198	99	60,720	3,795,000	5.5	632	316
120	60	54.7	2340	19.5	8.5	20,000	9	11	198	99	63,360	3,960,000	5.5	660	330
126	63	56.	2463	19.5	8.5	21,000	9	11	198	99	66.528	4,158,000	5.5	693	346½
132	66	57.	2552	19.4	8.5	22,000	9	11	198	99	69,696	4,356,000	5.5	726	363
136	68	58.	2642	19.4	8.6	22,666	9	10¾	197	99	71,808	4,488,000	5.5	748	374
140	70	59.	2734	19.4	8.6	23,503	9	10¾	197	99	73,920	4,620,000	5.5	770	385
145	72½	60.	2827	19.4	8.6	24,413	9	10½	196	98	76,560	4,785,000	5.5	797	398½
151	75½	61.	2922	19.3	8.6	25,424	9.6	10½	196	98	79,728	4,983,000	5.5	830	415
156	78	62.	3019	19.3	8.7	26,265	9.6	10¼	196	98	82,368	5,148,000	5.5	858	429
161	80½	63.	3117	19.3	8.7	27,246	9.6	10¼	195	97½	85,008	5,313,000	5.5	885	442½
166	83	64.	3217	19.3	8.7	28,092	9.6	10	195	97½	87,648	5,478,000	5.5	913	456½
172	86	65.	3318	19.2	8.8	29,258	9.6	9¾	194	97	90,816	5,676,000	5.5	946	473
178	89	66.	3421	19.2	8.8	30,435	10	9¾	193	96½	93,984	5,874,000	5.5	979	489½
189	94½	68.	3632	19.2	8.9	32,484	10	9½	192	96	99,792	6,237,000	5.5	1039	519½
200	100	70.	3848	19.2	8.9	34,555	10	9½	191	95½	105,600	6,600,000	5.5	1100	550
212	106	72.	4071	19.2	9.0	36,821	10	9½	190	95	111,936	6,996,000	5.5	1166	583

This Table is formed from obfervations of a great number of engines of different powers, and making the intermediate fizes to correfpond to the fame law of increafe. Thus, a twenty-horfe engine is always made with a cylinder of 24 inches diameter, which is allowing 22.6 fquare inches of the pifton's furface for each horfe-power; but larger engines have a lefs allowance; an eighty-horfe engine has 19.8 fquare inches to each horfe-power, and fmall engines have a much greater allowance; a ten-horfe engine having $24\frac{1}{2}$, and a one-horfe, 28 fquare inches. This difference is to compenfate for the numerous difadvantages which always attend fmall machines.

The proper length of the ftroke for different engines is not at all fettled. Mr. Watt's firft engines were made much longer than this Table, but of late years they have been made fhorter, and without any adequate reafon which we can perceive; for it muft be an advantage to a machine to make as few reciprocations as is confiftent with a practicable length of cylinder. Thefe differences in the length of ftroke do not affect the calculation of powers, becaufe if the length of the ftroke is altered, the number *per* minute is alfo changed, and the velocity of the pifton is the fame; at leaft it will be always nearly the fame as the Table for thofe engines which work a crank and fly-wheel. But it muft be obferved that thefe engines move with a greater celerity than the engines for pumping water, becaufe it is neceffary to accumulate a confiderable velocity in the fly-wheel, or it muft be immenfely heavy if the pifton was to move fo flowly as the pumping engine generally does.

It is ufual with engine-makers to calculate the velocity of the piftons of engines at 220 feet *per* minute; but we have rarely found them to come up to this in practice, and have therefore calculated them at lefs. In the Table, the preffure upon each fquare inch of the furface of the fteam-pifton is in proportion to the velocities there marked; and if the velocities are found lefs than the Table, as is the cafe with engines for pumping, then the load upon each inch of the pifton muft be increafed in proportion, or elfe the power of the engine will be different, although the cylinder remains the fame.

For inftance, the engine at the Birmingham canal, mentioned in the article STEAM-*Engine*, had a twenty-inch cylinder; and being a fingle engine, fhould, by our Table, be rather more than feven horfes power. How does this agree? The weight raifed *per* hour to one foot high was calculated, in the article STEAM-*Engine*, at 13,961,805 lbs.; which divided by 60 gives 232.697 lbs. *per* minute: divide this by 33,000, the horfe-power, and we have a feven-horfe power; fo far it agrees with the Table. But the preffure on each fquare inch of the pifton was 11.7 lbs., and the Table fays the preffure fhould be 7.1 lbs. This difference is reconciled by the differences of the velocities; for the pifton of the Birmingham engine moved $63\frac{1}{4}$ feet *per* minute, and the velocity in our Table for a fingle engine is 98 feet: now as 11.7 lbs. is to 7.1 lbs., fo is 98 feet to $59\frac{1}{2}$ feet, inftead of $63\frac{1}{4}$; the difference is very fmall, and may be thus accounted for. The Birmingham engine, although feven horfes power, had only a twenty-inch cylinder, yet, according to our Table, it fhould be 20.6; its pifton therefore required to move rather quicker, in order to make an equal produce. Thus, the area of a twenty-inch cylinder is 314 fquare inches; and of a cylinder 20.6 diameter, it is 332 fquare inches: now as 314 fquare inches is to 332 fquare inches, fo is $59\frac{1}{2}$ feet *per* minute to 63 feet *per* minute, inftead of $63\frac{1}{4}$, which the engine actually moved.

The allowance for fuel in this Table is as fmall as it will ever be found to be in actual practice; the confumption of fuel is not in direct proportion to the power of the engine, becaufe fmall engines lofe more heat, and have more friction in proportion than large ones, and the reciprocations of the motion are more frequent. We have taken the effect of the twenty-horfe engine at twenty millions of pounds of water *per* minute, raifed one foot with each bufhel of coals weighing 84 lbs.; this makes the confumption of fuch an engine very near two bufhels *per* hour; an eight-horfe burns one bufhel. We have alfo taken the performance of the engine of 100 horfes at 30 millions, and made all the intermediate fizes by a regular law of increafe; the refult agrees fo well with feveral engines which we have obferved, that we confidered the Table as very correct. The quantities of coal are the fmalleft; fcarcely any engines will do with lefs fuel when they are working with their full load; but many engines will require more. Engines will be conftantly found which are of the dimenfions marked in our Table, and are called fo many horfe-power, although they are working with either a greater or leffer power than the Table expreffes; in fuch cafes, allowance of fuel muft be altered in proportion.

We have now gone through the defcription of thofe machines for raifing water which are actuated by the mechanical force of animals, or water or fteam acting externally by means of levers and other connecting mechanifm; but there are fome machines in which a current or a column of water is made to operate within clofe veffels, and raife water to a confiderable height: thefe are the Chremnitz fountain, the fypho interruptus, and the hydraulic ram. Thefe are moft admirable machines, particularly the laft, becaufe they are fo fimple, and having fcarcely any moving parts, are not liable to decay and injury; and they do not wafte the motive power in unneceffary friction and refiftance.

The original fteam-engines of the marquis of Worcefter and Savery, which are all of this clafs, are fully defcribed under the article STEAM-*Engine*. The wafte of fuel in thefe engines is fo great, that they fall very far below other engines. We have mentioned the engine made by Mr. Kier, which by a calculation will be found to raife only $2\frac{3}{4}$ millions of pounds of water one foot high with each bufhel of coals, and the power of the engine is $2\frac{3}{4}$ horfes. An engine of the fame kind, of five horfes power, which Mr. Smeaton calculated raifed $5\frac{1}{3}$ millions, end this is perhaps the utmoft of this kind of engines. Another engine of $2\frac{3}{4}$ horfe-power, raifed $5\frac{1}{4}$ millions. The beft engine on Newcomen's principle will raife 10 millions; Mr. Watt's 30 millions; and Mr. Woolf's 50 millions. From this ftatement, it is clear that the expence of fuel in Savery's engines is fo great as to counterbalance any advantages arifing from their fimplicity.

The Chremnitz Machine.—In this a column of water, defcending from an elevated refervoir, is made to raife up another column of water from a confiderable depth, and air is introduced as the medium for communicating the preffure of the motive column to that column which is to be raifed. This machine is not a new invention; its principle is fully defcribed in the Italian book, "Le Machine," by Brancas of Rome, 1629. A machine at Chremnitz, in Hungary, is fo celebrated as to have given a name to this invention from its fize, and the moft extraordinary formation of ice and fnow by the working of it, befides that it is the only one of the kind which had been applied to large works. An account was given to the Royal Academy at Paris by their correfpondent M. Jars, which is inferted in their memoirs for the year 1768; and Dr. Wolfe has alfo defcribed it. The machine was executed by father Hell, a profeffor of aftronomy at Vienna, in the year 1755; it is ufed to raife the water in a fhaft named Amalie, in the mines at Schremnitz, or Chremnitz, in Hungary: *fig.* 14. *Plate Water-*

ter-works, is a ſketch of this machine, in which the pipes are not drawn in the proportion of their lengths, but are contracted to the ſpace of the deſign. O is a wooden trough, placed in the middle of the mountain, 143 feet above the place, K, where the water drains off; this water is conveyed from the mines above it, and the fall of the water from this reſervoir works the machine. There is alſo another trough higher up the mountain, *viz.* 260 feet above the place of delivery K, into which rain-water is conveyed for the purpoſe of working the machine with 260 feet fall, when a ſupply can be obtained therefrom; but when this ſupply fails, the machine is worked by the ciſtern O with 143 feet fall. T is an iron-pipe deſcending from the reſervoir, to convey the water to an air-veſſel of copper, A, placed at the foot of the mountain near the place of delivery. The water from the reſervoir O, or from the more elevated reſervoir, flows through the deſcending pipe T, whenever the cock H is opened: the pipe T deſcends very nearly to the bottom of the veſſel A A, as ſhewn by the dotted lines X, with the intention that the air included in the veſſel ſhall be compreſſed when the water enters, and forced through the tube L M into a lower veſſel, B, which is ſimilar to A, but only of half the capacity; it is placed at the bottom of the lower mine, which is to be drained at 104 feet below the delivery K, and veſſel A; this lower veſſel receives the waters collected in this mine from the trough D, through the pipe Q and cock C, and by the force of the compreſſed air introduced into B by the pipe M from the upper veſſel; the water contained in B is expelled through the pipe S, which deſcends to the bottom of the veſſel B, and is diſcharged at F.

The wooden trough D is the termination of a trough or channel from another engine, which raiſes the water from a yet greater depth; K is a pipe with a cock for diſcharging the water out of the veſſel A, when the operation is over, in order to fill it again with air ready to repeat it, for which purpoſe the ſmall pipe I is likewiſe opened to admit air; the cock L tranſmits and diſcharges air from the upper veſſel A into the lower veſſel, through the pipe M. The little pipe E, and its turncock, muſt be opened to let out the air from the veſſel B, and it muſt remain open whilſt B is filling, by the water from the trough D, through the pipe C Q, and it is at the orifice of the little pipe E that ſnow and ice are generated. A valve is placed at the lower ends of the pipe F S, to prevent the water from eſcaping out of the pipe F S, after it has been raiſed, and whilſt the veſſel B is filling with freſh water.

The operation is performed thus: two men are placed at the veſſels A and B to open and ſhut the cocks; ſuppoſe all the cocks ſhut, and the reſervoir O, at 143 feet high, is always full; the pipe T H is alſo full as far as the cock H; the reſervoir D is kept conſtantly full of water from the mine, which is to be drained by raiſing the water from D to F, 104 feet; for this purpoſe, it muſt firſt be admitted into the veſſel B: the cock C is therefore opened, and the water flows into B, the air being at the ſame time ſuffered to eſcape from that veſſel by opening the cock E. The veſſel B is known to be full by the emiſſion of water at E, at which inſtant both the cocks C and E are to be cloſed. The machine is now prepared for the operation, which is began by opening the cocks H and L; the deſcending water from the reſervoir O enters the veſſel A, and compreſſes the included air till its elaſtic force becomes equal to the preſſure of the column of water D F, and then the air deſcends through the pipe M, and enters the lower veſſel B, where it preſſes on the ſurface of the water contained in the veſſel, and forces that water to aſcend through S to F, which opens into the adit, through which the water is diſcharged from the mine. This water being raiſed, the lower veſſel B is become filled with condenſed air in place of the water, and the upper veſſel A is become filled with water in place of the air. The cocks H and L are then ſhut, and K and I are opened; the cock K ſuffers the water contained in A to flow off, and I accelerates the diſcharge, by admitting the external air into the veſſel A; and both theſe cocks are cloſed again as ſoon as the evacuation of the upper veſſel is completed. During this laſt operation another man below opens the cock E, by which the condenſed air included in the veſſel B iſſues with great force through E; he then opens C, and the water from D again fills the veſſel B, as at firſt; this being done, he cloſes C and E.

The apparatus is now charged again ready for action, and by opening H and L the above operation will be repeated; *viz.* the contents of B will be forced up to F, and thus the engine may be kept continually at work as long as the two reſervoirs O at the top, and D at the bottom, are kept ſupplied.

The dimenſions of the principal parts, as given by father Hell, are as follow, in Hungarian meaſure:

The diameter of the upper veſſel A $32\frac{1}{2}$ inches; its height 60 inches; the thickneſs of the copper $1\frac{1}{4}$ inches.

The iron-pipe T is 260 feet; from H, to the moſt elevated reſervoir above O, it is $4\frac{1}{2}$ inches bore; and the thickneſs of the metal is $1\frac{1}{4}$ inches.

The lower reſervoir O 143 feet above H.

The pipe F S, 104 feet long, $3\frac{1}{2}$ inches bore.

The air-pipe L M is formed narrower towards the bottom; at its upper end it is two inches bore, and at its lower end 1 inch; thickneſs of the metal $1\frac{1}{4}$ inches.

The Chremnitz foot is to the Paris foot, as 1538 to 1440; the pound, as 106 to 92. The Paris foot to the Engliſh, as 32 to 30.

A cubic foot of water of the mine weighs 72 lbs.

The upper veſſel A contains $57\frac{1}{2}$ cubic feet, and the lower veſſel B $27\frac{1}{2}$.

Twenty-five cubic feet are raiſed at every operation, and ſometimes $31\frac{1}{2}$ feet, as the water deſcends from the upper or lower reſervoirs at O, the duration of the operation being different; for when the upper ciſtern O is uſed at 260 feet of elevation, 20 or 21 draughts are made in an hour; but when the lower ciſtern is uſed at 143 feet elevation, only 17 or 18 draughts *per* hour.

Each of theſe veſſels is caſt in three pieces, which are joined by flanches and ſcrews, with a ring of lead and another of leather placed between each to ſecure the joint, and prevent the tranſmiſſion of any fluid. M. Jars obſerves that the pipes would have been better if connected by flanches, in the manner ſhewn by the figure; but the real practice is to drive the ends of the pipes into hollow cylinders of dry wood, bound with iron hoops; theſe anſwer tolerably well, and are of conſiderable durability.

The moveable plugs of the cocks, C, E, K, are ſcrewed in their places by caps or covers faſtened down with ſcrews.

The produce of water raiſed by this machine is thus eſtimated by Dr. Wolfe:

If the veſſel A were completely emptied after each operation, the expence of water, when the fall of 260 feet is uſed, would be 1178.25 cubic feet in an hour, deſcending 206 feet; and the effect, or the water raiſed, would be 563.75 cubic feet to a height of 104 feet; or, when the fall of 143 feet is uſed, the expence *per* hour would be 1006.25 cubic feet, and the effect 481.25. But as it is not neceſſary that the veſſel A ſhould be much more than half emptied, the expence of water will be nearly equal to, or will not much exceed the quantity raiſed.

It

It ſhould follow, from experiments on the nature of air, that the column F D is counterpoiſed by the compreſſed air in the inverſe ratio of 104 to 32: hence the volume of air contained in the veſſel A and the pipe L M, equal to $58\frac{1}{2}$ cubic feet, muſt be reduced to 18 cubic feet, before the elaſticity will be equal to the preſſure of the column C F 104 feet; but by increaſing the compreſſion a little more, the water in B will be made to flow out through F.

If, at the moment the veſſel A is full of water, the cock H be ſhut, the water will continue to flow through F, until the air occupies a ſpace of 18 cubic feet in the veſſel B, and in the pipe L M; the elaſticity of the air will then be in equilibrio with the column F D, and the efflux of the water through F will ceaſe. In this manner, not above 17 cubic feet of water are evacuated at each draught, and $10\frac{1}{2}$ cubic feet are conſtantly left in the veſſel B.

But if the cock H is not ſhut the very moment that the veſſel A is full, the water in A will follow the air through L M, and, before it gets to the veſſel B, will raiſe one cubic foot more out of that veſſel. After the water from A enters into the veſſel B, the diſcharge at F will not be the water of B, but the water of A deſcending and aſcending again by a uſeleſs circuit, until H be ſhut; which being done, the water will continue to flow at F, until the remainder of $10\frac{1}{2}$ cubic feet is expelled from B by the air contained in it. The moment when the water from A has deſcended into the lower veſſel B may eaſily be known, by the velocity of the efflux at F becoming ſuddenly three times greater.

That this is actually the caſe is proved, becauſe ſometimes $31\frac{1}{2}$ cubic feet are diſcharged; which quantity exceeds the capacity of the veſſel B by more than 4 cubic feet.

This inconvenience might eaſily have been prevented, by giving to the pipe S a diameter of 18 inches; for then there would have remained only the juſt ſpace of 18 cubic feet for the compreſſed air.

The height of the column T to the loweſt of the two reſervoirs at O is 143 feet, which, taken upon the diameter of the veſſel A as a baſe, is equal to the weight of $822\frac{1}{4}$ cubic feet, and would compreſs the air into a fourth; or, when the water is deſcending into the lower veſſel B, into a ſeventh part of its natural ſpace, provided it were equally reſiſted at F. The veſſel A becomes filled at a mean in 8 ſeconds; and in twice that ſpace of time, 17 cubic feet are evacuated through F.

The power of the column of 260 feet from the moſt elevated reſervoir, acting within the veſſel A, is equivalent to the weight of 1495 cubic feet of water. It can raiſe a greater quantity, if the veſſel B be ſo conſtructed as to allow no more than a juſt ſpace to the compreſſed air. If the veſſel A were filled in 4 ſeconds, then 17 cubic feet of water would be diſcharged through F in twice that time, and the air would be reduced into an eighth, and, during the deſcent of the water of the veſſel A into the lower veſſel B, into an eleventh part of its bulk. But this makes no alteration as to the quantity of the effect; and when water ceaſes to flow out at F, there will always remain $10\frac{1}{2}$ cubic feet of water in the veſſel B.

Two men are required to attend it, but it would be very eaſy to connect the levers of the cocks above and below, ſo as to require only one man to work the whole ſet; and indeed there would be little difficulty in making the machine work itſelf ſafely, without any attendant, except to ſet it off at firſt, or ſtop it when requiſite. The machinery for this purpoſe has been propoſed by Mr. Boſwell. See Nicholſon's Journal, 4to. iv. 117.

From what has been ſaid, it is evident that this machine, though it anſwers the author's intention, is ſo deficient as to the effect the ſame fall of water might produce, as to bear ſcarce any proportion; and there is a defect in the principle of the machine, *viz.* that the air will require a conſiderable ſhare of the power to compreſs it, and this air muſt be ſuffered to eſcape, before the veſſels can be refilled to repeat the action; in conſequence, all the power taken to compreſs the air is loſt, and expands itſelf in forcing out a ſtrong blaſt of air at the diſcharging cock, without producing any uſeful effect. Notwithſtanding this defect, the cheapneſs and eaſe of conſtruction, and the little wear and tear, together with the facility with which it may be made to work and ſtop for very ſhort periods of time, are powerful recommendations of this machine, in ſuch places as afford the requiſite fall of ſuperior water, and do not require a higher ſingle lift than 15 or 20 fathoms.

A curious phenomenon has been obſerved in this machine, when it is near the end of its operation, that is, when nearly the whole of the water has been raiſed out of the lower veſſel B, and the cock E be opened to give vent to the compreſſed air, and before the cock L is ſhut, ſo that the air is followed up by the water, then if a hat or miner's bonnet be preſented to the aperture E, the aqueous vapours diſperſed through the compreſſed air, and perhaps alſo, ſays M. Jars, part of thoſe of the external air are condenſed in the bonnet in the form of very white and compact ice, very much reſembling hail, and not eaſily ſeparated from the bonnet. It ſoon melts, which is not to be wondered at, as the temperature of the place itſelf is not cold. Meſſrs. Du Hamel and Jars remained in Hungary from January to July 1758, and obſerved the ſame phenomenon at all ſeaſons; but as they had no thermometer, they could not make a number of experiments, which might have been of value in the inveſtigation of the ſubject.

It is obſerved that the air iſſues out with ſuch impetuoſity, that the workman could not hold the bonnet at the diſtance of a few inches from the aperture, as he does in this experiment, if he were not ſupported behind. The ice is much more compact, if the cock be only in part opened.

When the cock at which the air is diſcharged is opened, it ruſhes out with prodigious violence, and the drops of water are changed into hail or lumps of ice. It is a ſight uſually ſhewn to ſtrangers, who are deſired to hold their hats, to receive the blaſts of air: the ice comes out with ſuch violence as frequently to pierce the hat like a piſtol bullet. This rapid congelation is a remarkable inſtance of the general fact, that air, by ſuddenly expanding, generates cold; its capacity for heat being increaſed.

The formation of the ice and ſnow, when the condenſed air ruſhes out of this machine, has been explained in a different way in almoſt every ſyſtem of philoſophy. It appears to us to be a neceſſary conſequence of the condenſed air, on ruſhing out into the open air.

The air of the atmoſphere, and the water when taken into the machine, are nearly of the ſame temperature; and it may be conſidered that each cubic foot of water and of air contains ſome certain quantity of heat or caloric; but they will readily impart a portion of this heat to any body containing a leſs degree than themſelves, or they will abſorb or take up heat from any body containing a greater proportion of heat than themſelves, in conſequence of that property of heat, by which it will diſtribute itſelf equally among all bodies which are in contact with each other. By the action of the machine, the air is compreſſed into one-third of the ſpace it before occupied, and the ſhare of heat contained in that air is likewiſe concentrated or thrown into a third of the ſpace, and in conſequence becomes more intenſe. Some part of the

the heat will, therefore, be communicated to the ſurrounding water, until the heat diſtributes itſelf again between the water and the condenſed air, ſo that they come to the ſame temperature. In this ſtate, if the air is ſuffered to ruſh out of the veſſel, it will ſuddenly expand and recover its former volume, and it muſt alſo recover its former ſhare of caloric, which it can only do by abſtracting heat from the ſurrounding air, or from any ſubſtance with which it comes in contact: hence the coldneſs of the blaſt of air. In reſpect to the formation of ſnow and ice, it muſt be conſidered that the air of damp places always contains a conſiderable portion of water in a ſtate of vapour, and the air in this machine will have taken up more than the ordinary ſhare, in conſequence of being in contact with the water. When the air expands itſelf, the heat being ſuddenly abſtracted from this watery vapour, it becomes fluid, and accumulates in drops like rain; which drops, by a farther abſtraction of heat, become ſolid like ſnow or hail.

An inſtrument which is in common uſe to produce fire, by the ſudden compreſſion of air, ſhews the reverſe of this action: it is a ſyringe fitted with a piſton, which is air-tight; at the bottom of the barrel a ſmall piece of tinder is placed. Now, if the piſton is very violently and ſuddenly forced down to the bottom of the barrel, and the piſton is then withdrawn, the tinder will be found on fire. The heat contained in the air which fills the barrel is ſo concentrated at the ſame time with the air, as to produce actual fire. If the piſton is forced ſlowly down, the air will be condenſed to an equal degree, but no fire will be produced, becauſe the heat has time to eſcape through the metal of the barrel, before it arrives at any conſiderable degree of concentration. We conſider that in all caſes when air (and perhaps other elaſtic fluids) is compreſſed into a ſmaller ſpace, part of the heat it before contained will be given out to the ſurrounding matter; or if it is ſuffered to expand to fill a larger ſpace, it will abſorb or take up heat from the ſurrounding matter.

A larger Machine at Chremnitz.—This does not differ from the original machine, ſo as to require a minute deſcription; but as this machine is not employed in England, and we think it might be uſeful in many caſes in mining diſtricts, we ſhall give the proportions and calculations of a larger machine, as a model for engineers.

	Feet.
Height of the ſource above the place of delivery or fall of water, which is to work the machine: deſcending pipe 4 inches bore	136
Depth from which the water is to be raiſed out of the pit to the place of delivery: aſcending pipe 4 inches bore	96

	Cubic Feet.
Upper veſſel a copper cylinder 5 feet diameter, and 8½ feet high; metal 2 inches thick; the deſcending pipe goes to within 4 inches of the bottom: contents	170
The lower veſſel a braſs cylinder 4 feet diameter, and 6½ feet high; metal 2 inches thick; the aſcending-pipe goes within 3 inches of the bottom: capacity	83
Air-pipe which communicates between the two veſſels, 2 inches bore, and 96 feet in length	

To underſtand the action of this machine clearly:—Suppoſe that the lower cylinder is charged with water, and the upper cylinder with air ready for action; when the water from the ſource is admitted into the upper cylinder, if no iſſue was given to the contained air, the water would enter into the veſſel, until the air was compreſſed into one-fifth of its bulk by the column of 136 feet high; for a column of 34 feet nearly balances the ordinary elaſticity of the air. But when there is an iſſue given to the air through the air-pipe, it will drive the compreſſed air along this pipe, and it will expel water from the lower cylinder.

When all the air is expelled from the upper cylinder, there will be 34 cubic feet of water expelled from the lower cylinder. Now if the aſcending pipe had been carried up more than 136 feet above the lower level, inſtead of 96 feet, then the water would have riſen 136 feet high in that pipe, by the intervention of the elaſtic air, before it was in equilibrio with the water in the deſcending pipe; but no more water would have been expelled from the lower cylinder than what would fill this pipe.

But the aſcending pipe being only 96 feet high, the water will be thrown out at the top of it with a conſiderable velocity. Were it not for the great obſtructions which the water and air muſt meet with in their paſſage along the pipes, it would iſſue from the mouth of the aſcending pipe with a velocity of more than 50 feet *per* ſecond. It iſſues, however, much more ſlowly.

When the upper cylinder is become filled with water, the ſupply is ſtopped; but the lower cylinder ſtill contains 34 cubic feet of compreſſed air of ſufficient elaſticity to balance the water in a diſcharging-pipe 136 feet high, whereas the aſcending-pipe is only 96 feet. Therefore the water will continue to flow at the mouth of the aſcending-pipe till the compreſſed air is ſo far expanded as to balance only 96 feet of water, that is, until it occupies one-fourth of its ordinary bulk, or one-fourth of the capacity of the upper cylinder, *viz.* 42½ cubic feet. Therefore 42½ cubic feet of water will be expelled, and then the efflux will ceaſe, leaving the lower cylinder about one-half full of water.

When the diſcharging-cock of the upper veſſel is opened the water iſſues with great violence, being preſſed by the condenſed air returning from the lower cylinder. It therefore iſſues with the ſum of its own weight, and of this compreſſion. Theſe gradually decreaſe together, by the efflux of the water and the expanſion of the air; and this efflux ſtops before all the water in the upper veſſel has flowed out, becauſe there are only 42½ feet of the lower cylinder occupied by air. This quantity of water nearly will therefore remain in the upper cylinder. The workman knows this, becauſe the diſcharged water from the upper veſſel is received firſt of all into a veſſel containing three-fourths of the capacity of the upper cylinder, which ſerves as a meaſure; when this is filled, the attendant opens the cock which admits the water into the lower veſſel, by a long rod which goes down the ſhaft: this allows the water of the mine to fill the lower cylinder, and the air returns into the upper cylinder through the air-pipe, and permits the remaining water to run out of it; and when the attendant finds no more water will come out, every thing is brought to its firſt condition.

The above account of the procedure in working this engine, ſhews that the efflux at the mouth of the aſcending-pipe becomes very ſlow near the end. On this account, it is found convenient not to wait for the complete diſcharge, but to cut off the ſupply when about 30 cubic feet of water have been diſcharged, and more work is done in this way.

A gentleman of great accuracy and knowledge of theſe ſubjects, took the trouble of noticing particularly the performance of the machine. He obſerved that each ſtroke, as it may be called, took up about three minutes and one-eighth, and that 32 cubic feet of water were diſcharged, and 66 cubic feet were expended.

The expence therefore is 66 cubic feet of water falling

136

136 feet, and the performance is 32 cubic feet raifed 96 feet, and they are in the proportion of 66×136 to 32×96, *viz.* 8976 to 3072, that is the power employed is to the effect produced, as 2.9 to 1. The quantity raifed, *viz.* 32 cubic feet, divided by the time $3\frac{1}{8}$ minutes, gives very nearly 10 cubic feet *per* minute, and multiplied by the height raifed 96 feet = 960 cubic feet raifed 1 foot high. Divide this by 528 cubic feet, which is the horfe-power, and it gives 1.8. The machine is not therefore equal in effective power to a fteam-engine of two-horfe power, but the power employed is juft equal to five-horfe power.

When we confider the great obftruction which water meets with in its paffage through long pipes, we find we may gain fome advantage by increafing the bore of the defcending-pipe of fupply. The quantity of water which defcends through this is 66 cubic feet in $3\frac{1}{4}$ minutes, or very nearly 30 cubic feet *per* minute; the area of the four-inch bore is 12.5 fquare inches, and therefore 11.5 fuch areas would make a fquare foot. Multiply 30 cubic feet by 11.5, and we have 345 feet, which is the velocity with which the water muft defcend in the pipe. This is much too great, and it would be an improvement if the pipe was increafed to fix inches bore, and the velocity would then be only 151 feet *per* minute. The performance of the machine would then be greatly increafed, we think as much as one-third; it is true that it would expend more water, but not in the fame proportion; for part of the deficiency of this machine arifes from the needlefs velocity of the water in the pipe, as well as from the violent efflux of the water by the condenfed air, as we have before mentioned.

The difcharging-pipe ought to be 110 feet high inftead of 96, and would not give fenfibly lefs water. It muft be confidered if the original expence of this fimple machine would not be lefs than a water-mill which would raife 10 cubic feet of water, 96 feet high, in a minute; the repairs of it would be fmall when compared with a mill. And, laftly, let it be noticed, that fuch a machine can be ufed where no mill whatever can be put in motion.

A fmall ftream of water, which would not move any kind of wheel, will raife one-third of its own quantity to the fame height, working as faft as it is fupplied.

From its fimplicity, we think the HUNGARIAN *Machine* (which fee) eminently deferves the attention of mathematicians and engineers, to bring it to its utmoft perfection, and into general ufe. There are many fituations where this kind of machine may be very ufeful. Thus where the tide rifes 17 feet, it may be ufed for compreffing air into feven-eighths of its bulk, and a pipe leading from a very large veffel inverted in the tide-water may be ufed for raifing water from another veffel of one-eighth of its capacity, 15 feet high; or if this veffel has only one-tenth of the capacity of the larger one fet in the tide-way, two pipes may be led from it, one into the fmall veffel, and the other into an equal veffel, 16 feet higher, which receives the water from the firft. Thus one-fixteenth of the water may be raifed 34 feet, and a fmaller quantity to a ftill greater height, and this with a kind of power that can hardly be applied any other way.

Sipho Interruptus to raife Water by Suction.—This machine is the reverfe of the Chremnitz machine in its action, for the power of a defcending column of water, running out of a clofe veffel, caufes a vacuum therein; and another column of water is fucked up into the veffel, or rather forced up by the preffure of the atmofphere to fill the vacuous fpace. This machine is fully defcribed by Leopold, in his Theatrum Machinarum Hydraulicarum, vol. i. It is provided with apparatus to open and fhut the cocks. It would be difficult to explain this machine without feveral figures, and we have therefore preferred to defcribe a machine of the fame kind invented by Mr. Goodwin; he calls it a machine that will raife a body of water to any height not exceeding the height of that column which will counterbalance the preffure of the atmofphere, (fay 30 feet) and acts by the defcent of part of the fame body of water through a fomewhat greater height, aided by the preffure of the atmofphere.

Let A, *fig.* 10, *Plate Water-works*, be a fpherical veffel of copper or other metal, about 18 inches diameter; B, another fphere, about two feet fix inches in diameter; C, a refervoir kept conftantly fupplied with water, part of which is to be raifed up to E, by the power of another part defcending to a confiderable depth beneath the refervoir C. D is a glafs cap, about fix inches long, fixed on the top of the upper veffel A, for the purpofe of feeing when the water begins to fill and has filled it; E is the upper refervoir into which the water of the refervoir C is to be elevated, and the contents of the upper veffel A is to be emptied; 1 is a pipe about half an inch in diameter, joined into the top of the lower veffel B, and rifing upwards to within about an inch of the top of the glafs cap D of the upper veffel; 2 is a pipe of the fame diameter, and a few feet longer than 1, 1, joined to the bottom of the lower veffel B, and defcending downwards in a perpendicular or inclined direction, to a rather greater diftance beneath C than the upper veffel A is elevated above C; 3 is a pipe one inch and a half in diameter, joined to the bottom of the upper veffel A, and paffing upwards through the bottom to within two inches of the top of the glafs cap D; 4, 4, is a pipe of about half an inch diameter, joined to the top of the veffel B, it paffes through the bottom of the refervoir C, and rifes above the furface of the water therein; 5 is a pipe of the fame diameter, fixed to the top of the veffel B, and terminating in and fixed to the bottom of the refervoir C; *a* is a pipe or fpout of the fame diameter, fixed into the bottom of the upper veffel A, to convey the water into the refervoir E; 7 is a trumpet mouth-pipe fixed to the bottom of the pipe 3, and extending downwards beneath the water to within about an inch of the bottom of the refervoir C; *a*, *b*, *c*, and *d*, are cocks fixed to the pipes. The veffels, pipes, cocks, and joints, muft all be air-tight.

In order to raife water from the lower refervoir C into the upper refervoir E, all the cocks being fhut proceed thus: open the cocks *b* and *c*, in order to fill the lower veffel B, and when B is filled, fhut the cocks *b* and *c*, and open the cock *d*. The water will then begin to run from the fphere B by its gravity, and by means of its communication with the upper fphere A, through the pipe 1, will draw off the air therefrom to fupply the fpace left in the lower veffel B, by the running out of the water the air in A is thus rarefied. The atmofpheric air at the fame time preffing on the water in the refervoir C, will caufe it to rife through the trumpet-mouth 7 of the pipe 3, and by falling over the top of the pipe 3 at D, it will fill the upper fphere A. When A is full, which may be feen through the glafs cap D, fhut the cock *d*, and open the three cocks *a*, *b*, and *c*, the cock and pipe *b* will allow the atmofpheric air to return into the veffel, and fill both with air, by which means the water contained in the veffel A will run into the elevated refervoir E, and B will be replenifhed for another operation. Then fhut the cocks *a*, *b*, and *c*, and open the cock *d*, and it will repeat the operation of raifing the water into A.

If it be required to raife any body of water from refervoir C into refervoir E, by means of the defcent of a body of fome other water from the veffel B, a communication muft be made into B, independently of the pipe 5, and

 cock

cock *c*; *viz.* through a pipe-cock leading from another refervoir, as is reprefented by the dotted lines communicating with B near the pipe and cock 5; the action is the fame as before; but the cock with the dotted lines is to be ufed in lieu of pipe 5, and cock *c*. By this means, if the water which is employed to work the machine is foul or tainted, it will have no communication with the water which it raifes. This machine has the fame defect as the Chremnitz machine; *viz.* that the power which is expanded in rarefying the air is greater than the quantity of water raifed, and the difference is loft when the cock in the lower veffel is opened, and the air rufhes in.

A different Form of the Siphon Machine.—Mr. Goodwin's engine is formed upon a very elegant principle, and operates by the affiftance of only a fmall quantity of water. It may be made in various forms, either to raife the fluid above the defcending column, or from below it to a level with the bottom, and the height may be doubled or trebled by proportionally increafing the defcending mafs, and raifing feveral columns of water from different elevations at the fame time, by combining two or more of the fimple machines together, as is fhewn in *fig.* 8. *Plate Water-works.*

C, as in the former figure, reprefents the refervoir or fource of water which is to work the machine; B reprefents the loweft of the two veffels which contain the rifing and defcending bodies of water; and the fmall fquare near *fig.* 8. reprefents the upper veffel A, *fig.* 10. Thefe veffels are fpherical in the original drawing, but to leffen the lofs of fpace in defcent, they are here made flat and cylindrical; E is the higher ciftern of the original figure, into which the water is to be raifed; 2, 3, and 4, are the pipes arranged in the fame manner as the former machine; F, a veffel the fame as A, with tubes 3 and 6: it communicates with the veffel B by a pipe, and is intended to raife water out of the ciftern E into a higher and additional ciftern G.

The veffels E, F, and G, form a fecond machine, which has the fame parts and properties as the former, except that the lower veffel B is common to both, and ferves as the lower veffel to exhauft and drive up the water both to A and to F; 2 is an enlarged tube like the original drawing, through which the water defcends to produce the action; 5 is a hole in the top of B, inftead of a tube. This hole, and the tubes 2, 4, and 6, muft be provided with valves inftead of cocks, which muft be kept clofe by weights or fprings, (while the water is rifing) except the valve to tube 2, which muft be open. The tubes 3, 3, may alfo have valves to fupport the raifed columns.

Operation.—Fill the cifterns C and E with water, and let the lower ciftern be conftantly fupplied; open the valves of the tubes 4, 5, 6, 6, and clofe the valve of the defcending-tube 2, the veffel B then becomes filled through the hole 5. Now clofe the valves of the tubes 4, 5, and 6, and open the valve of the tube 2, the water will then begin to defcend out of B, and will exhauft the air from A and F, juft as in the firft-mentioned machine; the preffure of the atmofphere on the furface of the water C, will raife one body of water out of C into A, and out of E into F; when B is nearly empty, or when A and F are full, open the tubes 4, 5, 6, 6, and clofe 2, then B will be filled a fecond time, and the veffels A and F will empty themfelves into their refpective cifterns E and G: thus the reciprocations continue without interruption.

Another body of water may be raifed out of G into a higher ciftern by additional apparatus, and by proportionally increafing the dimenfions of the veffel B and the tube 2. The dotted lines reprefent the apparatus for raifing water below the bottom of the tube 2, to be ufed inftead of thofe above the ciftern C.

This arrangement of the engine is of great utility in many cafes; and in fituations where this machine can be erected, it may be of confiderable ufe for raifing water out of mines for draining pieces of land, or elevating the water employed in domeftic purpofes.

Comparifon of different Preffure-Engines.—In Mr. Nicholfon's Journal, 8vo. vol. i. Mr. Bofwell has given a plan for conftructing Mr. Goodwin's engine on a large fcale, to operate without attendance of any perfon, to open and fhut the cocks, and another method of caufing the Chremnitz machine to raife water above the level of the prime refervoir; and he makes the following comparative view of the advantages of both kinds of engines and their powers.

It will be found that the powers and capabilities of thefe machines are nearly fimilar. 1ft, In both the greater the height of the original fall of water from the fource to the difcharge, and the greater the quantity of water which it can fupply in a given time, the greater quantity can be raifed by either of thefe engines in a given time. 2dly, Both engines can be conftructed fo as to raife water above the original level, and from below, to the furface, or from a pit. 3dly, By a fucceffive number of refervoirs, both engines can be brought to raife water to any height, but as they will raife a fmaller quantity as the height is increafed, the quantity wanted in a given time, and the expence of conftruction, will limit the extent of their elevation. 4thly, In both engines the diftance of one refervoir from another muft always be lefs than that of the original fall: the circumftances in which thefe engines differ arife from the difference in their manner of action. 5thly, The Chremnitz engine operates by caufing a fall of water to comprefs the air, which reacting on other water, forces it to rife in a pipe to a certain height. The fyphon engine acts by caufing a fall of water to rarefy a certain quantity of air, in whofe fpace the preffure of the atmofphere forces a quantity of water when permitted. 6thly, Hence in the Chremnitz engine the preffure acting from within outwards tends to burft the veffels ufed in the ftructure, and to open and extend any fiffures which may chance to be in them. 7thly, In the fyphon engine, the preffure acting from without inwards, clofes all the parts of which it is compofed more together. 8thly, The Chremnitz engine will always raife water of a height nearly equal to that of the original fall from one refervoir to another, fuppofing the original fall of any height whatfoever as 100 feet. The fyphon engine will not raife water by one refervoir fo high as thirty feet in any cafe whatfoever, as there cannot be a complete vacuum formed by it in the air-chamber, but only an approximation to one.

From this comparifon, it will follow that wherever the original fall of water is lefs than thirty-two feet, the fyphon engine will be much preferable to the Chremnitz, as from the feventh article of the comparifon it may be made of the cheapeft materials, fuch as ftrong wooden cafks and wooden pipes, whereas the Chremnitz engine from the fixth article muft be made of the ftrongeft, and of courfe the moft coftly materials, as metal, and that of confiderable thicknefs; but wherever the original fall exceeds the height of thirty feet confiderably, and it is required to raife the water to nearly the fame height, then the Chremnitz engine appears to be preferable, as, in all probability, the fewer number of parts which it will require in this cafe will more than compenfate for its coft in materials.

When it is required to raife water to a height much greater than that of the original fall above the firft level, or from a greater depth, either from the original fall being fhort, or the

the required height being great, it is better to employ an engine in which the preſſure of the water is made to act by a piſton in an apparatus ſimilar to that of a ſteam-engine. (See our article PRESSURE *Engine.*) When neither the ſyphon engine nor the Chremnitz can be uſed without a number of reſervoirs, then the piſton preſſure-engine ought to be preferred, but this will much depend on the number of reſervoirs; for perhaps one or two in addition to the Chremnitz might coſt leſs than boring the cylinder of the piſton-engine perfect, and conſtructing its additional machinery. For merely raiſing water the powers of each are nearly equal, depending entirely on the height of the original fall of water.

It would be a great advantage of the piſton-preſſure engine if a fall of water could be applied to it without any waſte, to work mills or machinery for any purpoſe; this would be of very great conſequence when the fall of water is of conſiderable height, and the ſtream or ſupply ſmall. We have mentioned the advantage in this engine to have its action made elaſtic, by the addition of an air-chamber, on the ſame principle as that uſed in engines for extinguiſhing conflagrations. Mr. Boſwell ſuggeſts that this might be effected by making the piſton hollow, and of a larger ſize, to contain air for this purpoſe, as the air's elaſticity would then act both on the upper and lower preſſure of the water.

Machine for raiſing Water by the lateral Communication, from the Motion of a Stream of Water running through a conical Tube.—This machine operates by ſuction, or more properly by the preſſure of the atmoſphere, and is in ſome reſpects ſimilar to the ſyphon machine. (See *fig.* 9. *Plate Water-works.*) A A repreſents a reſervoir of water kept conſtantly full, at the ſame time that the conical ſpout, B, is running full under a conſiderable preſſure; D, a ſpherical copper veſſel, with a tube, C, joined into its bottom, and riſing up within to ſome height above the centre of the ſphere; E, another tube joined to the bottom of the ſphere D, and terminating near its top; the lower part of this tube is bent, and the extremity of it is introduced into the ſmaller apertures of the conical tube B; F, a ſpout or tube to empty the veſſel D, when it is filled with water which has been raiſed up out of the reſervoir A; G, a ſmall tube paſſing through the ſpout F, and riſing to near the top of the ſphere, D, for the admiſſion of air to quicken the deſcent of water out of that veſſel. Both theſe tubes are cloſed at their lower ends by a leather valve at the end of the lever L, which lever is fixed upon the turning plug of a cock in the tube E, and has a weight upon one end, in order that the other end may bear the valve up againſt the openings of the tubes F, G, with a conſiderable force, and alſo to ſupport the weight of the ſmall bucket I, which is ſuſpended from the lever by a wire (at leaſt when the bucket is empty); H is a ſmall ciſtern to be filled with water from the reſervoir A, in the ſame time that the water is raiſed up into D; this muſt be done by regulating the cock, *k*, upon the pipe which ſupplies the ciſtern with water. The ciſtern H is provided with a ſyphon, which will begin running as ſoon as the veſſel is full of water, and will ſoon empty it. The ſmall bucket I, which is ſuſpended from the lever L, is alſo furniſhed with a ſyphon-tube, which will begin to run and empty the bucket whenever it is quite full, but not before.

The operation of the engine will be as follows:—The reſervoir A being kept conſtantly full of water, and the conical tube B completely filled at its wider end by the water which runs out of A, the force of the lateral motion of the fluid will be increaſed by the conical form of the tube B, and will act upon the end of the tube E to draw air out of the ſame, ſo as to rarefy the air in the veſſel D; and the preſſure of the atmoſphere upon the ſurface of the water in the reſervoir A, will cauſe part of that water to riſe up the pipe C, to run over its top and fill the ſphere D; it will then deſcend through E, and join the ſtream of water which flows out at B. When the veſſel D is full of water, if the valve at the ſpout F is opened, the water will run out.

In order to open the valve the cock *k* is regulated, that the ciſtern H will be filled ſoon after D is full, and the ſyphon of this ciſtern beginning to empty the water it fills the bucket I, which then overbalances the weight upon the lever L, and opens the ſpout F, and air-pipe G, and at the ſame time cloſes the cock in E; the column of water in the deſcending pipe C immediately deſcends into the reſervoir, and if the ſmall tube G be full of water it will be emptied by the deſcent of that column, and will admit air into D ſo as to allow the water to flow out at F into the elevated reſervoir. The ſyphon in the ciſtern H is regulated ſo that the ciſtern and the veſſel D will be empty of water about the ſame time, and the bucket I by its ſyphon will become empty ſoon after: the weight upon the lever L will then cloſe the ſpout F, and open the paſſage through E, when all the parts will ſtand as at firſt ready for a repetition of the operation of the lateral action of the ſtream, by which the water is raiſed up into D as before.

If the water ſhould deſcend through E before F and G are opened, it will render the cock in E more tight. To quicken the reciprocation of the engine, and increaſe the quantity of raiſed water, a valve may be made to ſupport the column of water in the ſuction-pipe; this valve may be placed in a cheſt at the bottom of the pipe.

The deſcending branch of the ſyphon in the higher veſſel H ſhould be made of conſiderable length, to prevent a conſtant dripping, and make the reciprocation end at once; the ſyphon of the bucket I ſhould fall as large in bore as the other, in order that the weight on L may preponderate quickly, and cloſe the valve immediately.

The inventor entertains no doubt reſpecting the operation of a machine of this kind, and that a column of water may be raiſed to any height not exceeding thirty feet by proportionally increaſing the preſſure of water in the reſervoir, and the dimenſions of the conical tube.

In many ſituations, however, the requiſite quantity of water for this purpoſe cannot be had, and others may not admit of ſufficient deſcent.

Where the ſtream has a conſiderable deſcent, the water may be raiſed by a number of lifts inſtead of one, by combining as many machines. Suppoſe three reſervoirs each with its conical tube or ſpout through which the water runs from one to the other; alſo three exhauſting veſſels each with its elevated ciſtern into which the raiſed water is to be delivered; and the ſuction-pipe of each veſſel draws its water from the elevated ciſtern of the veſſel below it. From each exhauſting veſſel a pipe is conveyed to the conical ſpout of one of the three reſervoirs, and the lateral motion of the ſtream paſſing through the ſpouts of the three reſervoirs will act upon all three engines at once.

In like manner, when there is plenty of water, but not convenience for a deep reſervoir, ſeveral conical ſpouts may be fixed to different parts of the reſervoir, and all upon the ſame level. Each machine muſt be provided with a lever and weight to work its own valves, but they may be all opened at the ſame time by the deſcent of one veſſel connected with all the levers, or each may have its reſpective bucket and ſyphons.

This kind of machinery, by altering the poſition of the rarefying tubes, may be made to raiſe water from a depth below the ſtream equally as well as to a height above it; and

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in fituations where there is plenty of water and convenience for a refervoir a lower body of water may be conveyed into a ftream above by the help of a fingle tube, one end of which is placed in the water to be raifed, and the other muft be introduced into the fmaller aperture of the conical tube adapted to the refervoir; a conftant ftream will then rife, fo long as water below can fupply the tube.

Mr. Whitehurft's Machine for raifing Water by its Momentum.—Fig. 7, Plate Water-works, is a reprefentation of the firft machine on this principle, which was executed in the year 1772, by the ingenious Mr. John Whitehurft, at Oulton in Chefhire, at the feat of Mr. Egerton, for the fervice of a brew-houfe and other offices, and which purpofe it was found to anfwer effectually. This firft form of the momentum machine would be a ufeful application in many fimilar fituations. The circumftances attending this waterwork are as follow: A reprefents the fpring, or original refervoir, which fupplies the water, the upper furface coincides with the horizontal line B C, and the bottom of the refervoir K, into which the water is to be raifed; D is the mainpipe, one inch and a half in diameter, and nearly two hundred yards in length; E, a branch-pipe, of the fame dimenfions, for the fervice of the kitchen-offices. It is to be obferved, that the kitchen-offices are fituated at leaft eighteen or twenty feet below the furface of the refervoir A; and that the cock F is about fixteen feet below it. G reprefents a valve-box, and g the valve within it; H is an air-veffel, and O, O, are the two ends of the main-pipe, inferted into the air-veffel H, and bending downwards, fo that in effect the pipes communicate with the loweft part of the veffel, and the air cannot efcape when the water is forced into it, but it muft be compreffed by the column of water; W is the furface of the water in the air-veffel. It is well known from theory that, when water is difcharged from an aperture, under a preffure of fixteen feet perpendicular height, it will move at the rate of thirty-two feet in a fecond; the velocity of the water from the cock F will be nearly as much, making fome allowance for friction and refiftance; and although the aperture of the cock F is not equal to the diameter of the pipe D, yet the velocity of the water contained in the pipe will be very confiderable; confequently when the cock is opened a column of water two hundred yards in length is put into motion, and if it is fuddenly ftopped by the fhutting-cock F, its momentous force will open the valve g, and condenfe the air in veffel H; this action will be repeated as often as water is drawn from F. It is needlefs to fay in what degree the air is thus condenfed in the inftance before us; but it will be fufficient to obferve, that it was fo much condenfed as to force the water up into the refervoir K, and even to burft the veffel H, in a few months after it was firft conftructed, although it was apparently very firm, being made of fheet-lead, about nine or ten pounds weight to a fquare foot. Whence it is reafonable to infer that the momentous force is much fuperior to the fimple preffure of the column in the refervoir K, above the level line C B, and therefore equal to a greater refiftance (if required) than a preffure of four or five feet perpendicular height. It may be neceffary farther to obferve, that the confumption of the water in the kitchen-offices is very confiderable, becaufe water is frequently drawing from morning till night all the days of the year.

From this account which is publifhed in the Philofophical Tranfactions for 1775, it is clear that Mr. Whitehurft was fully aware of the power of the momentum of running water, and though he applied it only to raife water to a fmall height, he knew it might be carried to a greater extent.

Montgolfier's Hydraulic Ram.—We have given the account of Mr. Whitehurft's machine, becaufe it fhews the firft origin of a moft valuable invention, which was afterwards practifed in France by M. Montgolfier, the inventor of the firft balloon with heated air. Mr. Boulton took a patent in England for Montgolfier's machine in 1797; he afterwards called his machine *belier hydraulique*, that is, hydraulic ram, becaufe of the fhock which the water makes when its motion is fuddenly ftopped. In his publication in the Journal des Mines, vol. xiii. he fays, "This invention is not originally from England, but belongs entirely to France; I declare that I am the fole inventor, and that the idea was not furnifhed to me by any perfon. It is true that one of my friends, with my confent, fent to Meffrs. Watt and Boulton copies of feveral drawings of this machine with a detailed memoir on its applications. Thefe are faithfully copied in the patent taken out by Mr. Boulton in England, dated December 13, 1797, as that gentleman has avowed." We do not wifh to detract from the merit of M. Montgolfier, as we believe that Whitehurft's machine was unknown to him, but we muft ftate the hydraulic ram an Englifh invention. To have an idea of this invention, it is proper to ftate its phyfical principle of action, which is as follows.

When water is running with a rapid current through a pipe or clofe channel, if the end at which the water iffues be fuddenly ftopped, the water (by its acquired motion, momentum, or impetus,) will act upon the fides or circumference of the pipe, and endeavour to efcape with a force proportioned to its quantity and velocity. If the materials of the pipe are ftrong enough to refift that impetus, the water may be made to iffue with violence and velocity, at any aperture which is opened in or near the clofe end of the pipe; therefore if an afcending pipe be joined to that aperture, a portion of water will afcend in it. The machine being provided with proper valves, to prevent the return of the water fo elevated, the operation may be repeated in a conftant fucceffion, and will form a kind of perpetual pump.

The fame effect will be produced by a different arrangement of this apparatus, *viz.* a pipe open at both ends, with a valve and afcending-pipe, fuch has as been defcribed. Let this be fo attached to fome kind of machinery, that it can be fwiftly moved along, in the direction of its length, through ftanding water; then, upon clofing the hinder part of the pipe fuddenly, a portion of water will be forced up in the afcending-pipe, in the fame manner as in the former cafe, and for the fame reafon, becaufe the water will be relatively in motion with refpect to the pipe.

The fame principle may be readily extended to raife water by fuction from a lower level than that on which the machine is placed, and this by either of the means abovementioned. Suppofe a fuction-pipe, which communicates with water at a lower level, be joined to the main-pipe through which the water flows, and that the junction is near that end of the pipe where the water enters into it. Suppofe alfo that the water has acquired a rapid motion through the pipe, either by the current of water running through the pipe, or by the pipe moving through the water; then let the mouth or end at which the water enters be fuddenly fhut by the machinery, and the water by its momentum will continue its motion relatively to the pipe, and will tend to exhauft the content of the pipe. This action will draw or fuck up water through the afcending-pipe from the lower level, fo as to fill up the vacuity in the main-pipe, occafioned when the water therein perfeveres in its previous motion.

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The firft aud moft fimple hydraulic ram is fhewn in fection at *fig*. 4. (*Plate Water-works*); here C C reprefents the main-pipe, or body of the ram, through which the ftream of current water is conducted; D, the afcending-pipe provided with a valve of exit at A, to allow the paffage of the water which is raifed, but to prevent its return; B is a ftop-valve to clofe the end of the main-pipe; E is a balance-weight fixed upon the lever G, which communicates with another, K, attached to the axis of the ftop-valve B; this weight tends to open the valve at the proper time. The main-pipe is to be fituated in a current or ftream of water, either produced by the natural current or declivity of a river or other ftream, or by penning up the water by a dam or weir, and inferting the end of the main-pipe through the dam, fo as to obtain the greateft fall of water which the natural circumftances will admit of. To put the machine in action, let the ftop-valve be opened to the pofition fhewn in the figure, the water will run through the main-pipe C, until it acquires a certain velocity which will be proportioned to the height of the fall of water which produces the current of water. The action of the current upon the ftop-valve B, in its reclined pofition, will increafe until it is fufficient to overcome the weight E, and then it will fhut the ftop-valve. The water being now fuddenly ftopped, and confined in the pipe C, by its impetus or momentum, will exert a confiderable force within the pipe, which will open the other valve A, and a portion of the water will rife up the afcending-pipe D. The force of the momentum being expended in raifing this water, the water in the main-pipe will immediately recover the equilibrium, and the clofing of the valve A will prevent the return of the water which is raifed in the afcending-pipe. The weight E now defcends, and opens the ftop-valve B, and the water in the main-pipe refumes its motion until its velocity is fufficient to clofe the valve A again, and the operation of raifing the water is again repeated.

This water gradually rifes in the afcending-pipe until it reaches its fummit, and then a quantity will iffue from it at every ftroke into a proper refervoir R. The quantity will be more or lefs, according as the height to which it is raifed, and to the velocity of the current, and the fize of the apparatus. In this defcription, we have taken no notice of the action of the air-veffel J, at the bottom of the afcending-pipe D, although its ufe is very important to the practicability of the contrivance; for where the water is to be raifed to any confiderable height, the pipes, although formed of the beft materials that can be procured, will be in danger of rupture from the great concuffion of the water when fuddenly checked; hence the rifing of the water would be limited to the height of a few feet, or the pipes muft be made of an extraordinary thicknefs, difregarding expence.

This danger of burfting the pipes is to be regarded in every cafe of applying this invention to practice; but it will be prevented, or very much diminifhed, by introducing an air-veffel I. The water from the main-pipe enters at every ftroke through the exit-valve A, and compreffes the air in the veffel J, which again, by its expanfion or elafticity, acts upon the water, (which is prevented from returning to the pipe C by the fhutting of the exit-valve,) and therefore rifes through the afcending-pipe, and by repeated ftrokes acquires the defired height.

The dimenfions of the air-veffel, as well as its form and pofition, and whether it is affixed to the main-pipe laterally or above, are in a great meafure arbitrary; but its contents of air ought not to be much lefs than ten times the quantity of water to be raifed through the afcending-pipe at each ftroke, and if very much larger ftill the better, the principal boundary being expence.

The regulation of the ftop-valve B, is a principal point in the conftruction of thefe machines. It may be opened and fhut by the current, as has been defcribed, in a very fimple manner, by adapting the valve to move upon an axle or hinge, and affifting it to open at the proper time by a weight attached to a lever fixed to its axis at the proper angle. The valve fhould be prevented from opening to fuch a degree, that the action of the current of water could not fhut it. This muft be done by fome fixed refiftance behind the valves, as fhewn at B, *fig*. 3, or by any other convenient means.

It is neceffary to adjuft the weight by experiment, fo as to open the valve at the right time, according to circumftances, which may be done either by fliding the weight nearer to, or farther from, the centre of motion, or by increafing or diminifhing the weight itfelf. The inconvenience of this method is, that the weight being generally under water, it is troublefome to adjuft it; therefore the mechanifm fhewn in *fig*. 4. is better adapted to the ftop-valve. The weight E is fitted upon a lever connected with a fpindle, to which another arm or lever G is alfo fixed, and that is connected by rod *a*, with the arm K fixed to the valve.

The rod may be prolonged to any neceffary length, and the weight and its mechanifm may be always placed above water, fo as to be eafily come at for adjuftment. Valves of this kind may be hinged either upon their lower or upper edge, or upon one of the perpendicular fides as a common door, as convenience requires, and the mechanifm is connected accordingly.

When it is required to open the ftop-valve fo completely that the current of water in the main-pipe cannot act upon it, to fhut it, a fmall ftream of water is led from the head, which fupplies the main-pipe, or from fome other fource into a pipe or trough, which is furnifhed with a cock to regulate the quantity. This pipe or trough pours its water into the bucket G, *fig*. 5, which caufes the bucket to preponderate, and by means of the lever *b c*, fixed to its axle, and the rod *c d* attached to it, it fhuts the ftop-valve B, by the connection of the lever *d e* attached to it. The bucket then empties its water, and the pendulous weight E, as foon as the recoil of the water in the main-pipe takes place, preponderating in its turn, opens the valve, and reftores the bucket to its place. In this contrivance, by opening the cocks of fupply more or lefs, and by adapting the capacity of the buckets in proportion to the weight E, the number of ftrokes to be made in any given time is regulated.

The ftop-valve may be conftructed in a circular form, and, inftead of being hinged upon one fide, may be fixed upon a fpindle in its centre, which flides in a focket, fimilar to what are called button-valves ufed in pump-work, and at the proper time is opened by mechanifm fimilar to the former; or, in place of the weight, a fpring may be employed.

In conftructing large machines, where the fhock, from fhutting the ftop-valve, might endanger the derangement of the machine, other kinds of ftop-valves will be preferable to thofe before defcribed.

A very good form of valve is that which opens in two leaves, like the gates of a canal-lock. The leaves may fhut one upon another in the middle, or may fhut upon an upright bar placed there. They are opened by the fame kind of mechanifm as we have defcribed before, only there muft be two connecting-rods, one to each leaf of the valve; and thefe being united together, will caufe them to fhut both together. The aperture for this valve is of a rectangular form.

A valve in two leaves, fuch as is called a butterfly-valve, may alfo be hinged in the middle of the opening, but would too much obftruct the water-way. When the main pipe is of a large diameter, (for inftance, two feet or upwards,) the ftop-valve may be made in three, four, or more leaves connected together by mechanifm, fimilar to Venetian window-blinds.

Another kind of valve is poifed upon an axis, like a common fire-ftove chimney damper; the axis does not pafs through its centre, but divides it into two unequal fegments. The valve is not opened fo far as to ftand in the line of the current of water, but, when opened, ftands inclined to that current; fo that the larger fegment being placed towards the ftream, the latter may by its action fhut it at the proper time. It is opened by mechanifm fimilar to the former. Another kind of valve is a fpherical ball of porcelain, which is fitted into a feat.

When the machine is made ufe of in an open river, which does not admit of having its water penned up by a weir or dam-head, the main pipe ought to be laid fo as to be covered by the low waters of the river; and it ought to be parallel to the furface of the river, fo as to have the greateft poffible declivity that can be obtained in the length of the main pipe: its mouth or receiving end fhould be fhaped like that of a trumpet or bell. In all cafes whatfoever, the valves ought to be completely under the furface of the water, in the lower refervoir.

Performance of the hydraulic Ram, (fee RAM).—M. Montgolfier, in his publication, fays, that a belier hydraulique, executed with care, is capable of rendering three-fourths of the force which is employed to move it, that is, the product of the weight of water raifed, multiplied by the height to which it is raifed, will be equal to three-fourths of the product of the weight of water which works the machine, multiplied by the height of the fall. Commonly it yields fix-tenths, but he would only engage to furnifh half. Thus, if the water was to be raifed 100 feet by a fall of 5 feet, he would engage to make a machine which fhould deliver at 100 feet a fortieth part of the whole quantity which fell. He recommends particularly that the machine fhould be fixed in the moft folid manner, by mafonry or timber, fo that the fhock of the water can produce no motion of the machine, becaufe all fuch motion will deduct confiderably from the quantity of water raifed. It is ftated that the machine will make from 20 to 120 ftrokes *per* minute.

The dimenfions of an hydraulic ram at the bleaching works of M. Turquet, near Senlis, in France, when reduced to Englifh meafure, are as follow: diameter of the body of the ram 8 inches, fall of the water 3 feet 4 inches, height to which the water is raifed 15 feet 1 inch. In three minutes this machine made 100 ftrokes, which expended 67 cubic feet of water, and raifed $9\frac{1}{4}$ cubic feet: hence, 67 cubic feet $\times$ $3\frac{1}{3}$ feet $=$ 223, and $9\frac{1}{4}$ cubic feet $\times$ $15\frac{1}{12}$ feet $=$ 140. Now $\frac{140}{223}$ is equal to $\frac{63}{100}$ths, fo that the effect produced is above fix-tenths of the power applied. In another experiment it was found to be 64-hundredths. This machine raifed a quantity of water equal to 6.2 inches of water (pouces de fontanier), for 269 litres which are nearly equal to 280 pints, in three minutes; and the pouce de fontanier is a meafure of running water equal to 14 pints (French) *per* minute, or 796.37 cubic inches, Englifh. This machine working 24 hours will raife 134400 pints (French), or 4512 cubic feet Englifh, of water to a height of 15 feet 1 inch. The water raifed by this machine is equal to $\frac{3}{4}$ the power of a man, according to our ftandard.

M. Montgolfier recommends the pipe or body of the ram to be of an equal diameter through the whole length; and all internal irregularities are to be avoided, becaufe they diminifh the velocity of the water: the ftrength of the pipe fhould be at leaft equal to fuftain a column of twice the height to which it is intended to raife the water.

He fays, that he executed one with a fall of 10 feet, which compreffed the air in an air-veffel to an equal degree with 40 atmofpheres, which, taking the preffure of the atmofphere equal to 33 feet of water, makes the preffure equal a column of water 1320 feet in height.

Improved hydraulic Ram.—M. Montgolfier, the fon of the inventor, has recently obtained a patent in England for an improved hydraulic ram, in which, by attention to fome minute particulars in the conftruction, he is enabled to make the length of the tube much lefs than in the former machines; and he has even obtained a refult equal to 84 *per cent.* of the power employed.

One of thefe improvements is the addition of a fmall fnifting-valve, which, at each movement, ferves to introduce a fmall quantity of air into the head of the ram, from whence it is driven by the next movement into the air-veffel, which would otherwife become filled with water, if the air, abforbed by the contact of the water under a ftrong preffure, were not continually replaced by fome fuch means.

Alfo, in the interior of the head of the ram is an annular fpace, furrounding the frame of the ftop-valve: this contains a fmall volume of air, which cannot be forced into the air-veffel, but which, at each movement, is compreffed by and receives the firft effort of the moving water. This he calls the air-matrafs, and by means of it, the fhutting of the ftop-valve makes lefs noife, the pipe is not ftrained, and all the operations take place with fo much eafe, that the machine is lefs fhaken, and lefs frequently out of repair. The following is a defcription of the new machine.

That end of the pipe or body of the ram which receives the water of the refervoir is formed like a trumpet-mouth, that the water may flow more readily into the pipe; and the length of the pipe muft be regulated according to the height of the fall of water, which is to produce the current through it. The pipe is compofed of feveral pieces or lengths fcrewed together by flanches, or other fimilar means; but it is in the end piece, which is called the head of the ram, that the moving parts of the machine are placed.

The extremity of the pipe or head of the ram is a hollow fphere, the diameter of which is nearly twice as great as the bore of this pipe: the upper part of the fpherical end is flattened, fo as to reduce it to a fegment of a fphere, with a flat circular furface on the top or upper fide, in the centre of which furface is a large circular opening to receive and hold the feat of the ftop-valves, at which the water iffues; but when the valve is clofed, it prevents the water from iffuing.

When the valve opens, it defcends perpendicularly into the hollow fphere, and leaves a free paffage through the opening. Its motion is guided between three or four perpendicular ftems, which have hooks formed at the lower ends to retain or fupport the valve when opened; and thefe ftems are fixed by fcrews, fo that they can be regulated to allow the valve to defcend more or lefs, and open a greater or lefs paffage for the water. The valve is made of metal, and hollow, for it has a flat circular plate of metal, with a hollow cup or difh of metal attached to its lower furface:

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this at the fame time renders the valve lighter in the water, and gives it a convex furface on the lower fide, which, when the valve is opened, correfponds in curvature with the interior concave furface of the fpherical end of the head of the ram. The feat of the valve is compofed of a fhort cylinder or pipe, of which the opening is much greater than the tranfverfe fection of the body of the ram. This fhort cylinder is fcrewed by its flanch into the opening in the upper furface of the head of the ram. This flanch of the feat is fo formed as to have an inverted cup round the upper part of the fhort cylinder, that is, a circular channel or annular fpace within the head of the ram, which will contain air, and from which the air cannot efcape when the water compreffes. The air in this channel is called the air-matrafs.

The fnifting-valve is at the end of a fmall pipe, which leads from the annular fpace or matrafs to the open air. The fnifting-valve opens inwards, in order to admit the air to enter into the matrafs; but to prevent its return, there is another fmall valve in the fame pipe, which opens outwards: the office of this is to admit a certain quantity of air into the matrafs, and then to fhut and prevent any farther entrance.

On the outfide of the feat of the ftop-valve that is over the aperture in the head of the ram, where the water iffues, another ftop-valve is applied, which is fimilar to the internal valve before mentioned, but fhuts down on the outfide of the feat. Its ufe will be hereafter explained.

The upper part of the pipe or head of the ram is made flat at the part near the end where it enlarges to a fphere; and this flat furface on the top of the pipe has feveral narrow openings acrofs it, which are covered by as many flap-valves of leather, to allow water to pafs out from the main pipe, but to prevent its return. And on each fide of the head of the ram, at the part oppofite to thefe flap-valves, is a hollow enlargement, in form of a fegment of a horizontal circle; and the two enlargements taken together form a circular bafon, through the centre of which the pipe of the ram paffes; but, as before ftated, the pipe, inftead of being circular, is flat at top at that part, to form the feats for the flap-valves. This circular bafon is covered by a cylindrical air-veffel, fcrewed down by means of a flanch at the edge, fo that the circular bafon forms the bottom of the fpace in the air-veffel; the flap-valves being covered by the air-veffel are therefore within the veffel.

In confequence of this arrangement, all the water which iffues from the body of the ram through the flap-valves will flow off on each fide, and be received in the bafon; but as the circular bafon or bottom of the air-veffel is divided into two parts, by the pipe of the ram which paffes through it, there is a paffage communicating from one of the enlargements to the other; for which purpofe, it curves down and defcends beneath the pipe of the ram; and the afcending pipe that carries away the water which the machine raifes, proceeds either from this curved paffage or from fome other part of the bafon, fo that it may receive the water which has paffed from the body of the ram through the flap-valves and the air-veffel into the bafon, at each fide of the pipe.

The action of this hydraulic ram is nearly the fame as the preceding. Suppofe the pipe or body of the ram is full of water, if the internal ftop-valve is opened, the water from the refervoir will flow through the body of the ram, and iffue through the opening at the end, it will lift up the external ftop-valve and efcape; but the current having continued until the water has acquired a certain velocity, the force of the current buoys up the internal valve, and clofes the paffage. The motion of the water contained in the ram will thus be fuddenly arrefted, and by its *vis inertiæ*, or moving force, will exert a fudden preffure againft the ftop-valve, and againft all the interior parts of the ram. The fmall quantity of air contained in the fpace around the interior ftop-valve, which is called the air-matrafs, is compreffed into a fmaller fpace, and, by its elafticity, takes off the violence of the fhock or blow which would otherwife be produced. This preffure opens the flap-valves on the top of the pipe, which are within the air-veffel, and a portion of the water will be driven into the air-veffel, which is fuppofed to be full of air, compreffed or condenfed, till its elafticity equals the preffure of the column of water which is to be raifed up the afcending pipe by the action of the machine.

The water which is forced into the air-veffel caufes the air therein to be condenfed, and to exert a greater degree of elafticity, until it will exceed the preffure of the column of water in the afcending-pipe; by degrees this air will therefore force through the faid pipe all the water which was injected through the flap-valves, and caufe that quantity of water to iffue from the upper extremity of that pipe.

The moving force, or *vis inertiæ* of the mafs of water, which was in motion in the body of the ram, having expended itfelf by forcing a portion of water into the air-veffel, and making a ftill greater compreffion of the contained air, a recoil of the water in the body will take place with a flight motion from the valve towards the open end of the body; this arifes from the reaction or elafticity of the air contained in the air-matrafs, and alfo of the metal of which the tube is compofed.

The flap-valves within the air-veffel fhut, and prevent the return of the water which has been forced into the air-veffel. This recoil of the water in the body towards the open end caufes a flight afpiration within the whole body of the ram, and the external ftop-valve defcends by its weight, and prevents the water with which it is covered from entering through it; but the air paffes through the fmall pipe, leading from the open air to the annular fpace or air-matrafs, and opens the fnifting-valve, and a fmall quantity of air is fucked into the matrafs; but this is a very fmall quantity, becaufe the external air-valve clofes as foon as the air flows with a rapid current through the pipe and fnifting-valve.

During the recoil, the internal ftop-valve having nothing to fuftain falls by its weight, and opens the paffage; and as foon as the force of the recoil has expended itfelf in acting againft the column of water contained in the refervoir at the open end of the body, the water begins again to flow through the body in its original direction, and repeats the action before defcribed.

It fhuts the internal ftop-valve when it has acquired the intended velocity, and being thus ftopped, the efflux of the *vis inertiæ* condenfes the air-matrafs, and opening the flap-valves, forces a quantity of water into the air-veffel, from which the reaction of the contained air will drive it up the afcending-pipe.

The *vis inertiæ* of the moving column of water being thus expended, the recoil commences by the reaction of the air in the matrafs, the flap-valves fhut, and the external ftop-valve likewife; the afpiration produced by the recoil draws fome air through the fnifting-valve, and it joins the air in the matrafs. The internal ftop-valve falls open by its weight and opens the paffage, fo that the water in the pipe can refume its motion when the recoil has exhaufted itfelf.

The fmall quantity of air which is drawn into the machine through the air-valve, at each afpiration, caufes an accumulation of air in the matrafs; and when the afpiration of the recoil takes place, a fmall quantity of this air paffes from the annular fpace, and proceeds along the pipe till it arrives beneath the flap-valve, and lodging in the fmall fpace beneath thefe valves, it will be forced into the air-veffel at the next ftroke, by which means the air-veffel is always kept filled with air.

The following are the dimenfions of a machine which is calculated to raife water up the tube to 100 feet above the furface of the water in the refervoir, when the fall by which it is worked is five feet, that is, where the level of the water in the refervoir is five feet above the lower level; and the length of the pipe from the open end to where the water is difcharged is to be twenty feet long, and fix inches in diameter.

Such a machine may be expected to expend about feventy cubic feet *per* minute to work it, and to raife up about two and one-third cubic feet *per* minute; but thefe quantities cannot be exactly ftated, becaufe they depend upon the care and accuracy with which the machine is conftructed. Under different circumftances, having a greater or lefs fall or quantity or water, the dimenfion of the machine muft be calculated accordingly.

The improvements in this laft form of the hydraulic ram are,

Firft, that by conftructing the head of the ram with the upper fide of the pipe flat, and applying the flap-valves immediately upon the top, there is very little fpace to contain dead water, that is, water which will be motionlefs when the current takes place in the pipe; and by dividing the fingle valve of the original machine into feveral fmall and narrow valves, they open and fhut more fuddenly, and with lefs lofs of water.

Secondly, in making the bafon on each fide of the pipe, which bafon is on a lower level than the flap-valves. By this means the water will flow off from the flap-valve on each fide, and at the inftant when the machine performs its ftroke, and forces water through the faid valves into the air-veffel, the valves will not be covered, or at leaft very flightly covered by water; confequently, when thofe valves open, and the water is forced into the air-veffel, it has only the compreffed air to oppofe it, which from its elafticity allows the water to enter with more facility than if it was refifted by a column of water refting upon the valves; not that there is any lefs hydroftatic preffure upon the valves, becaufe it is the air which bears upon them, inftead of the water, but there is a lefs mafs of matter to be put in motion by the water which enters into the air-veffel: for it has only the matter contained in the valves themfelves to put in motion.

Thirdly, in applying the external ftop-valve, the ufe of which is to prevent the water returning into the ram when the recoil takes place, and having this provifion, a greater quantity of air can be employed in the matrafs than could otherwife conveniently be done; this renders the fhock which takes place when the ftop-valve is fhut lefs fudden. We have examined feveral of thefe machines made in France by the inventor, and can with confidence recommend them to engineers as the very beft machine, and the moft fimple for raifing water when there is a natural fall. The laft improvements, as they enable us to fhorten the length of the body of the ram to nearly one-third, without reducing the performance, are very important.

The hydraulic ram is adapted to give motion to the hydroftatic preffes, which are in common ufe under the name of Bramah's preffes. For this purpofe, it is only neceffary to apply the afcending-pipe to the cylinder of the hydraulic prefs, and at each ftroke of the ram a fmall quantity of water will be forced or injected into the cylinder of the prefs, and will thus produce the afcent of the pifton of the prefs in the fame manner as is now performed by the fmall injection-pump worked by the force of men. But by the application of the hydraulic ram to that purpofe, the prefs can be worked in any fituation where there is a fmall fall of water, and the ram may be fet in motion whenever the prefs is wanted.

An *Hydraulic Ram*, or *Momentum Machine acting by Suction*, is fhewn at *figs.* 2 and 3. *Plate Water-works.* This is applicable in cafes where the water to be raifed is below the level of the main-pipe, and is to be difcharged at that level; a cafe which frequently occurs in the drainage of marfhy lands, where the action of the current of water, in an embanked river, or other ftream or fource of water on a higher level, can be employed; or this method can be applied in raifing water out of the holds of fhips by the motion of the veffel through the water; alfo to raife water out of a well of moderate depth.

C reprefents a portion of the main-pipe; B, *fig.* 2. is the ftop-valve fituated at the entrance of the pipe, and opening outwards fo as to ftop the paffage of the pipe when it is fhut; D, the afcending or fucking-pipe, communicating with the well at the bottom and with the main-pipe at the top; J is the air-veffel; and E the weight of the ftop-valve of the main-pipe. There is likewife a valve A opening from the air-veffel into the main-pipe.

The water in the main-pipe having acquired a proper velocity by the current, as in the former cafes, the ftop-valve B fhuts, and the water in the main-pipe continuing its motion for a time, draws air out of the air-veffel J, through the valve A. The momentum of the water in the main-pipe being foon expended it recoils, the receiving-valve A fhuts to prevent the return of the water into the air-veffel, and the ftop-valve B opens by the action of the weight E, the water thus regains its paffage, and foon acquires fufficient velocity to clofe the ftop-valve again, and the operation is repeated.

Thus in a few ftrokes the exhauftion is increafed till the air-veffel fucks up water from below, through the afcending-pipe D, or rather the preffure of the atmofphere on the furface of the valve below forces it up, when the preffure on the furface within the air-veffel is removed by the exhauftion. This action being continued, the afcending-pipe fills by degrees to the top, after which, at every fucceffive ftroke, a portion of the water from below paffes into the main-pipe, and is carried off into the pipe C, where it mixes with the upper water.

In cafes where the water of the tide or other alternating current is employed as the motive power, the apparatus may be conftructed in two ways, either by applying a ftop-valve, air-veffel, and afcending-pipe, fuch as is fhewn at one end in *fig.* 4. to each end of the main-pipe C, to be ufed alternately, according as the tide fets in the one direction or the other; or otherwife by applying two main pipes to one air-veffel, their mouths being placed in oppofite directions and to be ufed alternately, and applied to the raifing of water, for the ufe of falt-works, or for other ufes, fuch as the fupply of a country-houfe.

The firft machine above defcribed may be employed to raife water to fmall heights by the motion of the waves of the fea, or of any large pieces of water; in which cafe the mouth or receiving end of the main-pipe fhould be formed like a fpeaking-trumpet, as fhewn in *fig.* 4. and placed oppofite to the direction in which the waves beat upon the fhore at the place where the machine is. The water of the waves will enter the main-pipe, and rufh through it until

the

the ſtop-valve ſhuts; when the contained water will in part enter the air-veſſel by the action already deſcribed, and the next wave will produce another ſtroke.

Momentum-Pump, or Momentum-Machine, to raiſe Water by the Application of mechanical Power.—Where a fall of water cannot be obtained, *fig.* 1. ſhews an application of this momentum principle, in lieu of pumps for raiſing water, the main-pipe being put in motion through the water by the ſtrength of men, or other mechanical power in default of a current, as in the other caſes.

C C is the main-pipe bent in a ſpiral form round the air-veſſel J; it may either be made to touch it, or be kept at a diſtance from it, and may make one or more revolutions round the ſaid veſſel; the whole of the main-pipe is immerſed in the external water which is to be raiſed. Both ends of the pipe are open to the water; but one of them has the ſtop-valve opening inwards, which will occaſionally cloſe it, and near this latter end, a communication is made by a ſide-pipe with the air-veſſel, the orifice being covered by a valve opening into the veſſel. The whole turns upon a pivot K, at the lower end of the aſcending-pipe D, which ſerves as an axis, and is kept upright by a collar, in which it turns, as ſhewn at L. Upon this axis a toothed wheel M is fixed, and is put in motion by another wheel N, turned by a winch, crank, or other contrivance.

At the top, or upper end of the aſcending-pipe, the water is diſcharged into a trough, which ſurrounds it, and conveys it to the place of its deſtination.

This apparatus is made to raiſe water by a continued rotative motion, the open end moving firſt, through the water which paſſes out again through the other end; but whenever, by that motion, the main-pipe has attained a proper velocity, the ſtop-valve ſhuts ſuddenly, and by the concuſſion the water paſſes into the air-veſſel, from whence the egreſs of the water is prevented by the ſhutting of the exit-valve. The ſtop-valve then opens by means of a ſpring in lieu of a weight, as in the former caſes, and the apparatus continuing to revolve in the ſame direction, more ſtrokes are made at intervals proportioned to the velocity with which it moves. The ſpring of the ſtop-valve ſhould be ſo regulated in force as to allow the relative motion of the water in the main-pipe to ſhut the ſtop-valve at proper intervals. The perpendicular ſection of the main-pipe is drawn ſquare, but may be circular, or of any other convenient figure. A horizontal ſection of it is ſhewn at *fig.* 6, with the main-pipe and the air-veſſel.

In lieu of the wheel N, which produces a continued rotatory motion, the machine may be made to vibrate or ſwing upon an axis, backwards and forwards, the limits of the vibration or ſtroke being determined by a detent ſtriking againſt a ſtiff ſpring. In this caſe, the main-pipe ſhould be provided with ſtop-valves at both ends, and alſo have a communication at each end with the air-veſſel, which openings ſhould be cloſed by valves to prevent the return of the water from it. Such a machine may be put in motion by the following means: upon the aſcending-pipe D, a double pulley is fixed, round which are wound the ropes, and by pulling the ends of theſe alternately, the apparatus may be made to revolve in either direction. The main-pipe and the aſcending-pipe being filled with water by hand or otherwiſe, if the ropes are pulled alternately, they will make the pipe move through the water with ſufficient velocity to make the apparatus act. It is found if the apparatus makes about thirty vibrations in each minute, that it will act very completely.

Hydraulic machines are of the greateſt importance to ſociety, whether we look to a ſupply of the firſt neceſſity for domeſtic uſes, or to the advantageous uſes of neglected though valuable firſt movers. Theſe machines muſt, in moſt caſes, be modified by localities, and other circumſtances; and conſequently the moſt uſeful practical knowledge will not conſiſt in any acquaintance with one or more of the beſt engines, but with that great variety of happy contrivances which inquiry and reflection muſt point out. We have, as far as our limits permit, given all the machines which are practically uſeful, and we ſhall conclude this article by giving Dr. Young's catalogue of the moſt important and valuable writings on hydraulic engines.

Ramelli's Collection of Hydraulic Machines, in French and Italian, 1588, folio.

Deſcriptio Machinæ Hydraulicæ curioſæ Conſtructa, Joh. Georg. Faudieri, Venet. 1607.

Bates on Art and Nature, 1635.

Nouvelle invention de lever l'eau plus haut que la ſource avec quelque machines mouvantes par le moyen de l'eau, &c. par Iſac de Caus, 1657.

Joſephi Gregorii a Monte Sacr. Principia phiſico-mechanica diverſarum machinarum ſeu inſtrumentorum pneumatics ac hydraulices, Venet. 1664.

Nouvelle Machine Hydraulique, par Francini Journ. des Sçav. 1669.

[An account of this machine is likewiſe given in the Architecture Hydraulique of Belidor, tom. ii.; and in the 2d vol. of Deſaguliers' Experimental Philoſophy: in both which performances many other hydraulic machines are deſcribed.]

An Undertaking for raiſing Water, by Sir Samuel Moreland. Phil. Tranſ. 1674. N° 102.

An Hydraulic Engine. Phil. Tranſ. 1675. N° 128.

A cheap Pump, by Mr. Conyers. Phil. Tranſ. 1677. N° 136.

M. de Hautfeuille, Reflexions ſur quelque Machines à elever les eaux, avec ſa deſcription d'une nouvelle pompe, ſans frottement, et ſans piſton, &c. 1682.

Elevation des eaux par toute ſorte des Machines, reduite à la meſure, au poids, à la balance, par le moyen d'un nouveau piſton et corps de pompe, et d'un nouveau mouvement cyclo-elliptique et rejetant l'uſage de toute ſorte de manivelles ordinaires, par le Chevalier Morland, 1685.

A new Way of raiſing Water, enigmatically propoſed by Dr. Papin. Phil. Tranſ. 1685. N° 173. The ſolutions by Dr. Vincent and Mr. R. A. in N° 177.

M. du Torax, Nouvelles Machines pour épuiſer l'eau des foundations, qui, quoique très ſimples font un effet ſurprennant, 1695. Joun. des Sçav. 1695. p. 293.

An Engine for raiſing Water by the help of Fire, by Mr. Thomas Savery. Phil. Tranſ. 1699. N° 253.

D. Papin nouvelle maniere pour lever l'eau par la force du feu; à Caſſel, 1707.

Memoire pour la conſtruction d'une pompe qui fourni continuelment de l'eau dans le reſervoir, par M. de la Hire, Mem. Acad. Scien. Paris, 1716.

Deſcription d'une machine pour elever des eaux, par M. de la Faye, Mem. Acad. Scien. Paris, 1717.

Joh. Jac. Bruckmann's und Joh. Heinr. Weber's Elementar-maſchine oder univerſal-mittel bey allen waſſer-hebungen. Caſſel, 1725.

Jacob Leopold, Theatri machinarum hydraulicarum, 1724 et 1725.

Joh. Frid. Weidleri tractatus de machinis hydraulicis toto terrarum orbe maximis Marlyenſi et Londinenſi, &c. 1727. Vide Act, erudit. Lipſ. 1728.

A Deſcription of the Water-works at London-bridge, by H. Beighton, F. R. S. Phil. Tranſ. 1731. N° 417.

An account of a new engine for raifing water, in which horfes or other animals draw without any lofs of power (which has never yet been practifed); and how the ftrokes of the pifton may be made of any length, to prevent the lofs of water by too frequent opening of valves, &c. by Walter Churchman. Phil. Tranf. 1734.

Sur l'effet d'une machine hydraulique propofée, par M. Segner, par M. Leon. Euler. Mem. Acad. Scien. Berlin, 1750.

Application de la machine hydraulique de M. Segner, à toutes fortes d'ouvrages et de fes avantages fur les autres machines hydrauliques, par M. Leon. Euler. Mem. Acad. Scien. Berlin, 1751.

[M. Segner's machine is no other than the fimple yet truly ingenious contrivance known by the name of Barker's-mill, which has been defcribed in the 2d volume of Defaguliers' Philofophy, fome years before the German profeffor made any pretenfions to the honour of the invention. The theory of it is likewife treated by John Bernouilli at the end of his Hydraulics.]

Recherches fur une nouvelle manière d'elever de l'eau propofée, par M. de Mour, par M. L. Euler. Mem. Acad. Berlin, 1751.

Difcuffion particulière de diverfes manières d'elever de l'eau par le moyen des pompes, par M. L. Euler. Mem. Acad. Berlin, 1752.

Maximes pour arranger le plus avantageufement les machines deftinées à elever de l'eau par le moyen des pompes, par M. L. Euler, Mem. Acad. Ber. 1752.

Reflections fur les machines hydrauliques, par M. le Chevalier D'Arcy, Mem. Acad. Scien. Paris, 1754.

Memoires fur les pompes, par M. le Chevalier de Borda, Mem. Acad. Scien. Paris, 1768.

Dan. Bernouilli, Expofitio theoretica fingularis machinæ hydraulicæ. Figuris helvetiorum exftructæ. Nov. Com. Acad. Petrop. 1772.

Abhandlungen von der Wafferfchraube, von D. Scherffer, Priefter Wien. 1774.

Recherches fur les moyens d'exécuter fous l'eau toutes fortes de traveaux hydrauliques, fans employer, aucun epuifement, par M. Coulumb. 1779.

Saemund Magnuffen, Holm, Efterretning om fkye pumpen Kiobenhavn, 1779.

Moyen d'augmenter la viteffe dans le mouvement de la vis d'Archimede fur fon axe, tire des mémoires manufcrits de M. Pingeron, fur les arts utiles et agréables. Journ. d'Agric. Juin. 1780.

The Theory of the Syphon, plainly and methodically illuftrated, 1781. (Richardfon.)

Memoria fopra la nuova tromba funiculare umiliata, dal. Can. Carlo. Caftelli. Milano, 1782.

Differtation de M. de Parcieux fur le moyen d'elever l'eau par la rotation d'une corde verticale fans fin Amfterdam et Paris, 1792.

Theorie der Wirzichen fpiral pumpe erlaütert von Heinr. Nicander, Schwed, Abhandl. 1783.

Jac. Bernouilli, Effai fur une nouvelle machine hydraulique propre à elever de l'eau, et qu'on peut nommer machine pitotienne. Nov. Act. Acad. Petrop. 1786.

K. Ch. Langfdorf's Berechnungen über die vortheilhæftere benutzung angelegter fammelteiche zur betreibung der mafchinen. Act. Acad. Elect. Mogunt, 1784, 1785.

Nicander's Theorie de fpiral pumpe, 1789.

Nouvelle architecture hydraulique, par M. Prony, 1790, 1796.

A fhort account of the invention, theory, and practice of fire-machinery; or introduction to the art of making machines, vulgarly called fteam-engines, in order to extract water from mines, convey it to towns, and jets d'eaux in gardens, to procure water-falls for fulling, hammering, ftamping, rolling, and corn-mills, by William Blakey, 1793. Egerton.

Machines actuated by the Force of Currents or Streams of Water.—Thefe are very numerous, but all may be reduced to two kinds.

Firft, thofe which are adapted to receive the impulfe of moving water; that is, water which has been put in motion in confequence of a defcent towards the earth previoufly to its operating on the machine, which muft be provided with parts proper to refift and take away fome of the motion of fuch water, and it will thereby receive motion which may be applied to produce fome mechanical effect. Of this kind are underfhot and horizontal water-wheels.

Secondly, thofe machines which are provided with fome kinds of buckets or veffels to contain water, the weight of which buckets, and the water they contain, is fupported by the machine, fo that the water cannot defcend towards the earth in confequence of its gravitation, without giving motion to the buckets or veffels which contain and fupport it. Of this kind is the over-fhot water-wheel, breaft-wheel, chain of buckets, and preffure-engine.

In either cafe, the motive force or power is the fame; *viz.* the gravitation and motion of fuch bodies or maffes of water as are found more elevated above the furface of the earth than the general level of the fea, or of fome other water in its neighbourhood; fuch water will defcend by the force of gravity until it joins the fea, or until it is fupported or held up by fome fixed obftacle.

The difference between the two kinds of machines is, that in the firft cafe the water is fuffered to defcend before it operates upon the machine, and in confequence of its gravitation, acquires motion with a velocity proportioned to the fpace through which it has defcended; and the office of the machine is to take from the moving water as much of its compounded weight and motion, or power, as it can obtain.

In the other cafe, the machine receives its motion and power at the fame time, when the water acquires it, by defcending; or, in other words, the machine moves with the water.

The word *power*, as ufed in practical mechanics, fignifies the exertion of ftrength, gravitation, impulfe, or preffure, fo as to produce motion; and a machine actuated by means of ftrength, gravitation, impulfe, or preffure, compounded with motion, is capable of producing an effect: and no effect is properly mechanical but what requires fuch a kind of power to produce it.

The mufcular power of animals, as likewife preffure, impact, gravity, electricity, &c. are looked upon as forces, or fources of motion; for it is an incontrovertible fact that bodies expofed to the free action of either of thefe are put in motion, or have the ftate of their motion changed. All forces, however various, can be meafured by the effects they produce in like circumftances; whether the effects be creating, accelerating, retarding, or deflecting motions: the effect of fome general and commonly obferved force is taken as unity.

The moft proper meafure of power is the act of raifing fome weight with fome velocity of motion; that is, the overcoming of the gravitating force of a weight in fuch degree as to produce motion in oppofition to gravity. In confidering the quantum, the weight or mafs of matter operated upon muft be one quantity, and the velocity of the motion communicated is the other; the mechanical power is the

the compound of both. We can only meafure the weight of any body or mafs of matter by its relation to fome other weight with which we are acquainted ; hence we fay, the weight is equal to fo many pounds, or fo many cubic feet of water. In like manner, we meafure the velocity or intenfity of the motion, by ftating the height or perpendicular diftance from the earth, (meafured by relation to fome known diftance, as a foot or a yard,) through which height the weight is raifed in fome known fpace of time, as a fecond or a minute.

For inftance, 528 cubic feet of water is a known weight or mafs of water : let a machine operate upon this, and raife it upwards, through the fpace of one foot in the time of one minute ; then $528 \times 1 \times 1 = 528$ is the number which reprefents the power which the machine exerts. Suppofe another machine to operate on 132 cubic feet of water, and raife it four feet in one minute, then ufing the fame meafures to determine the quantities of weight, height, and time, we fay $132 \times 4 \times 1 = 528$; hence thefe two machines are equal in the power which they exert ; for in all cafes the weight raifed is to be multiplied by the height to which it can be raifed in a given time, and the product is the meafure of the power expended in raifing it ; confequently, all thofe powers are equal whofe products made, by fuch multiplication, are equal ; for example, take two powers, if one can in any given time raife twice the weight to the fame height, or the fame weight to twice the height, in the fame time that the other power can, the firft power is double the fecond ; or, if one power can raife half the weight to double the height, or double the weight to half the height, in the fame time that another can, thofe two powers are equal : but note, all this is to be underftood only in cafes of flow or equable motion of the body raifed, for in quick, accelerated, or retarded motions, the *vis inertiæ* of the matter moved will make a variation.

The machines actuated by the impulfe of flowing water are, the underfhot water-wheel, horizontal wheels, and Dr. Barker's mill. It is a common expreffion to call all wheels in which the water runs or fhoots under the wheel, underfhot ; but in this place we fhall only fpeak of

Underfhot Water-Wheels, acting by the Impulfe of flowing Water.—Thefe are the moft ancient and original forms of water-machines, although if they had been invented from the refult of reafoning, fuch as we have given, they would have been the laft, becaufe their manner of action is lefs obvious ; but this was not the cafe. The firft machines were wheels placed in a river or running ftream, and provided with vanes or wings on the circumference, called floats ; the floats at the lower part of the wheel, dipped into the ftream to intercept the water. When the plane of the floats became perpendicular to the direction of the current, or nearly fo, they would refift or oppofe the motion of the water, and the wheel would obtain motion from it in proportion to the quantity of motion, its floats abftracted from the water of the ftream. The power thus obtained would be found to be only a fmall proportion of the power of the ftream, becaufe the water would eafily efcape fideways from the floats, particularly if it were attempted to take away any confiderable fhare of the velocity of the water, by refifting or loading the wheel, fo as to make it move flowly. Hence it became an obvious improvement to contract the river to the exact fize of the float-boards of the wheel, or to make a clofe channel in which the wheel exactly fits. The next improvement would be to intercept the river or ftream of water by a dam, or obftacle, in order to make it pen up, or accumulate, till it had rifen to the greateft height which could be obtained, and to let the water out of the dam or refervoir into the channel or wheel-courfe, through a vertical aperture or door, level with the bottom of the wheel-courfe ; in this way, the water would be urged by the preffure of the water in the dam, and would rufh out from the aperture in a ftream or fpout, with a velocity proportioned to the perpendicular preffure, and would ftrike the float-boards of the wheel fo as to urge them forwards. Such is the form of the underfhot wheels ftill generally employed in France and on the continent ; but in England they have been long fuperfeded by more effectual applications of the power of the water, and it is very rarely we meet with an underfhot wheel acting by the impulfe of the water. They are called ground-fhot wheels, becaufe the water runs or fhoots along the ground or floor of the channels in which the wheels work.

It was firft proved by Mr. Smeaton, in 1754, that only a portion of the power of any fall of water could be obtained by means of an underfhot wheel ; for M. Belidor had not long before ftated the underfhot wheel as the beft mode of applying a fall of water. It was one of the continual occupations of Mr. Smeaton, during forty years, to improve the old water-mills, by fubftituting breaft-wheels for underfhot ; and the advantages were uniformly fo great, that thefe mills were copied by others, until fcarcely any of the original conftruction remained. We do not mean that Mr. Smeaton invented the breaft-wheel, for it is defcribed by Leopold ; but he firft inveftigated its comparative advantages.

It is from this circumftance that we find, in all the mechanical writings of foreign authors, much more mathematical inveftigation relative to the underfhot water-wheels than the importance of the fubject deferves, and we fhall difmifs it more briefly.

The excellent paper by Mr. Smeaton, in the Philofophical Tranfactions for 1759, contains a numerous lift of experiments moft judicioufly contrived by him, and executed with the accuracy and attention to the moft important circumftances which are to be obferved in all that gentleman's performances.

Mr. Smeaton's rules were originally deduced from experiments made on working models, which are the beft means of obtaining the outlines in mechanical enquiries ; but in every cafe it is neceffary to diftinguifh the circumftances in which a model differs from a machine at large, otherwife a model is more apt to lead from truth than towards it ; and we muft not, without great caution, transfer the refults of fuch experiments to large works. But we may fafely transfer the laws of variation, which refult from a variation of circumftances, although we muft not adopt the abfolute quantities of the variations themfelves. Mr. Smeaton was fully aware of the limitations to which conclufions drawn from experiments on models are fubject, and has made the applications with his ufual fagacity. The beft ftructure of machines cannot be fully afcertained but by making trials with them, when made of their proper fize.

Mr. Smeaton's Principles for Underfhot Wheels.—In comparing the effect produced by water-wheels with the powers producing them ; or, in other words, to know what part of the original power is neceffarily loft in the application, we muft previoufly know how much of the power is fpent in overcoming the friction of the machinery, and the refiftance of the air ; alfo, what is the real velocity of the water at the inftant it ftrikes the wheel ; and the real quantity of water expended in a given time.

The velocity Mr. Smeaton meafured in a moft fatisfactory manner in every experiment, by applying a cord and weight to the axle of the wheel, not to wind up the weight by the motion

motion of the wheel, but that the weight by deſcending ſhould turn the wheel. He applied ſo much weight as would make the wheel turn, and make its floats move with the velocity which he deſired or expected the effluent water to have; and this weight he adjuſted until he found, by repeated trials, that the wheel moved juſt at the ſame rate, whether the water was ſuffered to flow and ſtrike its floats, or whether the water was ſtopped, which proved that the floats of the wheel moved with preciſely the ſame velocity as the effluent water; then by meaſuring the circumference of the wheel, and counting the number of turns it made in a minute, he obtained the meaſure of the velocity.

From the velocity of the water at the inſtant that it ſtrikes the wheel, the height of head productive of ſuch velocity can be deduced from acknowledged and experimented principles of hydroſtatics; ſo that by multiplying the quantity or weight of water really expended in a given time by the height of a head ſo obtained, which muſt be conſidered as the effective height from which that weight of water had deſcended in that given time, we ſhall have a product equal to the original power of the water, and clear of all uncertainty that would ariſe from the friction of the water in paſſing ſmall apertures, and from all doubts ariſing from the different meaſure of ſpouting waters, aſſigned by different authors.

On the other hand, the ſum of the weights raiſed by the action of this water, and of the weight required to overcome the friction and reſiſtance of the machine, multiplied by the height to which the weight can be raiſed in the time given, the product will be equal to the effect of that power; and the proportion of the two products will be the proportion of the power to the effect: ſo that by loading the wheel with different weights ſucceſſively, we ſhall be able to determine at what particular load and velocity of the wheel the effect is a maximum.

From experiments conducted in this manner, Mr. Smeaton ſettled the following maxims:

Maxim 1. That the virtual or effective head of water, and conſequently its effluent velocity being the ſame, the mechanical effect produced by a wheel actuated by this water will be nearly in proportion to the quantity of water expended.

Note. The virtual or effective head of any water which is moving with a certain velocity, is that height from which a heavy body muſt fall in order to acquire the ſame velocity.

The height of the virtual head, therefore, may be eaſily determined from the velocity of the water; for the heights are as the ſquare of the velocities; and the velocities, conſequently, as the ſquare roots of the heights. Mr. Smeaton obſerved the velocity of the effluent water in all his experiments, and thence calculated the virtual head; he ſtates that the virtual head bears no proportion to the real head or depth of water; but that when either the aperture is greater, or when the velocity of the water iſſuing therefrom leſs, they approach nearer to a coincidence; and conſequently, in the large openings of mills and ſluices, where great quantities of water are diſcharged from moderate heads, the actual head of water, and the virtual head, as determined by theory from the velocity, will nearly agree.

For example of the application of his firſt maxim. Suppoſe a mill driven by a fall of water, whoſe virtual head is 5 feet, and which diſcharged 550 cubic feet of water *per* minute; and that it is capable of grinding four buſhels of wheat in an hour. Now another mill, having the ſame virtual head, but which diſcharges 1100 cubic feet of water *per* minute, will grind eight buſhels of corn in an hour.

Maxim 2. That the expence of water being the ſame, the effect produced by an underſhot wheel will be nearly in proportion to the height of the virtual or effective head. This is proved in the preceding example.

Maxim 3. That the quantity of water expended being the ſame, the effect will be nearly as the ſquare of the velocity of the water; that is, if a mill driven by a certain quantity of water, moving with the velocity of 18 feet *per* ſecond, is capable of grinding 4 buſhels of corn in an hour, another mill, driven by the ſame quantity of water, but moving with the velocity of $22\frac{1}{2}$ feet *per* ſecond, will grind nearly 7 buſhels of corn in an hour; becauſe the ſquare of 18 is 324, and the ſquare of $22\frac{1}{2}$ is $506\frac{1}{4}$. Now ſay, as 324 is to 4 buſhels, ſo is $500\frac{1}{4}$ to $6\frac{1}{6}$ buſhels; that is, as 4 to $6\frac{1}{6}$.

Maxim 4. The aperture through which the water iſſues being the ſame, the effect will be nearly as the cube of the velocity of the water iſſuing; that is, if a mill driven by water ruſhing through a certain aperture with the velocity of 18 feet *per* ſecond will grind 4 buſhels of corn in an hour, another mill, driven by water moving through the ſame aperture, but with the velocity of $22\frac{1}{2}$ feet *per* ſecond, will grind 51 buſhels; for the cube of 18 is 5832, and the cube of $22\frac{1}{2}$ is $11390\frac{3}{4}$; then, as 5832 is to 4, ſo is $11390\frac{3}{4}$ to $7\frac{3}{4}$.

Maxim 5. The proportions between the power of the water expended, and the effect produced by the wheel, was 3 to 1. Upon comparing ſeveral experiments, Mr. Smeaton fixed the proportions between them for large works; that is, if the weight of the water which is expended in any given time be multiplied by the height of the fall, and if the weight raiſed be alſo multiplied by the height through which it is raiſed, the firſt of theſe two products will be three times that of the ſecond.

Maxim 6. The beſt general proportions of velocities between the water and the floats of the wheels will be that of 5 to 2; for inſtance, if the water when it ſtrikes the wheel moves with a velocity of eighteen feet *per* ſecond, the wheel muſt be ſo loaded that its float-boards will move with a velocity of 7.2 feet *per* ſecond, and the wheel will then derive the greateſt power from the water, becauſe as 5 to 18, ſo is 2 to 7.2.

Maxim 7. There is no certain ratio between the load that the wheel will carry when producing its maximum of effect, and the load that will totally ſtop it; but it approaches neareſt to the ratio of 4 to 3, whenever the power exerted by the wheel is greateſt, whether it ariſes from an increaſe of the velocity, or from an increaſed quantity of water; and this proportion ſeems to be the moſt applicable to large works. But when we know the effect a wheel ought to produce, and the velocity it ought to move with whilſt producing that effect, the exact knowledge of the greateſt load it will bear is of very little conſequence in practice.

Maxim 8. The load that the wheel ought to have, in order to work to the moſt advantage, can be always aſſigned thus: aſcertain the power of the whole body of water, by multiplying the weight of the water expended in a minute by the height of the fall, take one-third of the product, and it gives the effect of power which the wheel ought to produce: to find the load, we muſt divide this product by the velocity which the wheel ſhould have, and that, as we have before ſettled, ſhould be two-fifths of the velocity with which the water moves when it ſtrikes the wheel.

The wheel muſt not be placed in an open river to be actuated by the natural current, in which caſe, after it has communicated its impulſe to the float, it has room on all ſides to eſcape: this is the ſuppoſititious caſe on which moſt mathematicians have proceeded; but in all theſe experiments,

ments, the wheel is placed in a conduit or race, to which the float-boards are exactly adapted, and the water cannot otherwiſe eſcape than by moving along with the wheel. It is obſervable in a wheel working in this manner, that as ſoon as the water meets the float, it receives a ſudden check, and riſes up againſt the float, like a wave againſt a fixed object, inſomuch that when the ſheet of water is not a quarter of an inch thick before it meets the float, this ſheet will act upon the whole ſurface of a float, whoſe height is three inches; and conſequently, where the float is no higher than the thickneſs of the ſheet of water, as theory alſo ſuppoſes, a great part of the force would have been loſt by the water daſhing over the float.

The wheel which Mr. Smeaton uſed had originally twenty-four floats, and was afterwards reduced to twelve, which cauſed a diminution in the effect, on account of a greater quantity of water eſcaping between the floats and the floor of the channel in which it moved; but a circular ſweep being adapted thereto, of ſuch a length, that one float entered the curve before the preceding one quitted it, the effect came ſo near to the former as not to give hopes of advancing it, by increaſing the number of floats beyond twenty-four in this particular wheel.

Mr. Smeaton obſerves that, in many of the experiments, the reſults were by different ratios than thoſe which his maxims ſuppoſed; but as the deviations were never very conſiderable, the greateſt being about one-eighth of the quantities in queſtion, and as it is not practicable to make experiments of ſo compound a nature with abſolute preciſion, he ſuppoſes, that the leſſer powers are attended with ſome friction or work under ſome diſadvantages, which have not been duly accounted for; and, therefore, he concludes that theſe maxims will hold very nearly, when applied to works in large.

Application of theſe Principles to Practice.—The firſt thing to be done in a ſituation where an underſhot wheel is intended to be fixed, is to conſider whether the water can run off clear from the wheel, ſo as to have no back water to impede its motion; and whether the fall which can be obtained by conſtructing a proper dam to pen up the water and ſluice for it to paſs through, will cauſe it to ſtrike the float-boards of the wheel with a ſufficient velocity to impel them forcibly forwards; and alſo, whether the quantity of the ſupply will be ſufficient to keep a wheel at work for a certain number of hours each day.

When we have aſcertained the height of the fall of water, that is, the height of the ſurface above the centre of the opening of the ſluice, we muſt find what will be the continual velocity of the water iſſuing out from ſuch opening.

In ſome caſes, we have the velocity of the water given when it iſſues from the opening of the ſluice, and we then require to know what height of column will produce that velocity. Theſe two things we may find by a ſingle rule, and an eaſy arithmetical operation, which is as follows:

1ſt. The perpendicular height of the fall of water being given in feet and decimals of feet, the velocity that the water will acquire *per* ſecond, expreſſed in feet and decimals, may be found by the following rule:

Multiply the conſtant number 64.2882 by the given height, and the ſquare root of the product is the velocity required.

Example 1.—If the height is two feet, the velocity will be found 11.34 feet *per* ſecond.

Example 2.—If the height is 16,0913 feet, the velocity will be 32,1826 feet *per* ſecond.

Example 3.—If the height is fifty feet, the velocity will be 56,68 feet *per* ſecond.

Note. The velocities thus obtained will be only the theoretic velocity, that is, the velocity any body would acquire by falling through ſuch height *in vacuo*, the velocity in reality will be leſs, generally ſix or ſeven-tenths.

The uniform velocity of a fluid being given, expreſſed in feet and decimals of feet *per* ſecond, the height of the column or fall to produce ſuch a velocity may be found by the following rule:

Multiply the given velocity into itſelf, and divide the product by 64,2882; the quotient will be the height required, expreſſed in feet and decimals.

Example 1.—If the velocity given is three feet *per* ſecond, the height will be 0.139 of a foot.

Example 2.—If the velocity given is 32,1826 feet *per* ſecond, the height will be found 16,0913 feet.

Example 3.—Let the velocity be 100 feet *per* ſecond, the height will be 155,649 feet.

The knowledge of the foregoing particulars is abſolutely neceſſary for conſtructing an underſhot water-wheel; but the moſt advantageous method of ſetting it to work, and to find out the utmoſt it could perform, would be very difficult, if we were not furniſhed with the maximum which Mr. Smeaton ſettled, by ſhewing, that an underſhot water-wheel will act to the greateſt advantage, when the velocity of its float-boards is equal to two-fifths or four-tenth parts of that of the water which gives it motion.

To illuſtrate this, let us conſider a wheel equally balanced on all ſides, and turning freely round upon its pivots, its circumference would ſoon move as faſt as the current it was placed in. Suppoſe the water to move at the rate of three feet in a ſecond, the circumference of the wheel would paſs through three feet in a ſecond. In this caſe, the wheel performs no work, and the effect produced is nothing.

Now in attempting to apply the power of this wheel to turn any kind of machinery, ſuppoſe the work to be ſo proportioned, that the reſiſtance would cauſe the wheel to ſtand ſtill and ſtop the water, or make it run over the floats, in conſequence of its not having ſufficient force to carry the float-boards along with it. In this caſe alſo, there being no motion, there could be no mechanical effect produced; but if the reſiſtance be diminiſhed by degrees, the wheel would begin to partake of the motion of the current of water, and being loaded, would produce a mechanical effect proportioned to the load and velocity. The wheel would increaſe in its velocity in proportion as the reſiſtance was diminiſhed, and the mechanical effect would increaſe alſo until a certain point when the wheel moved ſo faſt, that the water would not ſtrike the float-boards quick enough to produce the greateſt effect: this is found to be as before mentioned, when the floats move four-tenths as faſt as the water, becauſe then ſix-tenths of the water is employed in driving the wheel with a force proportional to the ſquare of its velocity.

If we multiply the ſurface or area of the opening by the height of the column, we ſhall aſcertain the body or column of water which ſhould preſs againſt that float-board, which is immediately under the wheel, ſuppoſing it has no motion; but it will be found, that a ſmall proportion of the weight of the original column hung on the oppoſite ſide of the wheel, would arreſt its motion entirely; but when we would have it to move with a proper velocity, that is, two-fifths of that velocity with which the water moves, $\frac{133}{1000}$ of the weight of the original column, is the weight which the wheel would raiſe with four-tenths of the velocity that the water moves with, and the power which the wheel would exert on the machinery to grind corn, lift hammers, raiſe water,

water, &c. is $\frac{133}{1000}$ of the weight of the water multiplied by $\frac{4}{10}$ of its velocity.

Thus it appears that an underſhot water-wheel, conſtructed after the foregoing manner, would only raiſe one-third part of the water expended to the ſame height, as the original head or level. This is the utmoſt that can be expected, though often leſs is done; becauſe here we ſuppoſe every part exactly performed, and the water applied to the wheel in the beſt manner; therefore, as we cannot come up to the maximum, we muſt come as near it as we can by loſing the leaſt poſſible of the power's impulſe.

It is no advantage to have a very great number of float-boards round the wheel, becauſe when they are ſtruck by the water, as applied in the beſt manner poſſible, the ſum of the impulſes exerted on the different floats, will but be equal to the impulſe made againſt one float-board ſtruck by all the water iſſuing from the ſluice at right angles to its ſurface. But as this float-board muſt move forward, there muſt be a ſucceſſion of float-boards to receive the impulſe of the water, and ſince they cannot receive it at right angles, there will be ſome loſs of impulſe in that ſucceſſion. Beſides when the firſt float-board is ſo far paſt the perpendicular, as to have the action of the water intercepted by the ſucceeding one, it is checked by the back water through which it muſt paſs in riſing out of the water, and thereby be ſo far retarded as to take from the full effect of the impulſe on the following float. Indeed if all the water could run off immediately after having performed its office, this would not happen; but it can ſeldom be effected in underſhot-mills, eſpecially thoſe built upon rivers. All the remedy in ſuch caſe is, (when the diameter of the wheel is ſettled) to fix juſt ſuch a number of floats upon it, that each one, after it has received the full impulſe of the water, may come out of the water as ſoon as poſſible, that another ſucceeding float may be brought to receive the impulſe, otherwiſe the wheel would remain a moment without any impulſe.

In the article MILL we have given a table for the dimenſions and proportions for underſhot wheels, which was calculated by Mr. Ferguſon. Dr. Brewſter, in his new edition of Mr. Ferguſon's works, has given an improved table, which is calculated upon the following principles.

It is evident that the water-wheel muſt always move with leſs velocity than the water, even when there is no work to be performed; for a part of the impelling power is neceſſarily ſpent in overcoming the *inertia* of the wheel itſelf; and if the wheel has little or no velocity, it is equally manifeſt that it will produce a very ſmall effect.

There is conſequently a certain proportion between the velocity of the water and the wheel, when the effect is a maximum. Mr. Smeaton has ſhewn the greateſt effect is produced when the velocity of the wheel is between one-third and one-half, but the maximum is much nearer to one-half than one-third. He obſerves alſo that one-half would be the true maximum, if nothing were loſt by the reſiſtance of the air, the ſcattering of the water carried up by the wheel, and thrown off by the centrifugal force, and the leakages of the water between the floats and the water-courſe, all which tend to produce a greater diminution of the effect at that velocity, which would be the maximum if theſe loſſes did not take place, than they do when the motion is a little ſlower. The great hydraulic machine at Marly, the wheels of which are underſhot, was found to produce a maximum effect when the velocity of the wheel was two-fifths that of the current. Hence Dr. Brewſter concludes that in theory the velocity of the wheel is one-half that of the current, and that in practice it is never more than three-eighths of the ſtream's velocity, when the effect is a maximum.

Dr. Brewſter's Table of underſhot Water-Wheels, in which the velocity of the wheel is three-ſevenths of the velocity of the water, and the effects of friction on the velocity of the ſtream are reduced to computation. The wheel is ſuppoſed to be fifteen feet diameter.

Height of the Fall of Water.	Velocity of the Water *per* Second, Friction being conſidered.	Velocity of the Wheel *per* Second being three-ſevenths that of the Water.	Revolutions of the Wheel *per* Minute, its Diameter being fifteen Feet.
Feet.	Feet and Decimals.	Feet and Decimals.	Revolutions and Decimals.
1	7.62	3.27	4.16
2	10.77	4.62	5.88
3	13.20	5.66	7.20
4	15.24	6.53	8.32
5	17.04	7.30	9.28
6	18.67	8.00	10.19
7	20.15	8.64	10.99
8	21.56	9.24	11.76
9	22.86	9.80	12.47
10	24.10	10.33	13.15
11	25.27	10.83	13.79
12	26.40	11.31	14.40
13	27.47	11.77	14.99
14	28.51	12.22	15.56
15	29.52	12.65	16.13
16	30.48	13.06	16.63
17	31.42	13.46	17.14
18	32.33	13.86	17.65
19	33.22	14.24	18.13
20	34.17	14.64	18.64

Another Manner of applying Water to an underſhot Wheel.—This was propoſed by M. Fabre as the reſult of much mathematical inveſtigation, and has been ſo frequently recommended by authors of eminence, that we ſhall give a ſhort deſcription without entering into all his rules for the proportions. The principal difference in this wheel from that in common uſe is, that the water is made to run down a rapid ſlope or inclined plane, in order to ſtrike the floats of the wheel, inſtead of iſſuing from an aperture or ſluice ſituated beneath the ſurface of the water in the reſervoir. A mill is uſually ſituated at a diſtance from the river, with a canal or water-courſe to conduct the water to the mill; as it is of the higheſt importance to have the height of the fall as great as poſſible, the bottom of the canal or water-courſe, which conducts the water from the river to the mill, ſhould have a very ſmall declivity; for the height of the water-fall at the mill will diminiſh in proportion as the declivity of the canal is increaſed: it will be ſufficient to make it ſlope about one inch in 200 yards, taking care to make the declivity about half an inch in the firſt 48 yards, in order that the water may have a velocity ſufficient to prevent it from flowing back into the river.

When the water is thus brought to the channel in which the wheel is placed, the water is recommended to be conducted down a ſlope or inclined plane, making an angle of $64\frac{1}{2}$ degrees with the horizon; that is, in a perpendicular of ten feet, the ſlope ſhould deviate from it $4\frac{3}{4}$ feet: at the bottom of this ſlope the water is to be again conducted horizontally, and then to ſtrike the float-boards of the wheel.

wheel. To render the fall of the water eafy, the flope is to be rounded off by a convexity at top and a concavity at bottom, to lead the water from the horizontal to the flope, and again from the flope without abruptnefs. It is fuppofed that the water, in running down this inclined plane, will acquire the fame velocity as if it had fallen perpendicularly through a height equal to the perpendicular height of the flope.

The diftance through which the water runs horizontally, from the foot of the flope before it acts upon the wheel, fhould not be lefs than two or three feet, in order that the different portions of the fluid may have obtained an horizontal direction; but if this horizontal diftance be much larger, the velocity of the ftream would be diminifhed by its friction on the bottom and fides of the water-courfe. That lefs water may efcape between float-boards and the bottom of the courfe, it fhould be formed into the arch of a circle concentric with the wheel, which fweep fhould be prolonged, fo as to fupport the water as long as it can act upon the float-boards; beyond this fweep fhould be a ftep or fall of not much lefs than nine inches with a flope of about 45 degrees, that the water having fpent the greater part of its force in impelling the float-boards, may not accumulate below the wheel and retard its motion. After this ftep the courfe of difcharge, or tail water-courfe to run off the water from the wheel, fhould be floored with wood or mafonry about 16 yards long, having an inch of declivity in every two yards.

The canal which conducts the water from the courfe of difcharge to join the river again, fhould flope about four inches in the firft 200 yards, and three inches in the fecond 200 yards, and fo decreafing gradually till it terminates in the river. But if the river to which the water is conveyed, fhould be fubject to be fwollen by the rains, fo as to force the water back upon the wheel, the canal muft have a greater declivity, in order to prevent this from taking place. Hence it will be evident, that very accurate levelling is neceffary for the proper formation of the mill-courfe. The tail water-courfe ought always to have a very confiderable breadth, which fhould be greater than that of the wheel-race, or part in which the wheel acts, that the water having room to fpread may have lefs depth. The fection of the fluid at the point where it ftrikes the wheel fhould be rectangular, the breadth of the ftream having a determinate relation to its depth. If there is a great ftream of water, the breadth fhould be triple the depth; if there is a moderate quantity, the breadth fhould be double the depth; and if there is very little water, the breadth and the depth fhould be equal. The depth of the water here alluded to is its natural depth, or that which it would have, if it did not meet the float-boards. The effective depth is generally two and a half times the natural depth, and is occafioned by the impulfe of the water on the float-boards, which forces it to fwell, and increafes its action upon the wheel.

As it is of great confequence that none of the water fhould efcape, either below the float-boards or at their fides, without contributing to turn the wheel, the breadth of the float-boards fhould be wider than the fheet of water which ftrikes them. The diameter of the water-wheel fhould be as great as poffible, unlefs fome particular circumftances in the conftruction prevent it; but ought never to be lefs than feven times the natural depth of the ftream or thicknefs of the fheet of water, where it meets the float-boards. The wheel will move irregularly, fometimes quick and fometimes flow, according to the pofition of the floats with refpect to the ftream; unlefs the number of float-boards is confiderable, the wheel muft have fo many floats, that two floats will at leaft be always in the circular fweep at the bottom of the wheel; but in order to remove any inequality of motion in the wheel, and prevent the water from efcaping beneath the tips of the float-boards, it fhould have as many float-boards as poffible, without loading it, or weakening the rim on which they are placed. The float-boards fhould not be perpendicular to the rim, or, in other words, a continuation of the radius, but fhould be inclined to the radius; the water will thus heap upon the float-boards, and act not only by its impulfe, but alfo by its weight. When the velocity of the ftream is eleven feet *per* fecond, or above this, the inclination fhould never be lefs than thirty degrees; or when this velocity is lefs, the inclination fhould diminifh in proportion; fo that when it is four feet, or under, the inclination fhould be nothing, that is, the float-boards fhould point to the centre of the wheel.

It is a ftrong practical objection to this manner of applying the water to the wheel, that when the water of the river finks in dry weather from a deficiency of water, it would not run over the top of the fall, and the mill could not work at all even if it funk only ten or twelve inches: in like manner, when the water rifes in floods, the water at the top of the fall would become fo deep, as to require fome fhuttle to prevent it from inundating the wheels, at the fame time that the ftagnant water in the mill-race would prevent the wheel from working. Almoft all rivers are fubject to floods, and often they rife and fall, three, four, fix, and eight feet above their ordinary level in fair weather; now the water moftly rifes at the tail or difcharge of the water as much as the head, and the wheel-race will therefore be full of ftagnant water, which is called tail-water, and obftructs the motion of the wheel.

In a ground-fhot wheel, where the water iffues from a fhuttle on a level with the bottom of the wheel-race, it can always work in dry feafons, as long as the river contains any water, although the power diminifhes almoft to nothing, when the water finks low, and will not rufh out with force from the fhuttle. In floods of water, this wheel has a greater advantage, becaufe the depth of head which urges the flowing water is increafed when the water is high, and this makes it drive the tail-water forcibly out of the wheel-race, and enable the wheel to work, when a wheel with an inclined fall would infallibly be ftopped.

Breaft-wheels and overfhot-wheels, properly conftructed, have ftill greater advantages, in clearing themfelves from tail-water, and this is a very important object.

Floating-Mill with underfhot Wheels.—A large floating water-mill, to be worked by the tides or currents, was ftationed fome years ago in the river Thames, between London and Blackfriars bridge, by permiffion of the Board of Navigation. Such permiffion having been granted with the view of reducing, if poffible, the price of flour in the metropolis, and contributing to a conftant fupply of that neceffary article of fubfiftence. The fimplicity of this invention renders a long defcription fuperfluous, as it confifts in merely applying the force of two large underfhot water-wheels on each fide of a barge, or any other veffel calculated to contain the interior part of the machinery; the float-boards are difpofed in a proper manner to be acted on by the tide or current, fo as to give the wheels a rotatory motion, and by connecting them with proper machinery, to anfwer the purpofes for which the mill is intended.

Any fhip, brig, floop, or other veffel, may be ufed for this purpofe, provided it is of fufficient fize to accommodate the works to be erected, yet in point of expence it will be better to employ fuch as are rendered unfit for fea-fervice.

When it is intended that the ſhip or mill ſhould be ſtationary, it muſt be anchored, moored, or otherwiſe made faſt, ſo as to ſwing with the tide when neceſſary; but the mill may be worked while the veſſel in which it is erected is ſailing, when wind and other circumſtances permit.

The number and ſize of the water-wheels to be uſed may be varied, according to the ſize of the ſhip or veſſel, or to the ſtrength of the tide or current, and the power required; and the wheels may be conſtructed as in common underſhot mills, or with folding-floats, for the more readily freeing them from the water: two wheels are to be placed vertically, on an horizontal axis, of ſuch length, that, the axis being placed acroſs the ſhip or veſſel, one wheel may run on each ſide of it on the ſame axis.

A mill conſtructed in the manner above deſcribed may be moved by the ſtrength of from two to ſix large water-wheels, or ſuch other number as the ſhip or veſſel will accommodate. Theſe water-wheels may dip into the water from three to four, or more feet deep; they ſhould be ſo connected together as to be eaſily engaged with and diſengaged from each other, ſo that during the weak part of the tide they may all be made to act on one pair of mill-ſtones, if neceſſary; and as the ſtrength of the tide increaſes, more ſtones or other machinery may be put in motion, ſo as at all times to do buſineſs in proportion thereto.

In a mill of this kind the water-wheels do not admit of having water-courſes, or any equivalent contrivances, to conduct the water to the wheels, as in other underſhot wheels; but the float-boards muſt be large enough to receive the power required from merely dipping into the current of the tide-water.

The veſſel of the mill in the Thames is the hull of an old ſhip of two or three hundred tons burthen, which being moored in the river by chains, ſo that it can ſwing round when the tide changes, the wheels will always turn the ſame way round; one water-wheel is fixed on each ſide of the veſſel, a long iron axis being common to both; the extreme ends of the axis are ſupported in a frame-work of timber, and another very ſtrong frame of timber is fixed outſide of the wheels at the level of the water, which floats in the water, and is only attached to the mill by chains; this is to protect the wheels from injury, by veſſels which paſs and repaſs. Each water-wheel is 18 feet diameter, and 14 feet broad; the float-boards are each 3 feet deep, and are about ſixteen in number, affixed on the circumference of cart iron-wheels, or circles, which are 12 feet diameter, there are three of theſe circles for each wheel; hence we find each float-board expoſes a ſurface of 42 ſquare feet to the action of the current, and if we ſuppoſe each wheel to have two floats in action at the ſame time, the power of the mill will be derived from 168 ſquare feet acted upon by the water, which ſeldom exceeds a velocity of four miles *per* hour, or 352 feet *per* minute.

The iron axis of the water-wheels is a hollow tube of nine inches diameter outſide, and five inches within, made in four lengths of 12 feet each, properly joined together, and extending acroſs the veſſel from one wheel to the other. On the middle of this axis a large wheel of 11 feet diameter is fixed, and ſurrounded by a brake or gripe like that uſed in a wind-mill, the uſe of which is to ſtop the mill when it requires repairing. Near to this brake-wheel is a large bevilled cog-wheel 13 feet diameter, with 89 cogs, which gives motion to a bevilled pinion two feet eight inches diameter, with eighteen cogs fixed on the top of a vertical axis. On this axis is alſo a large horizontal ſpur-wheel 12 feet diameter, with 201 cogs, which gives motion to pinions of one foot diameter, and 17 cogs fixed on the ſpindles of the mill-ſtones. There are four pair of mill-ſtones, two pair of $4\frac{1}{2}$ feet and two pair of $3\frac{1}{2}$ feet diameter, and the mill alſo works a dreſſing-machine for the flour. The mill-ſtones make $57\frac{1}{2}$ revolutions for one revolution of the water-wheels, which move very ſlow, ſcarcely two turns *per* minute, in the moſt favourable periods of the tide. The circumference of each taken through the middle of the float-boards is 47 feet; hence the float-boards move about 94 feet *per* minute, when the mill-ſtones make their proper number of revolutions to grind with the greateſt effect.

It was found that on a flood-tide, this mill would drive two pair of $3\frac{1}{2}$ feet mill-ſtones, and a flour dreſſing-machine, but on the ebb-tide only one pair of 4-feet ſtones and the machine; thus it is only the performance of a ſmall mill, although the wheels are of large dimenſions, and it would require enormous wheels to make an effective floating mill in the river Thames.

This machine is now removed from the river, becauſe it was found to do ſo much injury to the veſſels which continually ran againſt its floating frame, and the repairs of the damages frequently done to the mill by ice and the craft took away all the advantages of the mill.

Underſhot Wheels with oblique Floats.—Attempts have been made to conſtruct water-wheels for tide-rivers which receive the impulſe obliquely, like the ſails of a common wind-mill. This would in many ſituations be a great advantage. A very ſlow but deep river could in this manner be made to drive mills; and although much power would be loſt by the obliquity of the impulſe, the remainder might be very great. Dr. Robinſon ſpeaks of a wheel of this kind which was very powerful; it was a long cylindrical frame, having a plate ſtanding out from it about a foot broad, and ſurrounding it with a very oblique ſpiral like a cork-ſcrew. This was immerſed about one-fourth of its diameter (which was nearly 12 feet), having its axis in the direction of the ſtream. By the work which it was performing, it ſeemed more powerful than a common wheel which occupied the ſame breadth of the river. Its length was not leſs than 20 feet; had it been twice as much it would have been nearly redoubled in its power without occupying more of the water-way. It is probable ſuch a ſpiral continued quite to the axis, and moving in a hollow canal wholly filled by the ſtream, might be a very advantageous way of employing a deep and ſlow current.

In the Tranſactions of the Society of Arts, vol. xix. a water-wheel is deſcribed, in which the float-boards are placed obliquely to the axis of the water-wheel at about an angle of 40 degrees, being fixed to the rim in pairs, which are inclined equally to the axis of the wheel, but in oppoſite directions to each other; ſo that the two float-boards of each pair point towards each other in an angle of about 80 degrees, and if the pair of floats were continued they would meet in the middle of the breadth of the wheel. The water is made to ſtrike the floats within this angle, and in conſequence all the water which is emitted by the ſluice and ſtrikes upon the oblique floats will be reflected from the ſides or ends of the two pair of float-boards towards the vertex of the angle, which they make; but the pair of floats do not touch each other, ſo that the vertex of the angle is open; but to prevent the water paſſing freely through the open angle, one of the float-boards is made to extend far beyond the vertex, or point, where they would interſect, and the other is made to fall ſhort of it, nevertheleſs the water would certainly paſs through the opening. It is ſtated, that the motion of the ordinary wheel with parallel floats is greatly retarded by the reſiſtance which they experience in riſing up or quitting the tail-water of the ſtream, from the

preſſure

preſſure of the atmoſphere on their upper ſurface before the air gets admiſſion beneath the floats; but in Beſant's wheel this reſiſtance is greatly diminiſhed, as the floats emerge from the ſtream in an oblique direction. The water-wheel is conſtructed in the form of a hollow drum, ſo as to reſiſt the admiſſion of the water. Although this wheel is much heavier than thoſe of the common conſtruction, yet it revolves more eaſily upon its axis, as the ſtream has a tendency to make it float. We cannot recommend this wheel, but on the contrary think it one of the worſt forms, as it tends to increaſe that loſs which ariſes in all underſhot-wheels from the change of figure which the water muſt undergo when it ſtrikes the float, and we ſhould not have mentioned it, but that it has been ſo frequently copied and recommended by different authors.

Horizontal Water-wheels actuated by the Impulſe of Water.—Theſe have been conſiderably in uſe on the continent, and deſerve our notice from the ſimplicity of their conſtruction. The wheel is conſtructed in the ſame manner as an underſhot-wheel, having float-boards fixed round its circumference in the form of radii; it is mounted on a vertical axis, the upper end of which is fixed to the ſpindle of the mill-ſtone, if the mill is intended to grind corn; but in ſome caſes, it is better to fix a cog-wheel on the upper part of the vertical axis with teeth round its edge, to give motion to trundles or pinions on the ſpindles of the mill-ſtones, becauſe the floats of the wheel muſt always be made to move with a given proportion of the velocity of the water. The wheel-race or water-courſe may be made nearly the ſame as for an underſhot-wheel, if we ſuppoſe it laid down in an horizontal poſition; that is, a trough or channel of maſonry is conſtructed in which the wheel works, and the float-boards of the wheel are exactly fitted to it: at one end of this channel is the aperture or ſluice through which the ſtream of water iſſues, and ſtrikes the floats of the wheel ſo as to turn it round, and the water paſſes forwards and eſcapes at the other end of the channel. When the water is delivered upon the wheel in an horizontal direction, or perpendicular to its axis, the float-boards ſhould be inclined about twenty-five degrees to the plane of the wheel, and the ſame number of degrees to the radius, ſo that the loweſt and outermoſt ſides of the float-boards may be fartheſt up the ſtream and be met by the water firſt.

In many caſes, the water-courſe is made inclined to the plane of the wheel in ſuch a degree, that the water may ſtrike the float-boards perpendicular to their ſurfaces.

In the ſouthern provinces of France, where horizontal water-wheels are generally employed, the float-boards are made of a curvilineal form ſo as to be concave towards the ſtream; they are generally ſegments of ſpheres, or hollow wooden bowls or ladles fixed on the rim of the wheel: the water, in this caſe, is conducted through a pipe, and projected in a jet on a direction a little inclined to the horizon. When the height of water is very conſiderable, this is, perhaps, the beſt form for the floats, or ladles, as they are called.

The chevalier de Borda obſerves, that in theory a double effect is produced when the float-boards are concave, but that the effect is diminiſhed in practice, from the difficulty of making the fluid enter, and leave the curve in a proper direction. Notwithſtanding this difficulty, however, and other defects which might be pointed out, horizontal wheels with concave float-boards are always ſuperior to thoſe in which the float-boards have plane ſurfaces.

Mr. Smeaton conſtructed a ſmall corn-mill with a horizontal water-wheel, of which the following are the principal dimenſions. Fall of water $52\frac{1}{2}$ feet; diameter, or bore of the noſe-pipe through which the water iſſued in a jet to ſtrike upon the wheel, $1\frac{1}{2}$ inch; diameter of the water-wheel 10 feet to the centre of the floats or ladles, which were twelve in number; they were made of a concave form, nearly ſegments of ſpheres, and about 14 inches in diameter; and fixed round the circumference of the wheel, ſo that the planes of the circular rims, or edges of the hollow ladles, were not perpendicular to the plane of the wheel, but inclined thereto in ſuch a degree, that the jet of water iſſuing from the noſe-pipe at an angle of 22 degrees from the horizontal line, would ſtrike the floats in the centre and perpendicular to the circular edge of the hollow; the internal ſurface of the floats being really ſpherical, the water would always ſtrike perpendicularly into the concavity of the bowl. The water-wheel axis roſe up perpendicularly into the mill-houſe, and on the top a wheel of 4 feet 8 inches in diameter, and 44 cogs, was fixed for giving motion to the pinions on the axis of the mill-ſtones. The largeſt pinion of 17 cogs was fixed on the axis of a pair of ſtones 4 feet 6 inches in diameter, and the ſmaller pinion of 13 cogs on the axis of a ſtone 3 feet 6 inches in diameter. It was not intended to turn both theſe pairs of ſtones at the ſame time, but it was neceſſary to have two pairs for different uſes.

When this mill moved with a proper velocity to grind to the greateſt advantage, if the 4 feet 6 inches ſtones were uſed, the water-wheel made 25 revolutions *per* minute, and the ſtones therefore made 65 revolutions *per* minute, and the float-boards moved with a velocity of 784 feet *per* minute; but when turning the ſmaller mill-ſtones of 3 feet 6 inches diameter, the water-wheel went beſt when it made 26 revolutions, and therefore turned the mill-ſtone 88 turns *per* minute; and the velocity of the floats was 816 feet *per* minute.

Mr. Smeaton calculated the velocity of the water iſſuing from the pipe at 3403 feet *per* minute, which is the velocity due to a 50 feet feet, becauſe he allowed the $2\frac{1}{2}$ feet to overcome friction, and the expenditure of the $1\frac{1}{2}$ inch noſe-pipe at 30 cubic feet *per* minute allowing for friction. This mill ground one buſhel of wheat *per* hour, on the average of a great many experiments, now $30 \times 50 = 1500$ cubic feet, falling one foot *per* minute. It is found by repeated experiments, that 600 cubic feet falling one foot *per* minute on a good water-wheel is an ample allowance for grinding a buſhel of wheat, as it may be done by 530; hence this fall of water ought to have ground $2\frac{1}{2}$ buſhels *per* hour inſtead of one. The mill, however, admits of improvement in making the floats of the wheel move quicker.

When the mill-ſtone of an horizontal mill is fixed on the upper end of the axis of the water-wheel, if the mill-ſtone be five feet in diameter, it ſhould never make leſs than ſixty turns in a minute, and the wheel muſt perform the ſame number of revolutions in the ſame time; and in order that the effect may be a maximum, or the greateſt poſſible, the velocity of the current muſt be more than double that of the wheel.

Suppoſe the mill-ſtone, for example, to be 5 feet diameter, and the water-wheel 7 feet, it is evident that the mill-ſtone and wheel muſt at leaſt revolve 60 times in a minute; and ſince the circumference of the wheel is 22 feet, the float-boards will move through that ſpace in the 60th part of a minute, that is, at the rate of 22 feet *per* ſecond; which being doubled, makes the velocity of the water 44 feet one ſecond, anſwering, as appears from the rule, for the velocity of falling water, to a fall of 30 feet. But if the given fall of water be leſs than 30 feet, we may procure the ſame velocity to the mill-ſtone, by diminiſhing

ing the diameter of the wheel. If the wheel, for inftance, is only 6 feet diameter, its circumference will be 18.8 feet, and its floats will move at the rate of 18.8 feet in a fecond, the double of which is 37.6 feet *per* fecond, which anfwers to a head of water 22 feet high. The diameter of the water-wheel, however, fhould never be lefs than 6 or 7 feet, becaufe the float-boards change their direction fo rapidly, in confequence of their proximity to the centre, that they will not receive the full action of the water, becaufe it acts in a perpendicular direction to the float-board only for a moment. Hence there will be a certain height of the fall, beneath which the fimple horizontal wheel cannot be employed; and beyond that, wheel-work muft be introduced to obtain the requifite velocity for the millftones.

In the provinces of Guienne and Languedoc, in France, another fpecies of horizontal wheel is employed for turning machinery. It confifts of an inverted cone, with fpiral float-boards of a curvilineal form winding round its furface. The wheel moves on a vertical axis in a pit or well of mafonry, to which it is exactly fitted, like a coffee-mill in its box. It is driven chiefly by the impulfe of the water, conveyed by a fpout or canal in a ftream, which ftrikes the oblique float-boards; and when the water has fpent its impulfive force, it defcends along the fpiral float-boards, and continues to act by its weight till it reaches the bottom, where it is carried off by a canal. The idea of this machine is ingenious. The jet of water, being firft applied to the upper or largeft part of the cone, ftrikes the float-boards at the part where they move with the greateft velocity, in confequence of their being on the largeft radius; but as the water lofes its velocity, in confequence of the motion it has imparted to the wheel, it defcends in the cone, and acts upon the floats lower down, where, the radius being lefs, the floats move more flowly, and are therefore better adapted to receive the action of the water with its diminifhed velocity.

M. Mannoury Dectot's horizontal Water-Wheel, which he calls Danaide.—This receives the impulfe of the water in a different manner from any which we have defcribed, and is defcribed in a report to the Inftitute of France in 1813. The water-wheel is fixed in a horizontal pofition upon a vertical axis, and fupported upon the pivots thereof, fo as to be capable of turning round. It is not in reality a wheel, but a hollow cylinder or drum capable of containing water; it is open at top, and united to the axis in the centre of the circular plane, which forms the bottom. Within this drum, and concentric with it, a folid cylinder is fixed; it is of lefs dimenfions than the drum itfelf, and occupies fuch portion of the content of the drum as to reduce the open part which can contain water to a hollow ring or circular trough, open at top, and of a confiderable depth, but only a few inches in width. The depth is defcribed as being nearly as great as the diameter of the wheel.

The water coming from an elevated refervoir, is projected in jets from one or more pipes into this annular fpace which furrounds the rim of the wheel. Thefe pipes defcend in an inclined direction, till they are nearly on a level with the furface of the water in the annular fpace; and the extremities turn horizontally, fo as to project the jet horizontally, and in the direction of tangents to the mean circumference of the water contained in the annular fpace.

Suppofe this fpace which furrounds the wheel is full of water, then the ftream iffuing from the jet caufes the wheel to turn round upon its axis, becaufe it takes hold or acts upon the water in the annular fpace, and tends to give the water a circulating motion within the annular fpace; but the friction, or refiftance, which the water would find in fuch circulation, caufes the wheel to turn round with the water, unlefs the load on the wheel, or refiftance to its motion, is too great.

The water which is continually thrown into the wheel efcapes from the annular fpace by paffages which proceed from the bottom thereof to the centre of the wheel; and there are openings at the centre, where the water can drop out *below*. To form the paffages for this purpofe, the folid cylinder which is fixed in the centre of the hollow drum is of lefs depth than the other, and leaves a fpace between the bottom of the folid and the bottom of the hollow, which is divided into compartments by diaphragms fixed upon the bottom of the trough, and proceeding like radii from the circumference to a central hole in the bottom of the trough, which is left open to allow the water to efcape. The report ftates, that the velocity with which the water iffues from the jets makes the machine move round its axis; and this motion accelerates by degrees, till the velocity of the water in the annular fpace equals that of the water from the refervoir, fo that no fenfible fhock is perceived of the affluent water upon that which is contained in the machine. The motion of the wheel is regular, becaufe the action is continual; but in the cafe of other water-wheels, where the water ftrikes againft float-boards, fuch boards muft neceffarily be of a determinate number, and the motion muft be given to the wheel by a fucceffion of impulfes, as the floats arrive before the ftream. We might indeed fuppofe a wheel with an infinite number of floats, but it would then amount to a plain cylindrical or flat furface, upon which the water would not take fufficient hold to produce any fenfible effort to turn it round.

Now in M. Dectot's wheel, in place of float-boards, the rim of the wheel is clothed with water, which is capable of being acted upon by the water iffuing from the jets. This action tends to put the water in the annular fpace in motion, and to carry the wheel along with it, by the adhefion it muft naturally have to the fides of the channel which contains it. The velocity of the wheel will be in proportion to the refiftance that the load makes to its motion.

The circular motion of the wheel communicates a centrifugal force to the water contained in the annular cavity of its rim, which caufes it to prefs againft the outermoft fide of the channel. This centrifugal force acts equally upon the water contained in the compartments at the bottom of the faid rim; but its action diminifhes as the water approaches the centre.

The whole mafs of water is then animated by two oppofite forces, *viz.* gravity and the centrifugal force. The firft tends to make the water run out at the hole in the bottom of the wheel at the centre, and the fecond to drive the water from that hole.

To thefe two actions are joined a third, *viz.* friction or refiftance, which acts an important and fingular part; and in this machine the friction of the water produces its powers of action, while in moft other machines it always diminifhes their powers. The effect in this machine would be nothing, were it not for the refiftance which the water finds oppofed to its free circulation in the annular fpace round the rim of the wheel.

By the combination of thefe three forces there ought to refult a more or lefs rapid flow of water from the hole in the centre at the bottom of the wheel; and the flower this water iffues, the greater will be the effective power of the machine for producing the ufeful effect for which it is deftined.

The moving power in this machine, like all others, is the weight of the water which runs into the wheel, multiplied by by the elevation the reſervoir has above the bottom of the wheel, or orifice from which it iſſues in quitting the ſame; but the uſeful mechanical effect is ſtated to be equal to that product, diminiſhed by half the force which the water retains, when it flows out at the orifice below, and quits the machine.

In order to aſcertain, by direct experiment, the magnitude of this effect, Meſſrs. Prony and Carnot fixed a cord to the axis of the machine, which paſſing over a pulley, raiſed a weight by the motion of the machine. By this means the effect was found to be $\frac{7}{10}$ths of the power, and often approached $\frac{75}{100}$ths, without reckoning the friction of the pulleys, which has nothing to do with the effect.

We cannot help ſuſpecting ſome miſtake in theſe experiments, or in the ſtatement of them, but think the machine deſerves a trial; and if it ſhould produce near the reſult above ſtated, it would be a moſt valuable addition to our means of employing falls of water; and its ſimplicity would be a great recommendation, particularly for corn-mills, becauſe the perpendicular axis is immediately adapted for that purpoſe, without any wheel-work.

Horizontal Mill with oblique Vanes.—In Belidor's Architecture Hydraulique he deſcribes a different form of horizontal mill. The wheel is a circular rim, and the radii or arms are all oblique vanes or floats, preciſely the ſame as the common ſmoke-jack. This wheel is placed horizontally in a well, to which it is exactly fitted, but the rim of the wheel does not touch the circular wall of the well. The axis of the wheel aſcends upwards into the mill-houſe, and the ſpindle of the mill-ſtone is fixed into it. A horizontal arch-way is conducted to the well ſideways, and above the part where the wheel is ſituated. This arch conveys the water into the well over the wheel; and beneath the wheel there is a ſimilar horizontal arch to carry away the water, after it has paſſed through the wheel, that is, in the ſpaces between its vanes or floats. The weight of the water preſſes upon them in a perpendicular direction, and the planes of theſe floats being all inclined to the horizon, the action of the preſſure tends to turn the wheel round on its axis, by the ſame action as the ſmoke upon the vanes of a jack, or like a wind-mill.

The water is ſupplied in ſuch a body through the upper arch, that the well is always kept full, with a conſiderable depth of water preſſing upon the wheel; whilſt the lower arch carries away the water ſo freely, that it runs away from beneath the wheel as faſt as it can paſs through the vanes of the ſame.

The mill deſcribed by Belidor was at Toulouſe, and contained a number of ſuch wheels in a row, each giving motion to one pair of ſtones.

Horizontal Machines moved by the Reaction of Water.—The reaction of water, iſſuing horizontally through a ſpout or orifice, may be employed to communicate motion to machinery; and though this principle has not yet been adopted in practice, it appears from theory, and from ſome detached experiments on a ſmall ſcale, that a given quantity of water, falling through a given height, will produce greater effects by its reaction than by its impulſe. If we ſuppoſe a vertical pipe of any given height, open at both ends, and that water is poured into it at the top, the water will iſſue at the bottom of the pipe with a velocity proportioned in a certain manner to its altitude, becauſe every particle of water which iſſues is preſſed upon and impelled by the weight of all the particles which are above it. Now, ſuppoſe the pipe bent or curved at the bottom, ſo that it will turn the ſtream of water into a horizontal poſition; in this caſe, the preſſure and force, of which we have ſpoken, will be deflected from the vertical direction to the horizontal. Now it is clear that the bent part of the pipe, or ſome part of the interior ſurface of the tube oppoſite to the orifice, muſt ſuſtain all the preſſure which is thus deflected or tranſmitted in another direction; and if the tube is freely ſuſpended, it will retreat before this preſſure, and be put in motion. If we ſuppoſe the tube to have no reſiſtance to motion, then it would receive all the motion of the water, which would not move at all after it iſſued from the orifice, but the orifice and tube would move away from the water. This is an impoſſible caſe, and in reality the motion of the effluent water will be divided between the pipe or tube and the iſſuing water, in proportion to the reſiſtance with which each is loaded. Another and perhaps more familiar explanation is, that the water preſſes againſt every part of the interior part of the pipe, except againſt the orifice or aperture, which is open; and in conſequence, the unbalanced preſſure on the part oppoſite to the orifice will tend to put the pipe in motion. A ſky-rocket mounts in the air from a ſimilar cauſe.

Dr. Barker's mill by the reaction of water was the firſt of this kind of machines, and is deſcribed by Deſaguliers, in 1743. In his Experimental Philoſophy, vol. ii. p. 460, he calls it a machine to prove Mr. Parent's propoſition experimentally, *viz.* that an under-ſhot water-mill does moſt work, when the water-wheel moves with only a third part of the natural velocity of the water that drives it. He ſays, that Dr. Barker had this thought, and communicated it to him, ſaying, that it would be an experimental proof of Mr. Parent's propoſition; in conſequence of which, Deſaguliers made a working model of it, which he ſhewed to the Royal Society, and the experiments upon it, at their meeting in 1742.

It conſiſts of an upright pipe or trunk, communicating with two horizontal branches, like an inverted T; thus, ⊥. This perpendicular pipe is poiſed upon a pivot at the lower end, and the upper end is connected with the ſpindle of the mill-ſtone, or other machine to which it is to communicate motion. The top of the pipe is formed into a funnel, into which a ſtream of water is conducted, and runs down the pipe: the water eſcapes through a hole in each of the horizontal arms, which holes are near the ends of the arms, and open in oppoſite directions, and in ſuch a poſition that they will direct the ſtream of water horizontally, and nearly at right angles to the length of the arms.

Suppoſe water to be poured in at the top of the tube from the ſpout, it will then run out by the holes at the ends of the arms, with a velocity correſponding with the depth of theſe holes beneath the ſurface of the water in the vertical pipe. The conſequence of this muſt be, that the arms muſt be preſſed backwards, for there is no ſolid ſurface at the hole on which the lateral preſſure of the water can be exerted, while it acts with its full force on the inſide of the tube oppoſite to the hole. This unbalanced preſſure, acting upon the oppoſite ſides of both arms, will make the tube and the horizontal arm revolve upon the ſpindle as an axis.

This will be more eaſily underſtood, if we ſuppoſe the orifices to be ſhut up, and conſider the preſſure upon a circular inch of the arm oppoſite to the orifice, the orifice being of the ſame ſize.

The preſſure upon this circular inch will be equal to a cylinder of water, whoſe baſe is one inch in diameter, and whoſe altitude is the height of the fall; and the ſame force is exerted upon the ſhut-up orifice. Theſe two preſſures being equal, and acting in oppoſite directions, the arm will remain at reſt; but as ſoon as the orifice is opened, the water will iſſue with a velocity due to the height of the fall. The preſſure of the water upon the orifice will now be removed, and as the preſſure upon the circular inch oppoſite to to the orifice ftill continues, the equilibrium will be deftroyed, and the arm will move in a retrograde direction, unlefs it is withheld by fome force greater than that preffure.

In the original model made by Defaguliers, the vertical tube was a cylindrical pipe, but the lower arms were of a fquare figure in their crofs fection, and the apertures through which the water iffued were likewife of a rectangular figure, and provided with fliders or fluices, which were regulated by fcrews fo as to increafe or diminifh the openings.

It is clear that the machine muft prefs backwards, and there is no difficulty in underftanding the intenfity of this preffure, when the machine is at reft. But when it is allowed to run backwards, withdrawing itfelf from the preffure, the intenfity of it is diminifhed; and if no other circumftances intervened, it might not be difficult to fay what particular preffure correfponded to any rate of motion. Defaguliers affirms the preffure to be the weight of a column, which would produce a velocity of efflux equal to the difference of the velocity of the fluid and of the machine: and hence he deduces, that its performance will be the greateft poffible, when its retrograde velocity is one-third of the velocity acquired by falling from the furface; in which cafe, it will raife $\frac{8}{27}$ths of the water expended to the fame height.

But this is not a perfect account of the operation; for the water which iffues defcends in the vertical trunk, and then moving along the horizontal arms, partakes of their circular motion. This excites a centrifugal force, which muft be exerted againft the ends of the arms by the intervention of the fluid. The whole fluid contained in the arms is fubject to this action, each part in a degree proportioned to its diftance from the axis, becaufe every particle is preffed with the accumulated centrifugal forces of all the fections that are nearer to the axis. This increafes the velocity of revolution, and this mutual co-operation would feem to lead to a continual acceleration in the velocity of both motions. But, on the other hand, this circular motion muft be given anew to every particle of water, when it enters the horizontal arm. This can be done only by the motion already in the arm, and at its expence; neither can the perpendicular tube furnifh an unlimited fupply. Thus there muft be a velocity which cannot be exceeded even by an unloaded machine.

Improved Form of Dr. Barker's Mill.—This confifts in introducing the fupply of water at the lower end of the tube, inftead of the upper end. It was firft propofed by M. Mathon de la Cour, in the Journal de Phyfique, 1775; and the invention was, 20 years afterwards, claimed by a Mr. Ramfey, and very recently by M. Mannoury Dectot in France. This laft machine is very highly recommended by Meffrs. Perier, Prony, and Carnot, in a report to the Inftitute, from which we make the following extracts.

The water is introduced into the revolving arms at the lower part, through the axle: the pipe which brings the water enclofes the pivot, upon which it turns. This water is brought to the refervoir through a curved canal, by means of which the revolving arms, and the mill which it puts in motion, are placed by the fide of the refervoir, and neither above nor below it, which would much injure the working, and the fimplicity of the machine. By bringing the water from below, by means of a canal, the machine is reduced to a fimple water-wheel, the axis of which is fixed immediately to the moving mill-ftone.

Although the water enters with little velocity into the revolving arms, it caufes them to turn very faft, becaufe the apertures for its egrefs being much fmaller than thofe for its entrance, the velocity at the entrance is reciprocally much fmaller than it is at the egrefs. But this velocity at the egrefs is not an abfolute motion; it is only a relative motion with refpect to the tube from which it iffues, otherwife there would refult a fpontaneous augmentation of power, which would not agree with the principles of mechanics.

The apertures for the entrance and the egrefs of the water being proportioned as they ought to be, in order to obtain the greateft effect; then the report ftates,

1. The reaction, that is, the force of preffure which acts upon the revolving arms, at each of the apertures of egrefs, is equal to the weight of a column of water of the fame bafe as the aperture, and of the height of the level of water in the refervoir.

2. The velocity of the rotation of the arms meafured at the fame points is to the velocity due to the height of the level of the water in the refervoir, as the aperture for the entrance of the water into the mill-wheel is to the fum of the apertures of egrefs.

Whence it follows, by multiplying this force and this velocity, that the effect produced by the machine in a given time is equal to the weight of all the water that the refervoir can furnifh during this time, by the height of the level of the water in the refervoir. Now this product, it is well known, is the utmoft that can be obtained by the beft hydraulic machines.

This difpofition of Dr. Barker's machine has a confiderable advantage, which is, that the column of water which enters into the arms, by preffing from below on the part above, with all the weight of the refervoir, fuftains a great part of the weight of the machine, and confequently greatly diminifhes the friction of the pivot againft the focket in which it turns; while, on the contrary, when the water enters at the top, as in the old reacting machines, which is already very heavy of itfelf, this flowing water confiderably augments the weight, and confequently the refiftance.

This difpofition cannot be ufed, except where the bulk of water is not very confiderable.

As the arms turn, while the conduit which brings the water is immoveable, the pipe that brings the water to enter the collar of the arms is rather lefs than the collar, fo as to leave very little play between them, and is made tight by furnifhing this fmall interval with a leather collar. Another method is by furnifhing the tube at bottom, which is fixed, and the moveable collar of the wheel, with feveral cylindrical and concentrical furfaces, which fit one into the other without touching. The water fills the deep and clofe grooves formed by the cylindrical furfaces, and is fufficient to prevent that which is forced into the wheel from efcaping by the fides.

Dr. Robinfon defcribes a fuperior method of making fuch a joint, as will admit of a free motion, without any lofs or leakage. This is to make the fixed and moveable tubes very true at the joints, fo that one enters into the other, but do not touch. The two tubes are to be made exactly of the fame diameter withinfide at the joint, fo that a band of thin leather can be applied withinfide of the joint, to cover the crevice: this muft be fixed to the interior of the ftationary tube, and the revolving part being fmooth withinfide, will have very little friction, as it is only rubbed by the leather; but there can be no leakage at the joint, becaufe the water will prefs the leather clofe to the moving tube, but as much water will get in between the leather and the moving tube as to make it move fmoothly.

Theory of Barker's Mill.—This is a moft delicate fubject, and

and upon which it does not appear that fufficient experiments have been made to found a certain theory.

Mr. Waring, of the American Philofophical Society, has given a theory of Barker's mill with the laft-mentioned improvement, and, contrary to every other philofopher, he makes the effect of the machine equal only to that of a good underfhot wheel, moved with the fame quantity of water falling through the fame height.

Mr. Gregory, in his Mechanics, vol. ii. has given this paper with fome corrections, and recommends it as the beft theory. The following rules, deduced from his calculus, may be of ufe to thofe who may wifh to make experiments on the effect of this interefting machine.

1. Make each arm of the horizontal rotatory tube or arm of any convenient length, from the centre of motion to the centre of the apertures, but not lefs than one-third (one-ninth according to Mr. Gregory) of the perpendicular height of the water's furface above their centres.

2. Multiply the length of the arm in feet by .6136, and take the fquare root of the product for the proper time of a revolution in feconds, and adapt the other parts of the machinery to this velocity; or if the required time of a revolution be given, multiply the fquare of this time by 1.629 for the proportional length of the arm in feet.

3. Multiply together the breadth, depth, and velocity *per* fecond, of the race, and divide the laft product by 18.47 times (14.27 according to Mr. Gregory) the fquare root of the height, for the area of either aperture.

4. Multiply the area of either aperture by the height of the fall of water, and the product by $41\frac{2}{3}$ pounds (55.775 according to Mr. Gregory) for the moving force, eftimated at the centres of the apertures in pounds avoirdupois.

5. The power and velocity at the aperture may be eafily reduced to any part of the machinery by the fimpleft mechanical rules.

The only account we have of an actual machine, except the firft model by Defaguliers, is by M. Mathon de la Cour, who faw one at Bourg Argental, of the following dimenfions. Length of the revolving arms feven feet eight inches, and diameter three inches; diameter of each orifice $1\frac{1}{8}$ inch; fall of water, from the level furface in the refervoir to the apertures in the revolving arms, twenty-one feet. The water was introduced at the lower end of the revolving axis, through an opening of two inches, the two furfaces being fitted together by grinding.

When this machine was performing no work, and emitted water by one hole only, it made 115 turns *per* minute. This gives a velocity of (24 feet circumference $\times$ 115 $=$) 2760 feet *per* minute for the hole; but the effluent velocity by theory would be only 2215 feet *per* minute at 21 feet height, and in reality would be little more than fix-tenths of that velocity, or about 1370 feet *per* minute. Dr. Robinfon fuppofes even this to be much lefs than the velocity with which the water iffued from the pipe, as we may readily believe, becaufe all the force of the machine was expended in working like a centrifugal pump, to draw the water out of the pipe of fupply, with a velocity greater than that with which it would run by the preffure of the column alone. The empty machine weighed 80 pounds, $28\frac{1}{2}$ pounds of which would be borne up by the preffure of the column of 21 feet on a two-inch bafe, fo that the friction of the pivot would be much diminifhed. We have no account of any work done by the machine, as it was only employed to turn a ventilator for a large hall.

Euler's Machine to act by the Reaction of Water.—His machine confifts of a hollow conchoidal ring, that is, a folid fhaped juft like a large church bell. Suppofe alfo another bell, of fmaller dimenfions, placed within the former, and leaving a fpace all round between the two, the two bells are joined at the lower edges, fo that the water cannot efcape from the fpace between them. This machine is mounted on a perpendicular axis, and on the top is a fort of funnel bafon, which receives the water from the fpout, not in the direction pointing towards the axis, but in the direction of a tangent, and the water is delivered with the precife velocity of the wheel's motion. This prevents any retardation by dragging forward the water. The water paffes down from the funnel or bafon between the outer conchoid or bell, and the inner conchoid, through fpiral channels formed by partitions foldered to both conchoids. The curves of thefe channels are determined by a theory which aims at the annihilation of all unneceffary and improper motions of the water, but which is too abftrufe to find a place here. The water thus conducted arrives at the bottom of the fpace between the two bells. On the lower circumference of this bottom is arranged a number of fpouts, one from each fpiral channel, which are all directed horizontally, and turned one way in tangents to the circumference.

The fame effects will be produced, if we fuppofe only one bell, with a number of tubes or pipes wound in a fpiral direction round its external circumference, the lower ends of each tube being turned horizontally, and in the direction of tangents to the circle which it defcribes, alfo the upper or higher extremities of the tubes, connected with a circular fuperficies into which the water flows from a refervoir. When the machine has this form, it has been fhewn by Albert that the effect will increafe as the velocity is augmented, and that the maximum effect would be produced if the velocity could be infinite, and that then the effect would be equal to the power. A confiderable portion of the power muft, however, be confumed, in communicating to the fluid the circular motion of the tubes; and, as the portion thus loft muft increafe with the velocity of the tubes, the effect will not in reality fuftain an augmentation from an increafe of velocity, beyond a certain point.

It is plain that this form of the machine muft be a moft cumbrous mafs; even in a fmall fize and height it would require a prodigious veffel, and muft carry an unwieldy load. If we examine the theory which recommends this conftruction, we find that the advantages, though real and fenfible, bear but a fmall proportion to the whole performance of the fimple machine, as invented by Dr. Barker. It is therefore to be regretted, that engineers have not attempted to realize the firft project.

Machines actuated by the Weight of Water.—The principal of thefe are breaft-wheels, overfhot-wheels, chains of buckets, and preffure-engines. All thefe have an effential difference from the machines which we have yet defcribed, becaufe the water is prevented from defcending, unlefs the machine moves before the water. This is not the cafe with the machines which receive their motion from the impulfe of the water, becaufe the water is fuffered to defcend and acquire its full velocity before it ftrikes the machine.

In reafoning without experiment, we might be led to imagine, that, however different thefe modes of application are, yet whenever the fame quantity of water defcends through the fame perpendicular fpace, the effective powers of two machines, which are actuated by fuch fall of water, would be equal, provided that the machines were free from friction, and equally well calculated to receive the full effect of the power of water, and to make the moft of it.

For if we fuppofe the height of a column of water to be thirty inches, and that it refts upon a bafe or aperture of one inch fquare, then every cubic inch of water that departs

from

from the lower end of the column will acquire the fame velocity of motion, from the uniform preffure of the thirty cubic inches which are above it, that one cubic inch let fall from the top would acquire in falling down to the level of the aperture, *viz.* fuch a velocity as in a contrary direction would throw or project it to the level from whence it fell, the weights and velocities in both thefe cafes being equal, the products, or what we have called mechanical powers, will alfo be equal. We might therefore be led to fuppofe, that a cubic inch of water, let fall through a fpace of thirty inches, fo as to inpinge upon a folid body, would be capable of communicating thereto an equal motion or mechanical effect by collifion, as if the fame cubic inch had defcended through the fame fpace with a flower motion, and produced the effect gradually; for in both cafes gravity acts upon an equal quantity of matter through an equal fpace.

It is true that the gravitating force acts a longer fpace of time upon the body that defcends flowly, than upon the other which falls quickly; but this cannot occafion the difference in the effect: for we find by experiment, that an elaftic body falling through any given fpace will, by collifion upon another elaftic body which is fixed, rebound nearly to the height from which it fell: or, by communicating its motion to a body equal to itfelf, will caufe that body to afcend to the fame height. On thefe principles we might conclude, as fome authors have done, that whatever was the ratio between the power and effect in underfhot wheels, the fame would hold true in overfhot, and indeed in all others.

However conclufive this reafoning may feem, it will appear, in the courfe of the following deductions, that the effect of the gravity of defcending bodies is very different from the effect of the ftroke, of fuch as are *non-elaftic*, though generated by an equal mechanical power.

It is true that, in the cafes we have above fuppofed, the power of the fall of water is the fame; but the problem propofed to the engineer is, to obtain from it all or as much as poffible of the power, and render it applicable to fome ufeful purpofe. We have already given our definition of *power*, that it is weight or matter compounded with motion. Now to obtain all the power from any ftream of water, we muft abftract from it all its weight and all its motion. In underfhot wheels, or any others moved by the impulfe of the water, we cannot come near this, becaufe we have already fhewn, that the greateft effect is produced, when the velocity of the wheel is two-fifths of the velocity of the moving water. The water, after it has finifhed its effect, is difcharged with that velocity; hence it retains and carries away with it three-fifths of its original power. Neither can we obtain the full effect of the weight of the water, for another lofs is fuftained, in the change of figure which the water experiences, when it ftrikes the float-board. This is much greater than is ufually fuppofed, in confidering machines, although it muft be familiar to any one who confiders the refiftance of a boat, or other body, when drawn through water. No weight is raifed in thefe cafes, unlefs the motion be rapid, (fo as to raife a wave before the moving body;) but all the power is expended in changing the figure of the water, by dividing the particles, and putting them in new pofitions, fo that the body can pafs between them.

It is to this fource that we muft look, for the difference between two-fifths of the power, which we find is abftracted from the whole power of the water by an underfhot-wheel, and one-third of the power, which is the utmoft we can obtain by means of an underfhot wheel.

In the other clafs of machines, which are actuated by the weight of water, we can obtain a much greater fhare of the power of the defcending water. The weight of the water is borne by the machine, which muft therefore receive the whole weight of the water, and the lofs is chiefly in the motion which the water ftill retains after departing from or quitting the machine; but as we are not confined, as in the former inftance, to any fixed velocity of motion for the wheel, we may make it move almoft as flowly as we pleafe, fo that the water will carry away with it a very fmall fhare of the velocity which it would have acquired by falling through the height of the fall. Indeed, if we could fuppofe a wheel to be without friction, and no water to leak or efcape from thofe veffels, or parts of the wheel which contain the water, it would be poffible to obtain an effect from it very nearly equal to the power.

Breaft-Wheels.—Thefe are very commonly called underfhot wheels, becaufe the water runs beneath the wheel, but improperly, becaufe the water does not fhoot againft the floats of the wheel, or at leaft the principal power is derived from the weight of the water. A breaft-wheel partakes of the nature of both an overfhot and an underfhot, and is conftructed as is reprefented in *fig.* 1. *Plate* I. of *Water-wheels.* The lower part of the wheel is furrounded by a curved wall or fweep of mafonry, which is made concentric with the wheel, and the float-boards of the wheel are exactly adapted to the mafonry, fo as to pafs as near as poffible thereto without touching it; and the fide walls are in like manner adapted to the end of the float-board or fides of the wheel, the intention being, that as little water as poffible fhall be able to pafs by the float-boards without caufing the boards to move before it. The water is poured upon the wheel over the top of the breafting at I, the efflux from the mill-dam R being regulated by the fluice or fhuttle M, which is placed in the direction of a tangent to the wheel, and is provided with a rack N, and pinion P, by which it can be drawn up fo as to make any required degree of opening, and admit more or lefs water to flow on the wheel.

The water firft ftrikes on the float, and urges it by its impulfe; but when the floats defcend into the fweep, they form as it were clofe buckets, each of which will contain a given quantity of water, and the water cannot efcape from thefe buckets except the wheel moves, at leaft this is the intention, and the wheel is fitted as clofe as it can be to the race with that view. Each of the portions of water contained in thefe fpaces bears partly upon the wall of the fweep, and partly upon the floats of the wheel; and its preffure upon the floats, if not exceeded by the refiftance, will caufe the wheel to move; hence the action upon all the floats which are within the fweep of the breafting is by the weight of the water alone; but the water is made to impinge upon the firft float-board with fome velocity, becaufe the furface of the water in the dam K is raifed confiderably above the orifice beneath the fhuttle where the water iffues.

The upper part of the fall at I is rounded off to a fegment of a circle called the crown of the fall, and the water runs over it. The lower edge of the fhuttle when put down is made to fit to this curve, fo as to make a tight joint; and in confequence when the fhuttle is drawn up, the water will run between its lower edge and the crown in a fheet or ftream which ftrikes upon the firft float that prefents itfelf, nearly in a direction perpendicular to the plane of the float-board, or of a tangent to the wheel. The float-boards of the wheel are directed to the centre, but there are other boards placed obliquely which extend from one float-board to the rim of the wheel, and nearly fill the fpace between one float-board and the next. Thefe are called rifing-boards, and the ufe of them is to prevent the water flowing over the float-board into the interior of the wheel; but the edges of thefe these boards are not continued so far as to join to the back of the next float, because that would make all the boards of the wheel close, and prevent the free escape of the air when the water entered into the spaces between the floats.

As the water strikes with some force, the rising-board is very necessary, to prevent the water from dashing over the float-boards into the interior of the wheel.

This is the form of breast-wheel employed by Mr. Smeaton in the great number of mills which he constructed ; but although he speaks of the impulse of the water striking the wheel, he always endeavoured to make the top of the breasting or crown of the fall as high as possible, so as to attain the greatest fall and the least of the impulsive action. All rivers and streams of water are subject to variation in height from floods or dry seasons, and in some this is very considerable ; it was therefore necessary to make the crown I of the fall at such a height as that in the lowest state of the water R, it would run over the crown in a sheet of three or four inches in thickness, and work the wheel. When the water rose higher in the mill-dam, it would then have a pressure to force it through, and in that case would strike the wheel so as to impel it by the velocity.

Mr. Smeaton was well aware that the power communicated by this impulse was very small. In some cases, where the water was very subject to variation, he used a false or moveable crown, that is, a piece of wood which fitted to the crown I, and raised the surface thereof a foot or more, so as to obtain the greatest fall when the water stood at a mean height ; but when the water sunk too low to run over this moveable crown, it could be drawn up to admit the water beneath it. This effect has since been produced in a more perfect manner by making the crown of the fall a moveable shuttle, to rise and fall according to the height of the water in the mill-dam, by which means the inconvenience before-mentioned is avoided.

Improved Breast-wheel, in which the Water runs over the Shuttle.—*Fig.* 7. is a section of one of this kind. A is the water which is made to flow upon the float-board B, and urges the wheel by its weight only, the water being prevented from escaping or flowing off the float-boards by the breast or sweep D D, and the side-walls which inclose the floats of the wheel. The upper part of the breast D D is made by a cast-iron plate, curved to the proper sweep to line with the stone-work. On the back of the cast-iron plate the moving shuttle *e* is applied ; it fits close to the cast-iron so as to prevent the water from leaking between them, and the water runs over its upper edge. F is an iron groove or channel let into the masonry of the side-walls, and in these, the ends of the sliding shuttle are received ; *f* is an iron rack, which is applied at the back of the shuttle, and ascends above the water-line where the pinion *g* is applied to it to raise or lower the shuttle. The axis of the pinion is supported in a frame of wood I I ; *h* H is a toothed sector and balance-weight, which bears the shuttle upwards, or it might otherwise fall down by its own weight, and put the mill in motion when not intended. G is a strong planking, which is fixed across between the two side-walls, and retains the water when it rises very high, as in time of floods ; but in common times the water rises only a few inches above the lower edge of the planking. When the shuttle is drawn up to touch this lower edge, the water cannot escape ; but when the shuttle is lowered down, it opens a space *e* through which the water flows upon the float-boards of the wheel. This was the form first adapted for the falling-shuttle, but its construction has since been much improved.

Fig. 4. *Plate* II. is a section of the most improved form for a breast-wheel, taken from the Royal Armoury Mills, at Enfield Lock, erected by Messrs. Lloyd and Ostel. The general description of this, is like the former, but it is constructed in a better manner, and unites strength with durability. The breast of masonry is surmounted by a cast-iron plate A $2\frac{1}{2}$ feet high, which is let into the masonry of the side walls at each end, and the lower part is formed with a flanch, by which it is bolted to the stone-breast at top. This plate is made straight at the back for the shuttle B to lie against, and it slides up and down. The ends of the gate are guided by iron groove pieces or channels which are let into the stone-work of the side walls, and being made wedge-like, they fix the ends of the cast-iron breast fast in its place. The grooves are not upright, but inclined to the perpendicular so much, that the plane of the gate is at right angles to a radius of the wheel drawn through the point where the water falls upon the wheel. D is a strong plank of wood, extended between the iron grooves just over the shuttle. When the shuttle is drawn up it comes in contact with the lower side of this piece of wood, and stops the water ; but the piece D is fixed at such a height, that the water will run clear beneath it, unless its surface rises above its mean height.

The float-boards of the wheel do not point to the centre of the wheel, but are so much inclined thereto that they are exactly horizontal at the point where the water first flows upon them. In this way, the gravity of the water has its full effect upon the wheel, and the boards rise up out of the tail-water in a much better position, than if they pointed to the centre of the wheel ; and this is more particularly observable when the wheel is flooded by tail-water penned up in the lower part of the race, so that it cannot run freely away from the wheel. The dimensions of this wheel are as follow :—Diameter 18 feet to the points of the floats, and 14 feet wide ; the float-boards are 40 in number, each 16 inches wide, and each rising-board 11 inches wide. The wheel is formed of four cast-iron circles or wheels, each 14 feet 8 inches diameter, placed at equal distances upon the central axis, which is 14 feet 8 inches long between the necks or bearings, and 9 inches square ; the bearing-necks are $9\frac{1}{2}$ inches diameter. The wheel is calculated to make four revolutions *per* minute, which gives near $3\frac{1}{2}$ feet *per* second for the velocity with which the float-boards move. The fall of water is six feet, and the power of the wheel, when the shuttle is drawn down one foot perpendicular, equal to 28-horse power.

Breast-Wheel with two Shuttles.—In this wheel the piece of wood marked D in the last figure, is fitted into the groove of the shuttle, and is provided with racks and pinions to slide up and down, independently of the lower shuttle. The intention of this is, to make the lower shuttle rise and fall, according to the height of the water, so that the water shall always run over the top of it, in the proper quantity to work the mill with its required velocity, whilst the upper shuttle is only used to stop the mill by shutting it down upon the lower shuttle, and preventing the water from running over it. This plan is used when the mill is to be regulated by a governor, or machine to govern its velocity ; in that case the governor is made to operate upon the lower shuttle, and will raise it up, or lower it down, according as the mill takes too much or too little water, and this regulates the supply ; but the upper shuttle is used to stop the mill, and by this means the adjustment of the lower shuttle is not destroyed, but when set to work again, it will move with its required velocity. *Fig.* 3. *Plate* II., *Water-wheels*, is a section of one of the water-wheels at the cotton-mills of Messrs. Strutt, at Belper, in Derbyshire. The width of this wheel is very great, and to render the shuttles A B firm, a strong grating

grating of caſt-iron, is fixed on the top of the breaſt K, and the ſhuttles are applied at the back of the grating E, ſo as to ſlide up and down againſt it, the ſtrain occaſioned by the preſſure of the water being borne by the grating. The lower ſhuttle is moved by means of long ſcrews, *a*, which have bevilled wheels, *b*, at the upper ends, to turn them, by a connection of wheel-work with the wheel-work of the mill. The upper ſhuttle, A, is drawn up or down by racks and pinions, *c*, which are turned by a winch, or handle. The bars of the grating E are placed one above the other, like ſhelves, but are not horizontal; they are inclined, ſo that the upper ſurfaces of all the bars form tangents to an imaginary circle of one-third the diameter of the wheel deſcribed round the centre thereof. Theſe bars are not above half an inch thick, and the ſpaces between them are $2\frac{1}{2}$ inches. The bars are of a conſiderable breadth, the object of them being to lead the water, with a proper ſlope, from the top of the lower ſhuttle A to flow upon the floats of the wheel. This diſpoſition allows the ſhuttles to be placed at ſuch a diſtance from the wheel as to admit very ſtrong upright bars of caſt iron to be placed between the wheel and the ſhuttles, for the ſhuttles to bear againſt, and prevent them from bending towards the wheel, as the great weight of water would otherwiſe occaſion them to do. Theſe upright bars are very firmly fixed to the ſtone-work of the breaſt at their lower ends, and the upper ends are faſtened to a large timber, D, which is ſupported at its ends in the ſide walls, and has a truſs-framing applied to the back of it, like the framing of a roof, to prevent it from bending towards the wheel. The upright bars are placed at diſtances of five feet aſunder, ſo as to ſupport the ſhuttles in two places in the middle of their length, as well as at both ends; and large rollers are applied in the ſhuttle, where it bears againſt theſe bars, to diminiſh the friction, which would otherwiſe be very great.

Theſe precautions will not appear unneceſſary when the ſize of the work is known. The wheel is $21\frac{1}{2}$ feet in diameter, and 15 feet broad; the fall of water is 14 feet, when it is at a mean height; the upper ſhuttle is $2\frac{1}{2}$ feet high, and 15 feet long; the lower ſhuttle is 5 feet high, and the ſame length, ſo that it contains 75 ſquare feet of ſurface expoſed to the preſſure of the water: now taking the centre of preſſure at two-thirds of the depth, or $3\frac{1}{3}$ feet, we find the preſſure equal to that depth of water acting on the whole ſurface; that is, the weight of $3\frac{1}{3}$ cubic feet of water = 208 lbs. bears on every ſquare foot of ſurface, which is equal to 15,600 lbs., or near 7 tons on the lower ſhuttle only; but if we take the two ſhuttles together, the ſurface is 112 ſquare feet, and the mean preſſure 312 lbs. upon each, or 16 tons in the whole. The wheel has forty float-boards pointing to the centre. The wheel is made of caſt-iron. There are two wheels of the dimenſions above ſtated, which are placed in a line with each other, and are only ſeparated by a wall which ſupports the bearings; for they work together as one wheel, and the ſeparation is only to obviate the difficulty of making one wheel of ſuch great breadth as 30 feet, though this is not impoſſible, for there is a wheel in the ſame works 40 feet in breadth, but it is of wood and not in iron, framed in a particular manner, as we ſhall ſoon deſcribe.

Mr. Buchanan's Bucket Water-Wheel for a low Fall.—We have already ſhewn, that where water can be made to act on a wheel by weight, it is much more effectual than when the ſame water is made to act by impulſe; and we ſhall ſhew this more fully in ſpeaking of overſhot-wheels.

Where the fall is leſs than half the diameter of the wheel, if the buckets are made in the uſual form of the buckets for overſhot-wheels, the difficulty of filling them with water, and the ſhort time they are able to retain the water, are ſuch great defects, that in ſuch caſes breaſt-wheels, with open float-boards, ſuch as we have deſcribed, have been found in practice to be more advantageous than bucket-wheels.

Mr. Buchanan ſuggeſts, that, by adopting another form of the buckets, they might be ſo made as to be eaſily filled, and at the ſame time capable of retaining the water in a ſituation to produce nearly its full effect altogether by weight, on a low fall.

In a wheel of this conſtruction, contrary to the uſual practice, the water muſt be poured into the buckets from within the circle of buckets inſtead of from without the circle of buckets. How the filling of the buckets from within can be accompliſhed may not at firſt be obvious; but it may be done without the pentrough, which ſupplies the water, making any interference with the arms of the wheel, if it is conſtructed as ſhewn in *figs*. 4. and 5. *Plate* I. *Water-wheels*. *Fig*. 4. is an horizontal ſection of the wheel, and plan of the pentrough; and *fig*. 5. an elevation of the water-wheel.

The buckets in the figure, empty themſelves by means of apertures on the outſide of the wheel, which are the whole length of the buckets, but no wider than juſt ſufficient to diſcharge the water from the buckets when they arrive at the bottom of the wheel, and before they begin to aſcend. A A is the pentrough, into which the ſupply of water is conducted. From B to C a part of the wheel is repreſented, with the ſhrouding removed, to ſhew the form of the buckets, and the ſituation of the water in them; *a*, *a*, *a*, are the apertures by which the water eſcapes from the buckets; *b* the aperture by which the water enters from the pentrough to the buckets. The plan, *fig*. 4., ſhews, that the arms, N N, of the wheel, and the circular rims which ſupport the buckets, occupy only a ſmall part of the breadth of the circular ring of buckets M; ſo that about one-third of the length of the buckets at each end is expoſed on the inſide of the circle, and againſt theſe parts the penſtock is applied, as ſhewn at A A, and the arms and rim of the wheel, move clear of it; but the buckets, as they paſs, receive water, which flows in a continual ſtream at the orifices, *b*, *b*, of the pentrough; the buckets there become filled from the inſide. The partition-boards or plates which form the buckets are repreſented by the white lines in *fig*. 5., and are ſo ſhaped, that they will retain nearly the whole of the water until they arrive at the loweſt *a*; the water then begins to eſcape, and by the time that each bucket arrives at the loweſt point of the wheel, it will have diſcharged all the water, and will riſe up empty.

This is a truly ingenious contrivance; but we fear that in the execution it would preſent many difficulties, particularly the ring of buckets M, which could not, we think, be ſo firmly affixed, ſupported by the narrow bearing of the two rings and arms N, as to preſerve their circular figure for any great length of time; and any bending or warping of ſuch a heavy maſs as a water-wheel will ſoon deſtroy it. Neither is the advantage which could be derived from receiving the water in cloſe buckets, inſtead of open float-boards, ſo great as is generally imagined.

On the Power and Effect of Breaſt-wheels.—We ſhall fully examine the different effects of the power of water, when acting by its impulſe and by its weight, under the title of *overſhot-wheels*. In breaſt-wheels of the common conſtruction, the effects of impulſe and weight are combined; but what is there deſcribed being carefully attended to, the application of the ſame principles in theſe combined caſes will be eaſy.

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All kinds of machines, where the water cannot defcend through a given fpace, unlefs the wheel moves therewith, are to be confidered as of the fame nature with overfhot-wheels, and equal in power and effect to an overfhot-wheel, in which the perpendicular height that the water defcends from is the fame. All thofe machines that receive the impulfe or fhock of the water, whether in an horizontal, perpendicular, or oblique direction, are to be confidered of the fame nature as underfhot-wheels. Therefore, in a wheel which the water ftrikes at a certain point below the furface of the water in the mill-dam, and after that defcends in the arc of a circle, preffing by its gravity upon the floats of the wheel, the power will be equal to the effect of an underfhot-wheel, whofe fall is equal to the difference of level, between the furface of the refervoir and the point where it ftrikes the wheel, added to that of an overfhot, whofe height is equal to the difference of level between the point where it ftrikes the wheel and the level of the tail-water.

It is here fuppofed that the wheel receives the fhock of the water at right angles to its radii, and that the velocity of its circumference is properly adapted to receive the utmoft advantage of both thefe powers; otherwife a reduction muft be made on that account.

Mr. Oftel, an experienced engineer, informs us, that the velocity of the water-wheel's circumference fhould always be between three and four feet *per* fecond; but he has not been able to determine which of thefe two velocities is the beft, except in cafes where a wheel is fubject to be flooded by tail-water; and in that cafe four feet *per* fecond is beft. Mr. Smeaton advifed $3\frac{1}{2}$ feet.

On overfhot Water-Wheels.—An overfhot-wheel is fimply a circular ring of open buckets, fo difpofed round the circumference of a vertical wheel, as to receive the water from a fpout placed over the wheel in fuch a manner, that the buckets on one fide of the wheel fhall be always loaded with water, whilft the other fide is empty: in confequence, the loaded fide will caufe it to defcend; and by this motion the water runs out of the lower buckets, while the empty buckets of the rifing fide of the wheel, in their turn come under the fpout, and are filled with water.

A machine fo fimple does not appear to prefent any difficulties in its execution, which fhould require any application of theoretic reafoning to remove them; but in reality it is a matter of fome delicacy to conftruct a wheel in fuch a manner as to obtain the greateft effect from a given fall of water.

It is probable, that the earlieft overfhot water-wheels confifted of a number of wooden boxes or bowls, faftened on the circumference of the wheel; but thefe would foon give place to a better mode of conftruction, in which the circumference of the wheel being furrounded by a circular ring at each fide, the fpace between them was divided into feparate buckets by partition-boards. Thefe partitions did not point to the centre of the wheel in the direction of radii, but were inclined thereto nearly in an angle of forty-five degrees. By this means, the water which iffued from the fpout of the trough above, nearly in an horizontal direction, as a tangent to the wheel, would run into the buckets, and fill them as they arrived in fucceffion at the top or higheft point of the wheel; but as the buckets changed their pofition by the defcending-motion of one fide of the wheel, they would become inclined, and the water contained in the buckets would begin to run over the edges of the partitions between the buckets, and by the time the bucket arrived at the bottom point of the wheel, the whole of the water would be run out and leave the bucket empty, and they would remain empty whilft they afcended on the oppofite fide of the wheel. By this means, a conftant preponderance of one fide of the wheel would be kept up by the water falling into the buckets at the top of the wheel, and flowing from it at the bottom.

The points chiefly to be confidered in conftructing an overfhot-wheel are, firft, that the water fhall be applied on the circumference of the wheel, fo as to be incapable of defcending without communicating motion to the wheel, until the water has defcended to its loweft pofition, and that it fhall then quit the wheel entirely; fecondly, that the utmoft height of fall fhall be attained and ufefully employed; and thirdly, that the load or refiftance to the motion of the wheel fhall be fo adapted and proportioned to the weight of water which is applied in the defcending-buckets of the wheels, that the wheel will move flowly; becaufe we have before fhewn, that whatever velocity the wheel moves with, fo much velocity the water muft retain when it quits the wheel, and will thus carry away fome power with it.

We fhall now proceed to confider all the particulars which contribute to the attainment of thefe objects, taking Mr. Smeaton for our guide, and only adding fuch obfervations as appear neceffary to render his maxims more clear.

I. *On the maximum Effect which can be obtained from a Fall of Water by Means of an overfhot-Wheel.*—The effective power of the fall of water muft be reckoned upon the whole defcent, becaufe it muft be raifed that height, in order to be in a condition to produce the fame effect a fecond time. The ratio between the powers of the falling water fo eftimated, and the mechanical effects produced by the wheel at the maximum, deduced from the mean of feveral of Mr. Smeaton's experiments, is as 3 to 2 nearly. We have before, in our obfervations upon the effects of underfhot-wheels, fhewn that the general ratio of the power to the effect, when greateft, was 3 : 1. The effect, therefore, produced by an overfhot-wheel, under the fame circumftances of quantity and fall of water, is at a medium, double that produced by an underfhot. From this, it appears that non-elaftic bodies, when acting by their impulfe or collifion, communicate only a part of their original power; the other part being fpent in changing their figure in confequence of the ftroke.

The ratio of the power to the effect, computed upon the height of the wheel only, was, at a maximum, as 10 : 8, or as 5 : 4 nearly, becaufe Mr. Smeaton made the wheel of a lefs height than the fall of water, in order to allow fome run or defcent of the water through the fpout or trough, which conducted it into the buckets of the wheel. We find the ratio, between the power and effect, to continue the fame, in cafes where the conftructions are fimilar; hence we muft infer, that the effects, as well as the powers, are as the quantities of water and perpendicular heights multiplied together refpectively.

II. *On the moft proper Height of the Wheel, in Proportion to the whole Defcent.*—The preceding obfervation fhews, that the effect which can be obtained from the fame quantity of water, defcending through the fame perpendicular fpace, is double when it is made to act by its gravity upon an overfhot-wheel, to what could be obtained from it when made to act by its impulfe upon an underfhot-wheel.

Hence it follows, that the higher the wheel is, in proportion to the whole defcent, the greater will be the effect; becaufe an overfhot-wheel depends lefs upon the impulfe of the water when it firft ftrikes the wheel, and more upon the gravity of the water in the buckets. The water which is conveyed into the buckets can produce very little effect by its impulfe, even if its velocity be great; both on account of

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the obliquity with which it ftrikes the buckets, and in confequence of the lofs of water occafioned by a confiderable quantity of fluid being dafhed over their fides. Inftead, therefore, of expecting an increafe of effect from the impulfe of the water occafioned by its fall through fome part of the whole height, we fhould caufe it to act through as much as poffible of this height by its gravity, by making the diameter of the wheel as great as poffible. But a difadvantage attends even this rule; for if the water is conveyed into the buckets with a very fmall velocity, which muft be the cafe when the diameter of the wheel equals the height of the fall, the velocity of the wheel will be retarded by the impulfe of the buckets ftriking againft the water, in order to put it in motion, and much power would be loft by the water dafhing over them. In order, therefore, to avoid all inconveniences, the diftance of the fpout from the receiving-bucket fhould, in general, be about two or three inches, that the water may be delivered with a velocity a little greater than that of the wheel; or, in other words, the diameter of an overfhot-wheel fhould be two or three inches lefs than the greateft height of the fall; and yet it is no uncommon thing to fee the diameters of thefe wheels fcarcely one-half of that height. In fuch a conftruction, the lofs of power is prodigious.

It is always defirable that the water fhould have fomewhat greater velocity, than the circumference of the wheel in coming thereon, otherwife the wheel will not only be retarded by the buckets ftriking the water, but thereby dafhing a part of it over fo much of the power is loft.

The velocity that the circumference of the wheel ought to have, will be known by what we fhall fay next, and the depth of column requifite to give the water its proper velocity, is eafily computed from the rules and tables given in this article, and will be found much lefs than what is generally fuppofed.

This maxim obliges us to ufe a wheel, whofe diameter is nearly equal to the whole fall; but we fhall not gain any thing by employing a larger wheel. It is true, we could then apply the water upon a part of the circumference where the weight will act more perpendicularly to the radius, but we fhould lofe more, by the neceffity of difcharging the water at a greater height from the bottom, becaufe the water, in all cafes, begins to run out of the buckets long before they arrive at the bottom of the wheel.

Suppofe the buckets of both wheels equally well conftructed in either cafe, whether the wheel is only as high as the fall, or of a greater height, then the heights above the bottom, where they will difcharge the water, will increafe in the proportion of the diameter of the wheel. That we fhall lofe more by this, than we gain by a more direct application of the weight, is plain without any further reafoning, by taking the extreme cafe, and fuppofing our wheel enlarged to fuch a fize, that the ufelefs part below would be equal to our whole fall. In this cafe, the water would be fpilled from the buckets as foon as it is delivered into them. All intermediate cafes, therefore, partake of the imperfection of this. It was the object of Mr. Buchanan's bucket-wheel, which we have already defcribed, to avoid this difficulty, and employ a height of fall which bore only a fmall proportion to the whole height of the wheel. This obfervation neceffarily leads us to confider the beft form for the buckets.

III. *On the beft Form for the Buckets of overfhot Wheels.*—It is impoffible to conftruct the buckets fo that they will remain completely filled with water till they reach the bottom of the wheel: indeed, if the buckets were formed by partitions directed to the axis of the wheel, the whole water muft run out by the time they have defcended to the level of the axis; and, in confequence, there muft be a great diminution in the mechanical effect of the wheel. Millwrights have, therefore, turned their chief attention to the determination of a form for the buckets which fhall enable them to retain the water through a great portion of the circumference of the wheel. An infpection of *figs.* 2 and 3 will fhew at once the proper form which has been eftablifhed by long practice. Thefe are called elbow-buckets, becaufe each partition is formed by two boards, which are put together with an angle or elbow. The rule for fetting thefe out is, to divide the wheel into the number of buckets it is intended to have; then take four-fifths of the fpace or interval between two partitions for the depth of the fhrouding, that is, the breadth of the circular rings at the fides of the wheel, which form the ends of the buckets, and are called the fhrouds; whilft the planking, which forms the bottom of all the buckets, is called the fole of the wheel. That board of each partition which is in the direction of a radius to the wheel, rifes from the fole half the depth of the fhroud; the other board of the bucket is fo inclined, that its outer end fhall be advanced beyond the line of the next radius-board, if it was produced.

It is a great advantage to make the partitions of the buckets thin, particularly the edges of the partitions, which will meet and divide the ftream of water flowing upon the wheel; and if thefe edges are not made fharp, they will fplafh the water about; the edges are, therefore, finifhed by iron-plate, or it is better to make all the inclined parts of the partition of iron-plate. The greater number of buckets, and the fhallower they are, the more regularly the wheel will act. The limits are, that the mouths of the buckets fhall be of fuch width as to allow the air to efcape, at the fame time that the ftream of water flows in; and alfo that the breadth of the wheel fhall not be extravagantly great, to make its buckets contain as much water as would produce the power required from the wheel.

The lofs of water, at the lower part of the wheel, will very much depend upon the proportion of water which is poured into each bucket. It is evident, that if the buckets, of whatever form they are made, were totally filled when at the top of the wheel, they muft begin to fpill the water immediately when they departed from that pofition. But, on the other hand, if only a part of the content of each bucket is filled with water, then it will bear a greater degree of inclination, and be a longer time before the water will begin to fpill from the bucket. This is a reafon for making large buckets, and filling only a part of their contents. In practice a medium muft be ftruck between thefe contending circumftances, and the wheel will act to advantage.

It has been propofed to apply another bend to the partition-boards of each bucket which fhall be beyond the inclined board that we have defcribed, and fhall be concentric with the rim of the wheel, in the fame manner as is reprefented in Mr. Buchanan's wheel, *fig.* 5. It is true that this form would retain the water from fpilling for a longer time, and thus be an advantage; but it is not favourable for admitting the water into the buckets when at the top of the wheel.

The inclined boards, when made as we have defcribed, may be exactly in the line of the ftream of water, which iffues from the fpout when it paffes beneath fuch ftream; and in this way, if the edge of the inclined board is made thin, there will be as little fplafhing of the water as poffible. But by the addition of another part to the edge of the partition, which is concentric to the circle of the wheel, the ftream of water cannot be made to proceed exactly in the line

line of the partition, and will therefore ſplaſh the water. The ſplaſhing may appear immaterial, but it is in reality very prejudicial, becauſe the broken water fills the mouth of the bucket, and prevents the air from getting out readily, and it is for this reaſon that it is very neceſſary to allow ſo much of the fall above the height of the wheel, as will make the water run into the buckets, with a little greater velocity than the motion of the wheel.

Dr. Robinſon, in the Encyclopædia Britannica, deſcribed a plan for the buckets of an overſhot wheel, which was invented by Mr. Robert Burns, millwright, and executed by him at a cotton-mill in Scotland: it is ſhewn in *fig.* 5. *Plate* II. *Water-wheels*. In this way, the wheel has two ranks of buckets, one within the other. The buckets conſiſt of a partition A B, in the direction of a radius of the wheel, which is joined to another B C, inclined to that, and alſo to a third C D, which is concentric with the rim of the wheel.

The bucket is divided into two, by a partition L M, alſo concentric with the rim of the wheel, and ſo placed as to make the inner and outer portions of the bucket nearly of equal capacity. It is evident, without any farther reaſoning, that this partition will enable the double bucket to retain its water much longer than the ſingle one could. When they are filled only one-third, they retain the whole water at eighteen degrees from the bottom of the wheel, and they retain half of the water at eleven degrees. The only objection is, that they do not admit the water quite ſo freely as buckets of the common conſtruction.

This ariſes from the air, which muſt find its way out to admit the water, but is obſtructed by the entering water, and occaſions a great ſputtering at the entry. This may be entirely prevented, by making the ſpout conſiderably narrower than the wheel, and will leave room at the two ends of the buckets for the eſcape of the air. It was found in practice, that a ſlow moving wheel, allowed one half of the water to get into the inner buckets, eſpecially when the partitions which form the inner buckets, did not altogether reach the radius drawn through the lip D of the outer bucket. The doctor conſiders this as a very great improvement of the bucket-wheel; and when the wheel is made of a liberal breadth, ſo that the water may be very ſhallow in the buckets, it ſeems to carry the performance as far as it can go. Mr. Burns made the firſt trial on a wheel of twenty-four feet diameter, and its performance is manifeſtly ſuperior to that of the wheel which it replaced, and which was a very good one. It has alſo another valuable property. When the ſupply of water is very ſcanty, a proper adjuſtment of the ſtream of water iſſuing from the ſpout, will direct almoſt the whole of the water into the outer buckets; which, by placing it at a greater diſtance from the axis, makes ſome addition to its mechanical energy.

IV. *Concerning the proper Velocity of the Circumference of an overſhot Wheel, in order to produce the greateſt Effect.*—If a body of water is let fall freely from the ſurface of the water in the upper reſervoir to the bottom of the deſcent, it will take a certain time in falling; and in this caſe, the whole action of gravity will be ſpent in giving the water a certain velocity. But if this water in falling is intended to act upon ſome machine, ſo as to produce a mechanical effect, the falling water muſt be retarded, becauſe a part of the action of gravity is then ſpent in producing the effect, and the remainder only will give motion to the falling water, which motion it will retain, after it has quitted the machine. On this principle, the ſlower a body deſcends the greater portion of the action of its gravity can be applied to produce mechanical effect, and in conſequence the greater that effect will be.

If a quantity of water falls from a ſtream, into each bucket of an overſhot-wheel, it is there retained until the wheel, by moving round, diſcharges it. Now, the ſlower the wheel moves, the more water each bucket will receive, becauſe it remains a longer time beneath the ſpout, ſo that what is loſt in the ſpeed with which the wheel moves, is gained by the preſſure of a greater quantity of water acting in the buckets at once; and if conſidered only in this light, the mechanical power of an overſhot-wheel to produce effects will be equal, whether it moves quick or ſlow. The popular reaſoning adduced to prove this has been of the following kind. Suppoſe that a wheel has thirty buckets, and that four cubic feet of water are delivered in a ſecond on the top of the wheel, and diſcharged, without any loſs by the way, at a certain height from the bottom of the wheel.

It is clear that this ſtream will ſupply the ſame quantity, whatever is the rate of the wheel's motion; and the buckets muſt be of a ſufficient capacity to hold all the water which falls into them when the wheel moves very ſlow. Suppoſe this wheel employed to raiſe a weight of any kind, for inſtance to draw a baſket of coals out of a deep pit or mine, and that the rope winds upon a barrel of ſuch ſize that the baſket will be drawn up with the ſame velocity as the water in the buckets deſcends. Suppoſe, further, that the wheel will make four revolutions in a minute, or one turn in fifteen ſeconds, when the load or weight in the baſket which forms the reſiſtance to the motion of the machine is one-third of the load of water contained in the buckets of the wheel.

Now, during the time of one revolution, ſixty cubic feet of water will have flowed into the thirty buckets, and each have received two cubic feet. In this caſe, the baſket may contain a weight equal to twenty cubic feet of water, which weight will be drawn up a height equal to one circumference of the wheel, during one turn of the wheel, or in fifteen ſeconds of time.

Now ſuppoſe the machine ſo loaded, by making the baſket more capacious, that the wheel can only make two turns in a minute, or one turn in thirty ſeconds, then each deſcending bucket of the wheel will receive four cubic feet of water. If the baſket contained a double weight, *viz.* equal to forty cubic feet, the effect produced by the machine would be the ſame as before, becauſe the velocity is only one half; but we find in practice, that it will raiſe more than in this proportion when it moves ſlower, for if we attend to what we have juſt obſerved of the falling body, we find that ſo much of the action of gravity as is employed in giving motion and velocity to the wheel and water therein, muſt be ſubtracted from its preſſure upon the buckets. The product made by multiplying the number of cubic inches of water which act on the wheel at once by its velocity, will be the ſame in all caſes; yet, as each cubic inch, when the velocity is greater, preſſes more lightly upon the buckets than when the velocity is leſs, the power of the water to produce effects will be greater in the leſs velocity than in the greater. This leads us to the general rule, that the leſs the velocity of the wheel, the greater will be the effect produced by any given quantity, and fall of water.

A confirmation of this doctrine, together with the limits it is ſubject to in practice, is a matter of experiment and obſervation which has been ably decided by Mr. Smeaton. The velocity of the wheel ſhould not be diminiſhed, further than what will produce ſome ſolid advantage in point of power; becauſe, as the motion is ſlower, the buckets muſt be made larger, that the increaſe of their weight may compenſate

penſate for the ſlowneſs of their motion. The wheel being thus more loaded with water, the ſtreſs upon every part of the work will be increaſed in proportion.

The beſt rule for practice will be, to make the velocity of the circumference a little more than three feet in a ſecond.

Experience confirms, that this velocity of three feet in a ſecond, is applicable to the greateſt overſhot wheels as well as the ſmalleſt; and all other parts of the work being properly adapted to this velocity, the fall of a given quantity of water, will produce very nearly the greateſt effect poſſible. But it is alſo certain from experience, that large wheels may deviate further from this rule before they will loſe their power, by a given aliquot part of the whole, than ſmall ones can be admitted to do; for inſtance, a wheel of twenty-four feet high may move at the rate of ſix feet *per* ſecond, without loſing any conſiderable part of its power. This may perhaps be accounted for, when we conſider how ſmall a proportion of the whole fall is requiſite to give the water the proper velocity which the wheel ought to have; whilſt in a ſmaller wheel, the ſame height muſt be allowed for that purpoſe, and conſequently, a greater proportion of the whole height. On the other hand, Mr. Smeaton tells us, that he had ſeen a wheel of thirty-three feet diameter that moved very ſteadily and well, with a velocity but little exceeding two feet *per* ſecond.

There is a natural wiſh to ſee a machine move briſkly; it has the appearance of activity: but a very ſlow motion always looks as if the machine was overloaded. For this reaſon, mill-wrights have always yielded ſlowly, and with reluctance, to the advice of Mr. Smeaton, but they have yielded; and we now ſee them adopting maxims of conſtruction more agreeable to ſound theory, that is, making their wheels of great breadth, and loading them with a great deal of work. The reluctance to adopt this ſyſtem did not ariſe ſolely from prejudice, but from a real inconvenience attending the ſlow motion of the wheel when the reſiſtance which is oppoſed to its motion, and which is the cauſe that it moves ſlowly, is not uniform in the different parts of a revolution.

In all machines, there are ſmall inequalities of action which are unavoidable; and in ſome machines very great inequalities ariſe, from the intermitting motions of cranks, ſtampers, and other parts which move unequally or reciprocally. When a water-wheel is employed to give motion to ſuch machines, it may be ſo reſiſted or loaded, as to be nearly in equilibrio with its work, in the moſt favourable poſition of the parts of the machine; but when theſe change into a leſs favourable poſition, the machine may ſtop the wheel altogether, or at all events hobble, and work very irregularly. And for the ſame reaſon that a water-wheel accommodates its motion very quickly to the reſiſtance it is to overcome, ſo all tendency to irregular motion is increaſed. A wheel, when its load is increaſed, moves more ſlowly, and receives more water into each bucket; thereby taking to itſelf a weight of water equal to overcome its load, and on the other hand by moving quicker, it takes leſs water into each bucket when the load is diminiſhed. But theſe changes do not take place inſtantaneouſly, becauſe it can be only in the moment that each bucket paſſes beneath the ſtream, that the ſhare of water it ſhall have, will be influenced by the rate of the wheel's motion. When a bucket is once filled it continues with that charge until it arrives at the bottom of the wheel.

This ſelf-regulating property of the wheel can only apply in caſes of ſmall and permanent changes of reſiſtance, for it always comes too late to correct ſudden and conſiderable changes in the reſiſtance; then it acts in the contrary direction. Suppoſe, for inſtance, an overſhot wheel is employed to work a ſingle pump by means of a crank, the reſiſtance of this machine will be continually varying; it will be nothing during one-half of the period of the revolution when the pump is not drawing any water, and during the other half it will be in a conſtant ſtate of increaſe and diminution. Now, during the time this wheel has nothing to do, it will turn round very quickly, and therefore each bucket will receive very little water; conſequently, when the wheel comes to be reſiſted, the wheel will have ſo little water in its buckets, that it will perhaps be quite ſtopped: in this caſe, the bucket beneath the ſpout will receive water until it is quite full, and then the water will run over and fill ſo many of the buckets beneath it, as to put the wheel in motion ſlowly; in conſequence, the ſucceeding buckets will receive a large ſhare of water during the half revolution when the pump makes its ſtroke; but when this is finiſhed, and the reſiſtance ceaſes, the wheel being well loaded with water, will in conſequence move very rapidly for a half revolution, and its buckets will receive very little water.

This is indeed an extreme caſe of irregular reſiſtance, and muſt be remedied by applying two pumps inſtead of one, or a balance-weight, or a fly-wheel; but the ſame principle will apply in caſe of ſmaller irregularities. In all caſes, the reſiſtance muſt be reduced to a great degree of uniformity, before a water-wheel can be applied to it with advantage, particularly if the wheel is intended to move ſlowly, with a view of obtaining the greateſt power, the irregularities will then have more ſerious conſequences.

A little more velocity enables the machine to overcome thoſe increaſed reſiſtances by its *inertia*, or the great quantity of motion inherent in it. Great machines poſſeſs this advantage in a ſuperior degree, and will conſequently work ſteadily with a ſmaller velocity. In all caſes, the machine muſt have ſo much moving matter in it as is ſufficient to overcome the irregularities, and regulate the motion of the wheel. If this is not already found in the machine, as in the mill-ſtones of a corn-mill for inſtance, the weight muſt be placed in the water-wheel itſelf, or in a fly-wheel applied for the purpoſe.

Mr. Buchanan meaſured the quantity of water which a cotton-mill required, when going at its common velocity; and when going at half that velocity. The reſult was, that the laſt required juſt half the quantity of water which the firſt did. In the experiments, the quantities of water were calculated from the depth of water and apertures of the ſluices.

From which experiments, he inferred that the quantity of water neceſſary to be employed in giving different degrees of velocity to a cotton-mill, muſt be nearly as the velocity. The water from the cotton-mill on which he made the obſervation, falls a little below it, into a perpendicular-ſided pond, which ſerves as a dam for a corn-mill. By meaſuring the time which the water took to riſe at a certain height in that pond, he determined the expenditure of water when the corn-mill moved at its common velocity; and alſo when it moved at nearly half that velocity.

The reſult of theſe experiments approached very nearly to the former, and all the differences could be accounted for, by a ſmall degree of leakage, which took place at the ſluices on the lower end of the pond; and the time being greater when the mill moved ſlower, the leakage would of courſe be greater.

In

In thefe experiments, the motion of the water-wheel being exactly proportioned to the quantity of water expended, the load upon the wheel muft have been equal when it moved quick or flow, that is to fay, the buckets muft have been equally filled when the wheel moved at its ordinary motion, or at half that motion.

The effect, therefore, of letting more water on a wheel when the refiftance continues the fame, is not to lodge a greater quantity in each of the buckets, but to fupply the fame quantity to each bucket when the wheel is in a greater motion.

The greateft velocity that the circumference of an overfhot wheel can acquire, depends jointly upon the diameter or height of the wheel, and the velocity of falling bodies; for it is plain, that the velocity of the circumference can never be greater, than to defcribe a femicircumference, in the time that a body let fall from the top of the wheel would defcend through its diameter, nor indeed quite fo great; as a body defcending through the fame perpendicular fpace cannot perform its courfe in fo fmall a time, when paffing through a femicircle, as would be done in a perpendicular line. Thus, if a wheel is fixteen feet one inch diameter, a body will fall through the line of its diameter in one fecond: this wheel, therefore, can never arrive at a velocity equal to the making one turn in two feconds. An overfhot wheel can never come near this velocity, for when it acquires a certain fpeed the greateft part of the water is prevented from entering the buckets; and the reft, at a certain point of its defcent, is thrown out again by the centrifugal force. The velocity, when this action will begin to take place, depends in a great degree upon the form of the buckets as well as other circumftances; fo that the utmoft velocity that an overfhot wheel may be capable of is not to be determined generally; and indeed the knowledge of it is not at all neceffary in practice, becaufe a wheel, in fuch cafe, would be incapable of producing any mechanical effect.

V. *On the proper Load for an overfhot Wheel, in order that it may produce a maximum Effect.*—The maximum load or refiftance for an overfhot wheel, is that which will reduce the circumference of the wheel to its proper velocity, of three or three and a half feet *per* fecond; and this will be known, by dividing the effect it ought to produce in a given time, by the fpace intended to be defcribed by the circumference of the wheel in the fame time; the quotient will be the refiftance to be overcome at the circumference of the wheel, and is equal to the load required, the friction and refiftance of the machinery included.

VI. *On the greateft Load that an overfhot Wheel can overcome.*—The greateft load an overfhot wheel can overcome depends upon the magnitude of the buckets; and the refiftance which will ftop the wheel, muft be equal to the effort of all the buckets in one femicircumference, when quite filled with water.

The ftructure of the buckets being given, the quantity of this effort may be affigned, but is not of much importance in practice, as in this cafe alfo, the wheel lofes its power; for though the water makes the utmoft exertion of gravity upon the wheel, yet, being prevented by a counterbalance from moving at all, it is not capable of producing any mechanical effect, according to our definition. An overfhot wheel, generally ceafes to be ufeful before it is loaded to that pitch, for when it meets with fuch a refiftance as to diminifh its velocity to a certain degree, its motion becomes irregular; yet this never happens until the velocity of the circumference is reduced to lefs than two feet *per* fecond, where the refiftance is equable, as appears not only from the preceding fpecimen, but from experiments on larger wheels.

VII. *Conftruction of the Pentrough for fupplying the Water to overfhot Wheels.*—We have hitherto fpoken of the ftream of water, as if it iffued from a fpout nearly in an horizontal direction, or with only fo much inclination as will make the line of the ftream correfpond with the direction of the oblique part of the bucket-board. This is the ancient, and ftill the common way; Mr. Smeaton's, which is a much better, is fhewn in *fig.* 2. *Plate* I. *Water-wheels.* G reprefents the pentrough through which the water flows, and F F ftrong crofs-beams on which it is fupported; the wheel is fituated very clofe beneath the bottom of the trough, as the figure fhews. E E are two arms of the wheel, which are put together, as fhewn in *fig.* 7. D B is the wooden rim of the wheel; the narrow circle beyond this is the fection of the fole planking, and on the outfide of this the bucket-boards are fixed as the figure fhews; one of the bottom boards, *b*, of the trough at the end is inclined, and an opening is left between that end and the other boards of the bottom, to let the water pafs through; this opening is clofed by a fliding fhuttle, *c*, which is fitted to the bottom of the trough, and can be moved backwards and forwards by a rod, *d*, and lever, *e*, which is fixed into a ftrong axis *f*; this axis has a long lever on the end, which, being moved by the miller, draws the fhuttle along the bottom of the trough, and increafes or diminifhes the aperture through which the water iffues. The extreme edge of the fhuttle is cut inclined, to make it correfpond with the inclined part *b*, and by this means it opens a parallel paffage for the water to run through, and this caufes the water to be delivered in a regular and even fheet; and to contribute to this the edges of the aperture where the water quits it, are rendered fharp by iron plates; the fhuttle is made tight where it lies upon the bottom of the trough by leather, fo as to avoid any leakage when the fhuttle is clofed. When the wheel is of confiderable breadth, the weight of the water might bend down the middle of the trough until it touched the wheel; to prevent this, a ftrong beam, O, is placed acrofs the trough, and the trough is fufpended from this by iron bolts which pafs through grooves in the fhuttle, fo that they do not interfere with the motion of the fhuttle.

Fig. 3. of the fame plate is an overfhot wheel, for which Mr. Nouaille took a patent in 1813; he recommends that the water-wheel be made the full height of the fall of water, and that the water be applied upon the wheel at 53 degrees from the vertex. The pentrough is made nearly on the fame plan as Mr. Smeaton's. O R is the trough, *h g* the end inclined in the direction in which the water is intended to be directed, *f* the fhuttle, fliding horizontally on the bottom of the trough, *c d e* the lever for drawing the fhuttle, to which motion is given by a regulating fcrew *a* and nut *b*.

Fig. 9. *Plate* II. *Water-wheels*, is the method of laying on water, which has for feveral years been in common ufe in Yorkfhire and the north of England. In this the water is not applied quite at the top of the wheel, but nearly in the fame pofition as the laft defcribed; but the advantages of this wheel over all others is, that the water can be delivered at a greater or lefs height, according to the height at which the water ftands in the trough; but in all the preceding methods if the water is fubject to variations of height, as all rivers are, then the wheel muft be diminifhed, fo that in the loweft ftate of the water it will ftand a fufficient depth above the orifice in the bottom of the trough to iffue with a velocity rather greater than the motion of the wheel. In this cafe, when the water rifes to its ufual height, or above it, the increafe of fall thus obtained is very little advantage to the wheel; the improved wheel

wheel can at all times take the utmoſt fall of the water, even when its height varies from three to four feet. A A is the pentrough made of caſt-iron ; the end of it is formed by a grating of broad flat iron bars, which are inclined in the proper poſition to direct the water through them into the buckets of the wheel. The ſpaces between the bars are ſhut up by a large ſheet of leather, which is made faſt to the bottom of the iron trough at *a*, and is applied againſt the bars ; and the preſſure of the water keeps it in cloſe contact with the bars, ſo as to prevent any leakage. This is the real ſhuttle, and to open it ſo as to give the required ſtream of water to the wheel, the upper edge of the leather is wrapped round a ſmaller roller *b* ; the pivots at the ends of this roller are received in the lower ends of two racks, which are made to ſlide up and down by the action of two pinions fixed upon a common axis which extends acroſs the trough ; this axis being turned, raiſes up or lowers down the roller, and the leather ſhuttle winds upon it as it deſcends, or unwinds from it as it aſcends, ſo as to open more of the ſpaces between the bars, or cloſe them as it is required. In order to make the roller take up the leather, and always draw it tight, a ſtrap of leather is wound round the extreme ends of the rollers, beyond the part where the leather ſhuttle rolls upon it. Theſe ſtraps are carried above water and applied on wheels, which wind them up with a very conſiderable tenſion by the action of a band and weight wrapped on the circumference of a wheel, which is on the end of the axis of thoſe wheels.

The water runs over the upper ſide of the roller, and flows through the ſpaces between the grating into the buckets of the wheel ; the deſcent of the water paſſing through the bars, and afterwards in falling before it ſtrikes the bottom of the bucket, is found fully ſufficient to produce the neceſſary velocity of the water, for a fall of four inches produces a velocity of more than four feet *per* ſecond.

We recommend this as the beſt method of applying the water, as we ſee in all other forms that a much greater portion of the fall is given up in order to make the water flow into the wheel ; not that any ſuch depth as is commonly given is at all neceſſary, but the aperture in the trough muſt be placed ſo low that the water will run through it in the very loweſt ſtates of the water, otherwiſe the wheel muſt ſtop at ſuch times.

On the Manner of framing Water-wheels.—The weight of every wheel muſt be ſupported by its axis, which therefore demands the firſt conſideration. If the axis is to be of wood it ſhould be made of a tree of hard and durable wood, of a length and ſize proportioned to the ſize and weight of the wheel ; into each end a gudgeon or centre ſhould be fixed for the wheel to turn upon. There are two methods of fixing the gudgeon into a wooden axis ; one is, by forming the gudgeon with a croſs, which is let into the end of the tree, and faſtened by ſcrews, and the wood is compreſſed round the croſs by two or three iron hoops, fitted on the end of the tree and wedged ; this is explained in the article MILL-*Work*. The other method is, to make a ſtrong iron box in a piece with the gudgeon, into which box the end of the tree is received and ſecured by wedges. The box being of an octagon ſhape, and the wood being cut to the ſame figure, it cannot ſlip round within the box.

Of late years it has been uſual to make the great axis of water-wheels of caſt-iron, which is a very good plan, provided the axis is made of ſufficient dimenſions. This was firſt practiſed by Mr. Smeaton, but he was rather unfortunate, as ſeveral of them broke after having been many years in uſe : he then employed hollow tubes of caſt-iron of large dimenſions and conſiderable thickneſs of metal. Even now that the ſtrength of caſt-iron is better underſtood, it is not uncommon for the axis of a water-wheel to break, particularly in cold and froſty weather, and for this reaſon ſome millwrights uſe wrought iron, but the hollow tube is ſo much ſtronger, as to be very ſecure from accident.

In an iron axis it is adviſeable to make the bearings of the axis cloſe to the ſides of the water-wheel, and leave the ends of the axis projecting beyond the bearings, in order to attach the cog-wheel, by which the power of the wheel is to be communicated to other machinery. This diminiſhes the length of the axis between the bearings, and renders it much ſtronger ; wooden axes muſt have the gudgeons at the extreme ends.

The next point to be conſidered is, the beſt means of affixing the arms of the wheel firmly to the axis. If the arms are of wood, and the axis alſo, the moſt obvious plan is to mortiſe the arms into the axis ; but this is the worſt method that can be adopted, becauſe the axis is much weakened, and the water being admitted into the centre of the tree cauſes it ſoon to decay, nor can an arm be eaſily replaced without taking all the wheel to pieces.

A better way is to uſe eight timbers for the arms, and put them together ſo as to interſect each other at right angles, (as is ſhewn in *fig.* 7. *Plate* I.) leaving a ſquare opening in the centre for the reception of the axis, which is made up to a ſquare by adding pieces of wood to it, and the wheel is faſtened on by wedges. The only objection to this is, that the arms are weakened by interſecting each other, and they ſupport the circular rim of the wheel in unequal ſegments.

In Mr. Buchanan's water-wheel, which we have before deſcribed in *figs.* 4 and 5, *Plate* I. *Water-wheels*, is a particular conſtruction of the arms formed by thin planks of wood. He ſtates that this plan is applicable to any kind of water-wheel ; and ſince 1790, when he firſt conſtructed a wheel with arms on that principle, a conſiderable number of large wheels have been erected in Scotland on the ſame plan. It is evident that arms, ſuch as are commonly fixed in mortiſes in the axis, are weakeſt in one direction, and that commonly in the direction of the ſtrain. To remedy this defect the feather-pieces F F are applied all round, having their broadeſt ends towards the centre of the wheel, and being at right angles to the breadth of the principal arms. In order to unite them ſtrongly to the principal arms, and connect the whole more firmly together, a ring of iron, R, is applied on each ſide ; blocks of wood being put in the vacant ſpaces between, and the keys or wedges, K K, bind the whole cloſe to the axis.

The very beſt method of uniting the arms to the axis is to have a caſt-iron centre-piece, or ſtrong hoop, to fit on the wooden axis with a broad projecting flanch round it, againſt the flat ſurface of which the arms of the wheel are applied, and the intervals between them filled up by wooden blocks or wedges ; the arms and blocks are firmly bound to the iron flanch by iron rings applied to the arms on the oppoſite ſide to the flanch, with ſcrew bolts to go through the whole. This ſame plan is applicable to an iron axis, and will be more clearly underſtood by a reference to the article MILL, and *Plate* XXXIV. *Mechanics* ; but it is there deſcribed that the broad circular flanch to ſcrew the arms againſt, is caſt in the ſame piece with the axis. This was Mr. Smeaton's original plan, but the flanch ſhould be made in a ſeparate piece, and faſtened on the axis with wedges ; for if caſt in the ſame piece, the contraction of the metal contained in the flanch when cooling, renders the metal of the axis ſpongy at the part where it joins to the flanch, and cauſes them to break at that part. Sometimes the caſt-iron centre-piece is made with a

diſtinct

diſtinct cell to receive each arm, and they are faſtened into the cells by wedges and ſcrew-bolts, but a flat flanch with the intervals filled up by blocks is more ſimple and ſecure. Modern wheels are very frequently made with caſt-iron arms, which in this caſe are attached to the axis by a ſimilar centre-piece.

The circular rims of water-wheels are commonly made of wood, put together in two or three thickneſſes, the joinings of one ring not coinciding with thoſe of the other, and 8 or 10 ſegments in each thickneſs, according to the ſize of the wheel; the thickneſſes are united together by rivets. The arms are attached to the ring by notching them in, and ſecuring them by bolts. Caſt-iron rings are now generally uſed, and with great advantage, becauſe the neceſſary mortiſes can be made in iron, without weakening the ring; but the ſtrength of a wooden ring is greatly impaired by the mortiſes through it.

The number of rings in a wheel depend upon its breadth; when the wheel is four feet wide, two rings will ſupport the float-boards or buckets, but the rings ſhould not be more than five feet aſunder, or the floats may bend and yield; for want of a ſufficient ſupport each ring is framed with its ſet of arms, ſo that every one derives its ſtrength from the axis. When a wheel is of great breadth, the whole will be very much ſtrengthened, by applying oblique braces, extending from the centre-pieces of the outſide rings to the circumference of the middle ring, by firmly attaching theſe oblique braces to the arms of all the rings which they intercept; they form truſs-frames which prevent the wheel and the axis from bending by its weight: this is particularly uſeful in wide overſhot wheels.

In breaſt and underſhot wheels the float-boards are nailed to pieces of wood called ſtarts, which are fixed into the mortiſes in the rings, and project outwards for that purpoſe.

In overſhot-wheels, the rings of the wheels are covered by boards laid parallel to the axis, well jointed together, and ſpiked down to the rings like the boards of a floor to the joiſts. This boarding forms a cloſe cylinder, which is called the ſole of the wheel, and is the foundation for the buckets. When the rings of the wheel are of iron, holes are left in the caſtings in the edge of the rings, at regular diſtances round the circumference, and theſe are filled up with plugs of wood, into which the nails can be driven to faſten on the boarding of the ſole. The ſole of the wheel is ſometimes made of iron plates rivetted together, and rivetted alſo to the rings of the wheel.

At the ends of the ſole-boards, two circular rings of wood or iron, called ſhrouds, are fitted on perpendicularly to the ſole to form the ends of the buckets; and it is uſual, if the wheel is wide, to apply a ſhrouding over each ring of the wheel, and then the buckets are divided into lengths of about four or five feet. In the flat ſurfaces of the ſhroudings, grooves are made for the reception of the ends of the bucket-boards. It is uſual to make the firſt board, which is in the direction of a radius, of wood, and the outſide one is generally made of iron plate; but ſometimes the whole are made of plate iron, and both parts of the buckets are then bent up out of one piece, and the ends of the plate; and alſo that part of the edge which is to apply to the ſole, is turned ſquare to lie flat againſt the ſole and the ſhrouding, ſo that rivets and nails may unite all together, and make water-tight joints.

When the ſhrouding is of caſt-iron, it is made to ſerve inſtead of the rings of the wheel, becauſe it has ſufficient ſtrength to ſerve both purpoſes: the arms of the wheel are in this caſe applied flat againſt the ring of ſhrouding, and bolted to it.

The breaſt-wheel, *fig.* 3. *Plate* II. *Water-wheels*, at Meſſrs. Strutt's works, which we have already noticed, is deſerving of further notice from the manner of putting it together. The rings of the wheel are made of caſt-iron, and the float-boards are included between the rings in the manner of an overſhot wheel, but the arms are only of wrought iron, being made of ſmall round iron rods, which are very light, and have little ſtrength to reſiſt bending; but as they are all tied in from the centre, the ring cannot deviate from its true circular figure, and to ſuſtain the wheel ſideways, oblique bars are extended from the centre-pieces at each end of the axis, and are united to the circular ring in the middle of its breadth, which is 15 feet. We have ſeen two overſhot-wheels of 24 feet diameter, and 9 feet broad, made in the ſame way. It is plain that in this conſtruction the axis of the wheel can do no office but to ſupport the weight of the wheel; for though theſe arms are ſufficiently ſtrong for that purpoſe, they can have little ſtrength by way of levers to tranſmit the force of the circular motion of the rim of the wheel to the axis; but the power is tranſmitted in a better way than from the axis, *viz.* by a ring of cogs ſcrewed to the circular rim of the wheel, and working in a pinion which conveys the motion to the mill. There is another ſimilar ring of cogs at the other ſide of the wheel, which works into a pinion fixed on the ſame ſhaft, by this means nearly all the ſtrain is taken from the axis of the water-wheel; for the pinion is placed on the deſcending ſide of the wheel, ſo that the weight of the water acting on the float-boards is immediately tranſmitted to the pinions by the ſtrength of the rings of the wheel.

This method of tranſmitting the power is alſo applied to other wheels than thoſe which are made with ſlight arms like the above; the ring of cogs is ſometimes placed in the middle of the breadth of the wheel, and then acts upon one pinion, but it is much better to place it at one ſide or both ſides, if the wheel is very broad, becauſe the circle of the teeth may then be made rather leſs than the diameter of the rings of the wheel, and the ſide of the ring being cloſely fitted to the ſtone-work of the race, the water may be excluded from the cogs.

It is obvious that of the various conſtructions of water-wheels, that is the ſtrongeſt which communicates its motion by means of a ring of cogs immediately attached to its rim, where the power of the water is alſo applied, the leaſt poſſible ſtrain being thus thrown on its arms and axis.

The only objection to this plan is, that as the teeth of the cog-wheel are in moſt caſes conſtantly wet, which prevents the greaſe from adhering, the uſual mode of occaſionally greaſing the cogs is of little or no uſe, and the dirt in the water grinds away the teeth; or, were the water even free from dirt, there would be much unneceſſary friction and waſte of power.

Greaſing Machine for the Cog-Wheel of a Water-Wheel.— Mr. Buchanan mentions two water-wheels of this kind, in which the rings of the teeth were wearing very faſt, and knowing the trouble and expence of renewing them, he was ſolicitous to diſcover ſome means of rendering them more durable. The only way which preſented itſelf was by ſome contrivance to keep them well greaſed.

This he did by a machine ſhewn in *fig.* 8. *Plate* I. *Water-wheels*; it is nothing more than a kind of pinion, with one or more of its teeth made hollow to contain the greaſy ſubſtance, and the metal plate of which the hollow cog is compoſed is perforated with ſmall holes, for exudating the greaſe through thoſe parts which come in contact with the teeth of the wheel.

Fig. 8. is a ſection of the greaſing machine; A B repreſents part of the ring of teeth on the circumference of the water-

water-wheel. The greafing-pinion which works in thefe teeth is mounted on an axis, as is clearly fhewn.

N O a retarding lever, of which N is the fulcrum, and O a weight to make it prefs on the axis of the greafing-pinion, fo as to caufe a refiftance, and make the cogs of the wheel prefs forcibly on the cogs of the pinion.

G H I K, the hollow teeth for containing the greafe; they are made of copper-plate or iron; and to make the perforated fides of the greafing leaves come in clofe contact with the face of the teeth of the wheel, the lever N O, with a fmall weight on it, acts on a pulley fixed on the axle of the pinion, and ferves to retain it.

E F, &c. the folid teeth of the pinion, made of wood; there are fliders which open for admitting the greafe into the hollow teeth at their ends.

The number of leaves in the greafer fhould be fuch, that thofe containing the greafe fhall apply themfelves in the courfe of feveral revolutions of the wheel to each of its teeth. Mr. Buchanan found a greafer of 12 leaves, 4 of which contained greafe, had this effect upon a wheel of 304 teeth; and one of 13 leaves, with one tooth only filled with greafe, ferved a wheel of 168 teeth.

It is beft to ufe a mixture of tallow, oil, and black lead for greafing, made of a confiftency to feed regularly, and frefhened about twice in a week.

Conftruction of a Breaft-Wheel of very great Width.—At Meffrs. Strutt's works is a very powerful breaft-wheel, made of the extraordinary width of 40 feet, and it deferves our notice from the manner of framing it together; its diameter is only 12½ feet, and it is made without any axis, or rather the axis is hollow, and fo large that the float-boards are fixed immediately upon it. It is made like a very long cafk, 48 feet long, compofed of 32 ftaves of fix inches thicknefs, bound together by hoops like an ordinary cafk; it is five feet in diameter at one end and fix feet at the other, and in the middle 7 feet 2 inches; the fmall end is made up folid for three feet in length, and the gudgeon is fixed in this folid part; the larger end is folid for four feet from the end, and on this part the large cog-wheel is fixed to communicate the motion to the mill; it is 14 feet diameter, and has 120 cogs, whilft the water-wheel is only 12½ feet diameter to the outfide of the floats. The floats are fupported by 10 circular rings, which are fixed on the outfide of the axis or cafk, at four feet diftance from each other, and the float-boards are fixed between thefe rings, 24 floats being arranged in each circle; but the floats in the different fpaces are not made to line with each other, becaufe if the water was to ftrike upon the whole length of 40 feet of float-board at once, it would give a fenfible fhock to the water-wheel, and work the mill irregularly; hence the floats between all the different rings are placed oppofite to the intervals between the floats in the adjoining fpaces, by which means the water acts on the floats in rapid fucceffion, fo that the ftroke upon any one float is imperceptible.

The float-boards are not made to touch the central-barrel or axis within two inches, in order to leave fpace for the air to efcape. The float-boards in the middle of the wheel are 2 feet 4 inches wide, and at the ends are wider. This wheel has two fhuttles, one above the other, like the breaft-wheel before defcribed in *fig.* 3, and the fame dimenfions; for the wheel is placed in the fame mill, but is adapted to work when the tail-water rifes in time of floods to fuch a height as to prevent the other wheel from working.

A very large overfhot Wheel.—The largeft overfhot water-wheel of which we have heard, is that at Mr. Crawfhaw's iron-works at Cyfarthfa, near Merthyr Tidvil, in South Wales: it is ufed to blow air into three of the large blaft furnaces for fmelting iron; the water-wheel is fifty feet in diameter and fix feet wide: it is chiefly made of caft iron, and has 156 buckets. The axis is a hollow tube, and is ftrengthened by twenty-four pieces of timber applied round it. On each end of the axis is a cog-wheel of twenty-three feet diameter, which turns a pinion. On the axis of thefe are two cranks, and a fly-wheel twenty-two feet diameter, and twelve tons weight; each of the cranks gives motion to a lever, like that of a large fteam-engine, and works the pifton of a blowing cylinder or air-pump 52½ inches in diameter, and five feet ftroke, which blows air into the furnace, both when the pifton goes up and down. The work on the other fide being the fame, it actuates in the whole four of thefe double cylinders; the wheel makes about two and a half turns *per* minute, and each cylinder makes ten ftrokes. It is called Æolus, and was built in 1800 under the direction of Mr. Watkin George.

At Aberdare, in South Wales, is an immenfe double water-wheel, confifting of two wheels of forty feet in diameter, placed one above the other like the figure 8, (fee our article CANAL,) the water from the upper one actuating the lower one, and both being connected together by cog-wheels on their refpective rings. We underftand this machine has not anfwered, and we only mention it as an attempt to occupy a fall of water of eighty feet; in fuch cafes, the *Preffure-engine*, defcribed under that article, is a better method, particularly if the work will admit of a reciprocating motion.

Chain of Buckets.—This is applicable in many fituations where there is a confiderable fall of water. This fketch was taken from one in Scotland ufed to give motion to a thrafhing-mill; the *fig.* 6. *Plate* I. is fo obvious as to need little explanation. The buckets C, D, G, H, &c. muft be connected by feveral chains to avoid the danger of breaking, and united into an endlefs chain, which is extended over two wheels A and B, the upper one being the axis which is to communicate motion to the mill-work; E is the fpout to fupply the water. The principal advantage of this plan is, that no water is loft by running out of the buckets before they arrive at the loweft part, as is the cafe with the wheel. Another is, that the buckets being fufpended over the wheel A of fmall diameter, it may be made to revolve more quickly than a wheel of large diameter, and without increafing the velocity of the defcending buckets beyond what is proper for them. This faves wheel-work when the machine is to be employed, as in a thrafhing machine to produce a rapid motion. On the other hand, the friction of the chain in folding over the wheel at the top, and feizing its cogs, will be very confiderable; thefe cogs muft enter the fpaces in the open links between the buckets, to prevent the chain flipping upon the upper wheel. We think this machine might be much improved by contriving it fo, that the chain would pafs through the centre of gravity of each bucket, whereas in the prefent form, the weight of each bucket tends to give the chain an extra bend.

The *Chain-Pump reverfed* has been propofed as a fubftitute for a water-wheel when the fall is very great, and we think it would anfwer the purpofe with fome chance of fuccefs. It would have an advantage over the chain-pump when employed for raifing water, in the facility of applying cup leathers to the piftons on the chain, in the fame way as other pumps, which leathers expand themfelves to the infide of the barrel, and are kept perfectly tight by the preffure of the water. In the chain-pump fuch leathers cannot be employed, becaufe the edges of the leather-cups would turn down and ftop the motion, when the cups were drawn upwards into the barrel. It is the defective mode of leathering the piftons of the chain-pump which occafions its great friction. In the motion of a machine of this kind the piſtons would deſcend into the barrel, and might therefore be leathered with cups like other pumps, ſo as to be quite tight without immoderate friction. This machine was propoſed by a Mr. Cooper in 1784, who obtained a patent for it, and Dr. Robiſon has again propoſed it with recommendation.

Mechaniſm for equalizing the Motion of Water-Wheels.— When a part of the machinery of a mill is ſuddenly detached from the firſt mover, or ſuddenly connected with it, the load of the machine is either increaſed or diminiſhed; and the moving power remaining the ſame, an alteration in the velocity of the whole will take place; it will move faſter or ſlower. Every machine has a certain velocity, at which it will work with greater advantage than at any other ſpeed; hence the change of velocity ariſing from the above cauſe, is in all caſes a diſadvantage, and in delicate operations exceedingly hurtful. In the caſe of a cotton mill, for inſtance, which is calculated to move the ſpindles at a certain rate, if from any cauſe the velocity is much increaſed, a loſs of work immediately takes place, and an increaſe of waſte from the breaking of the threads, &c.; on the other hand, there muſt be an evident loſs from the machinery moving too ſlow. In ſteam-engines this evil is remedied by a contrivance called a governor, which we have already deſcribed in our article STEAM-*Engine.*

Governors are ſometimes applied to water-wheels, and made on various conſtructions. Smith-bellows have been applied to that uſe, the upper board riſing and falling on any augmentation or diminution of the velocity of the lower board, which received its motion from the mill, and forced air into the ſpace beneath the upper board; from this ſpace the air was permitted to eſcape by a pipe with a cock. If the lower board worked faſter than the air could eſcape, the upper board would riſe, but if it moved ſlower, then the board would ſink; and this riſing and falling was applied to regulate the ſhuttle of the water-wheel, not by the force of the bellows alone, but the bellows were made to throw the wheel-work of the mill into action, either to raiſe or lower the ſhuttle.

Of late years a new kind of water-wheel governor has been introduced, the principles of which are nearly the ſame as the governor of a ſteam-engine. It has a revolving pendulum, which receives its motion from the mill, and in proportion as the machinery moves faſter or ſlower, the centrifugal force acts with greater or leſs force upon the balls of the governor, making them approach to, or recede from, the perpendicular axis. This raiſes or depreſſes an iron croſs, which ſlides upon the perpendicular axis of the revolving pendulum, and by acting on a lever, is made to engage the ſluice with a train of wheel-work, which is kept in conſtant motion by the power of the water-wheel. When this train is connected with the ſluice, it operates upon it ſo as to enlarge or leſſen the paſſage of the water to the water-wheel, and by augmenting or leſſening the quantity of water falling on the wheel, increaſes or diminiſhes its ſpeed.

This ſluice is made on the principle of the throttle-valve of ſteam-engines. In order that it may be moved by a ſmall power, it is poiſed on an axis of motion paſſing through the middle of the ſluice. When it is turned edgeways to the ſtream of water, it makes no obſtruction; but if it is turned perpendicularly, it cloſes the paſſage of water, or by placing it more or leſs obliquely, it alters the area of the paſſage for the water.

The axis on which the ſluice turns, if horizontal, ſhould be one-third of the height of the ſluice from the bottom, in order that the preſſure of the water above the centre may balance that below.

So long as the machinery is moving at a proper velocity, this wheel-work of the ſluice apparatus is not connected with the ſluice, and it remains at reſt. But if the mill goes too ſlow, the croſs is depreſſed, and ſtriking the lever in an oppoſite direction, connects the ſluice with a different part or train of wheel-work, which has a motion in a contrary direction to the former, and ſo produces a contrary effect on the ſluice.

The train of wheel-work is ſo calculated, as to reduce the action on the ſluice to a very ſlow motion, and it is found, from experience, that this is neceſſary. Where the area of the aperture is too ſuddenly changed, the effect on the water-wheel would be too violent. See a more complete deſcription of this contrivance in Vol. XXIII. MILL-*Work.*

On the Conſtruction of the Wheel-race and Water-courſe.— The wheel-race ſhould always be built in a ſubſtantial manner with maſonry, and if the ſtones are ſet in Roman cement, it will be much better than common mortar. The earth behind the maſonry ſhould be very ſolid, and if it is not naturally ſo, it ſhould be very hard rammed and puddled, to prevent percolation of the water. This applies more particularly to breaſt-wheels, in which the water of the dam or reſervoir is uſually immediately behind the wall or breaſt in which the wheel works, a ſloping apron of earth being laid from the wall in the dam to prevent the water leaking. The wall of the breaſt ſhould have pile planking (ſee CANAL) driven beneath, to prevent the water from getting beneath, becauſe that might blow up the foundation of the race. The ſtones of the race are hewn to a mould, and laid in their places with great care; but afterwards when the ſide walls are finiſhed, and the axis of the wheel placed in its bearings, a gauge is attached to it and ſwept round in the curve, and by this the breaſt is dreſſed ſmooth, and hewn to an exact arch of a circle: the ſide walls in like manner are hewn flat and true at the place where the float-boards are to work. It is uſual to make the ſpace between the ſide walls two inches narrower at each ſide, in the circular part where the floats act, than in the other parts.

In ſome old mills the breaſt is made of wood planking, but this method has ſo little durability that it cannot be recommended. In modern mills, the breaſt is lined with a caſt-iron plate, but we do not approve of this, becauſe it is next to impoſſible to prevent ſome ſmall leakage of water through the maſonry, and this water being confined behind the iron breaſt cannot eſcape, but its hydroſtatic preſſure to force up the iron is enormous; and if the water can ever inſinuate itſelf behind, the whole ſurface of the plate rarely fails to break it, if not to blow it up altogether. This is beſt guarded againſt by making deep ribs projecting from the back of the plate, and bedding them with great care in the maſonry; theſe not only ſtrengthen the plate, but alſo cut off the communication of the water, ſo that it cannot act upon larger ſurfaces at once, than the ſtrength and weight of the plate can reſiſt. Stone is undoubtedly the beſt material for a breaſting. In overſhot-wheels the loſs of water, by running out of the buckets as they approach the bottom of the wheel, may be conſiderably diminiſhed by accurately forming a ſweep, or caſing round the lower portion of the wheel, ſo as to prevent the immediate eſcape of the water, and cauſing it to act in the manner of a breaſt-wheel, which has been already deſcribed. While this improvement remains in good condition, and the wheel works truly, it produces a very ſenſible effect; but it is frequently objected to, becauſe a ſtick or a ſtone falling into the wheel would be liable to tear off part of its ſhrouding, and damage the buckets; and again, a hard froſt frequently binds all faſt, and totally prevents the poſſibility of working during its conti-

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nuance; but we do not think the latter a great objection, for the water is not more liable to freeze there than in the buckets or on the shuttle, and may be prevented by the same means, *viz.* by keeping the wheel always in motion; a very small stream of water left running all night will be sufficient. Mr. Smeaton always used such sweeps, and with very good effect; it is certainly preferable to any intricate work in the form of the buckets.

On setting out Water-courses and Dams.—The most ancient mills were undershot-wheels placed in the current of an open river, the building containing the mill being set upon piles in the river. It would soon be observed that the power of the mill would be greatly increased, if all the water of the river was concentrated to the wheel, by making an obstruction across the river which penned up the water to a required height; and also to form a pool or reservoir of water. A sluice or shuttle would then become necessary to regulate the admission of water to the wheel, and other sluices would be necessary to allow the water to escape in times of floods; for though in ordinary times the water would run over the top of the obstruction or dam, yet a very great body of water running over might carry away the whole work, by washing away the earth at the foot of the dam, and then overturning it into the excavation. This is an accident which frequently happens to mills so situated, and the danger is so obvious, that most water-mills are now removed to the side of the river, and a channel is dug from the river to the mill to supply it with water, and another to return the water from the mill to the river. The difference of level between these two channels is the fall of water to work the mill, and this is kept up by means of a weir or dam entirely across the river; but the water can run freely over this dam in case of floods, without at all affecting the mill, because the entrance to the channel of supply is regulated by sluices and side walls.

The dam should be erected across the river at a broad part, where it will pen up the water so as to form a large pond or reservoir, which is called the mill-pond or dam-head. This reservoir is useful to gather the water which comes down the river in the night, and reserve it for the next day's consumption; or for such mills as do not work incessantly, but which require more water, when they do work, than the ordinary stream of the river can supply in the same time. The larger the surface of the pond is, the more efficient it will be; but depth will not compensate for the want of surface, because as the surface sinks, when the water is drawn off, the fall or descent of the water, and consequently the power of the water, diminishes.

The dam for a large river should be constructed with the utmost solidity; wood framing is very commonly used, but masonry is preferable. Great care must be taken, by driving pile planking under the dam, to intercept all leakage of the water beneath the ground under the dam, as that loosens the earth, and destroys the foundation imperceptibly; when a violent flood may overthrow the whole. It is a common practice to place the dam obliquely across the river, with a view of obtaining a greater length of wall for the water to run over, and consequently prevent its rising to so great a height, in order to give vent to the water of a flood. But this is very objectionable, because the current of water constantly running over the dam, always acts upon the shore or bank of the river at one point, and will in time wear it away, if not prevented by expensive works. This difficulty is obviated, by making the dam in two lengths which meet in an angle >, the vertex pointing up the stream. In this way the currents of water, coming from the two opposite parts of the dam, strike together, and spend their force upon each other, without injuring any part. A still better form is a segment of a circle, which has the additional advantage of strength, because if the abutments at the banks of the river are firm, the whole dam becomes like the arch of a bridge laid down horizontally. This was the form generally used by Mr. Smeaton.

The foot of the dam where the water runs down should be a regular slope, with a curve, so as to lead the water down regularly; and this part should be evenly paved with stone, or planked, to prevent the water from tearing it up, when it moves with a great velocity.

When the fall is considerable, it may be divided into more than one dam; and if the lower dam is made to pen the water upon the foot of the higher dam, then the water running over the higher dam will strike into the water, and lose its force. There is nothing can so soon exhaust the force of rapid currents of water as to fall into other water, because its mechanical force is expended in changing the figure of the water (see *circular weir* in our article CANAL); but when it falls upon stone or wood, its force is not taken away, but only reflected to some other part of the channel, and may be made to act upon such a great extent of surface as to do no very striking injury at any one time, but by degrees it wears away the banks, and requires constant repairs: for it is demonstrable that, as much of the force of the water as is not carried away by the rapid motion with which it flows, after passing the dam, must be expended either in changing the figure of the water, or in washing away the banks, or in the friction of the water running over the bottom.

The cotton-works of Messrs. Strutt at Belper, in Derbyshire, are on a large scale, and the most complete we have ever seen, in their dams and water-works. The mills are turned by the water of the river Derwent, which is very subject to floods. The great weir is a semicircle, built of very substantial masonry, and provided with a pool of water below it, into which the water falls. On one side of the weir are three sluices, each 20 feet wide, which are drawn up in floods, and allow the water to pass sideways into the same pool; and on the opposite side is another such sluice, 22 feet wide. The water is retained in the lower pool by some obstruction which it experiences in running beneath the arches of a bridge; but the principal fall of the water is broken by falling into the water of the pool, beneath the great semicircular weir.

The water which is drawn off from the mill-dam above the weir passes through three sluices, 20 feet wide each, and is then distributed by different channels to the mills, which are situated at the side of the river, and quite secure from all floods. There are six large water-wheels; one of them, which is 40 feet in breadth, we have mentioned, from the ingenuity of its construction; and another which is made in two breadths, of 15 feet each, we have also described. They are all breast-wheels. The iron-works of Messrs. Walker at Rotherham, in Yorkshire, are very good specimens of water-works; as also the Carron works in Scotland.

The largest works for overshot-mills are in Russia, at Colpino, near St. Petersburgh, on the river Neva. They were erected principally under the direction of Mr. Gascoigne of the Carron works in Scotland, and have been greatly improved by the present director, who is an engineer of his school. An immense dam of granite is built across the river to pen up the water, until it makes a large reservoir. The waste and flood waters do not run over this dam, but are conducted out of the reservoir by a semicircular branch of the river, and run over a great weir to join the original course of the river below the works. The mills

mills are ſituated in the valley below the great dam, the water being conveyed to the wheels by channels coming through the dam, and conveyed away into a large tail baſon, which is the original courſe of the river. The wheels, which are very numerous, are all 22 feet diameter. They are placed in ſeveral different mills, for rolling and forging iron and copper, boring guns, making anchors, &c. Theſe mills are arranged on the ſides of the tail baſon, which is navigable to bring the boats up to them. There are alſo two large ſaw-mills at the end of the ſemicircular channel.

Theſe works are very complete, owing to the excellent execution of the dam and water-works; but it is not a good plan to place the mills beneath the dam, becauſe if it ſhould fail, or the water pour over it by an extraordinary flood, the mills and buildings below would be in danger of being carried away; whereas, on the other conſtruction, the mills, being placed at a diſtance from the river, are perfectly ſafe, and would not be injured if the dam ſhould be wholly carried away. This is not a fault imputable to the gentlemen we have mentioned, as the foundations of theſe works were commenced in the time of Peter the Great, and too far advanced to admit of altering the plan radically, when the empreſs Catherine invited Mr. Gaſcoigne to Ruſſia, in 1786, to enlarge them to their preſent magnitude.

On the Diſtribution of the different Falls of Water in Rivers.—In erecting a mill, care muſt be taken to place it ſo that it ſhall not be impeded by flood-waters, except when they riſe to exceſs. When the water below will not run off freely, but ſtands penned up in the wheel-race, ſo that the wheel muſt work or row in it, the wheel is ſaid to be tailed, or to be in back water or tail water.

Upon moſt rivers in this country all the falls of water are fully occupied, and at every mill there is a weir, which pens up the water as high as the mill above can ſuffer it to ſtand without inconvenience. Each miller is anxious to obtain the greateſt poſſible fall, and he can at any time augment the fall, by raiſing the ſurface of his weir; but as this may produce an inconvenience to the mill above, in preventing the water from running freely away from its wheel, it is a conſtant ſource of diſpute and litigation. A mill may be ſubjected to tail-water by the concurrence of ſo many circumſtances, that it is frequently very difficult to know where to ſeek the beſt remedy, whether the miller ought to raiſe his wheel higher and diminiſh his own fall, or inſiſt upon a diminution of his neighbour's below him by lowering his weir.

The following rule is that which Mr. Smeaton conſtantly followed, in placing ſucceſſive dams upon rivers, whether for the erection of mills or for navigation. In flat countries, where the falls of water are ſmall, and conſequently tail or back water is moſt troubleſome, thoſe dams muſt be ſo built, that no one ſhall pen the water into the wheel-race of the mill next above it, when the river is in its ordinary ſummer's ſtate. The ſame rule we have found generally ſubſiſting in ancient mills.

This rule is founded upon reaſon; for if the erection of a dam does not affect the mill above by tail-water, in dry ſeaſons, when water is the moſt ſcarce, it can do no material injury at any other time. Every mill that is well and properly conſtructed will clear itſelf of a conſiderable depth of tail-water, provided it has at the time an increaſe of the height of water in the mill-dam or head, and an unlimited quantity of water to draw upon the wheel; for if floods produce tail-water, they alſo increaſe the head water, and afford a ſuperior quantity to be expended. This is the proper means by which a number of mills on the ſame river are to be cleared of back-water, as far as is conſiſtent with the mutual enjoyment of their ſeveral falls of water. This alone is a very ſufficient ſecurity againſt any one being injured. Common breaſt-mills will bear two feet of tail-water, when there is an increaſe of head, and plenty of water to be drawn upon the wheel, without prejudice to their performance; but mills well conſtructed, with ſlow moving wheels, will bear three and even four feet and upwards of tail-water. Mr. Smeaton mentions having ſeen an inſtance of ſix feet; and it is a common thing in level countries, where tail-water is moſt annoying, to lay the wheels from ſix to twelve inches below the water's level of the pond below, in order to increaſe the fall of water; and, if judiciouſly applied, is attended with good effect, as it increaſes the diameter of the wheel, and though it muſt always work in that depth of tail-water, it will perform full as well, becauſe the water ought always to run off from the bottom of the wheel, in the ſame direction as the wheel turns.

The law reſpecting mill property is by no means ſettled, but is greatly influenced by the cuſtom of the mills upon any river or in any diſtrict; ſome few points however are eſtabliſhed. Every one has a right to that fall which the water has, in running through his own grounds, and may make what uſe he pleaſes of the deſcent of the water, provided that he does not divert the water, at the tail of his eſtate, into any other channel, or that he does not pen up the water higher than the level at which it has always entered into his land; he has alſo a right to inſiſt that the miller below ſhall let the water depart from his grounds, at the ſame level at which it has always been uſed to do. The knowledge of this is very neceſſary, becauſe a miller very frequently finds himſelf ſeriouſly injured, when he is not entitled to any redreſs. It ſcarcely ever happens that any conſiderable improvements or alteration in mills can be made, without producing diſputes among the parties intereſted. Suppoſe, for inſtance, that there are two ancient mills upon a river, with an unoccupied deſcent in running over the lands between them, the proprietor of this land, by deepening the channel and erecting a weir, may bring all the fall into one place and erect a mill, without infringing the conditions we have laid down; but ſtill the miller below him may be conſiderably injured: for in the original ſtate the river, in running down with a regular and eaſy ſlope, from the upper mill to the lower, held a great quantity of water, which was a *corps de reſerve* for the miller below, and tended to regulate his ſupply. If the upper mill ſtopped working, the water contained in the river would ſtill run down to him, and ſo long as that laſted he could continue to work, perhaps until the upper mill began to work again, and thus he would ſuffer no interruption. The erection of an intermediate mill cuts off this reſource, and he will be obliged to ſtop working very ſoon after the new mill ſtops working; and further, he is obliged to work when the new mill is at work, or elſe the water poured down will run over his mill-dam and be waſted; but, in the former inſtance, the water would have come down leſs ſuddenly, and he might be able to ſet to work before the whole of the water had eſcaped over his weir.

In ſuch a caſe the lower miller may be inclined to appeal to the law, but he will find that he has no right to prevent his neighbour above from uſing the water in the ſame manner as he does himſelf, and if he finds any alteration in his own mill, it is for want of a capacious mill-pond to reſerve the water. In the original ſtate the channel of the river in his neighbour's ground above ſerved him in ſome meaſure as a mill-dam, by retaining the water for a given time, though it would not retain it permanently. The advantage of this he had enjoyed for a long time, when it was no inconvenience to his neighbour, but had acquired no right to demand

demand that his neighbour's property ſhould be ſacrificed for his convenience, but he muſt relieve himſelf by making an artificial pond for his own mill.

The ſame queſtion ariſes when any mill is altered or enlarged, ſo as to conſume the water faſter than the river brings it down, for ſuch a mill can only work for ſhort intervals, and muſt then ſtop that the water may accumulate in the dam until there is a ſufficient quantity to ſet to work again. This is the ſyſtem of copper-mills and rolling-mills, for during the time that the iron or copper is heating in the furnace, the mill is ſtopped, and the water gathered in the dam; but when the metal is ready, it is ſet to work with all the power of the water penned up. This is very prejudicial to a mill below, particularly if it is a corn-mill, which cannot conſume the water faſter than the regular ſupply of the river, and ſometimes alſo to mills above by frequently tailing their water.

Much uſeful information on theſe points will be found in Smeaton's Reports, 3 vols. 4to. 1813.

We have not, in the preceding article, entered into any of the mathematical inveſtigations upon the ſubject of water-wheels, becauſe we find few of them founded on experiment; but thoſe who wiſh to purſue this ſubject farther may conſult the following authors, which Dr. Young points out in his catalogue.

Künſtliche abriſs Allerhand, Waſſer, Wind-roſs, und Hand-muhlen, &c. von Jacob. de Strada a Roſberg, 1617.

Georg Chriſtoph Luerner Machina toreutica nova; oder beſchreibung der neu erfundenen Drehmühlen, 1661.

Theatrum Machinarum Novum; das iſt, neu vermehrter Schauplatz der Mechaniſchen Künſte, handelt von Allerhand, Waſſer, Wind, Roſs, Gewicht, und Hand-muhlen, von Geo. And. Bocklern, 1661.

Contenta diſcurſus mechanici, concernentis Deſcriptionem optimae formea Velorum horizontalium pro uſu Molarum, nec non fundamentum inclinatorum Velorum in Navibus, habita coram Societate Regia, a R. H. tranſlata ex Collectionibus Philoſophicis M. Dec. num. 3. pa. 61, 1681.

Diſſertatio hiſtorica de Molis, quam praeſide Joh. Phil. Treuer defend. Jo. Tob Mühlberger Ratiſbonens Jenae, 1695.

Martin Marten's Wiſkundige beſchouwinge der Wind of Wadermoolens, vergeleken met die van den heer Johann Lulofs Amſterdam, 1700.

Vollſtändige Mühlen-baukunſt, von Leonhard Chriſtoph. Sturm, 1718.

Jacob Leopold's Theatrum Machinarum Molinarum, folio, 1724, 1725.

Remarques ſur les Aubes ou Palettes des Moulins, et autres Machines mues par le Courant des Rivières, par M. Pitot, Mem. Acad. Roy. Paris, 1729.

Joh. van Zyl Theatrum Machinarum univerſale of Groot Algemeen, Moolen-bock, &c. Amſterdam, 1734.

Jo. Caral. Totens. Diſſer. de Machinis Molaribus optime conſtruendis, Lugd. Batav. 1734.

Kurze, aber Deutliche anweiſung zur conſtruction der Wind und Waſſer-muhlen, von Gottſr. Kinderling, 1735.

Deſaguliers' Experimental Philoſophy, 2 vols. 4to. 1735. 1744.

Architecture Hydraulique, par M. Belidor, 4 vols. 4to. 1737. 1753.

Mr. W. Anderſon, F.R.S. Deſcription of a Water-wheel for Mills. Phil. Tranſ. vol. xliv. 1746.

Leonh. Euleri, De Conſtructione aptiſſima Molarum alatarum diſp. Nov. Com. Acad. Petrop. tom. 4. 1752.

Memoire dans lequel on démontre que l'Eau d'une Chûte, deſtinée à faire mouvoir quelque Machine, Moulin ou autre peut toujours produire beaucoup plus d'effect en agiſſant par ſon poids qu'en agiſs ant par ſon choc, et que les roues à pots qui tournent lentement produiſent plus d'effet que celles qui tournent vite, relativement aux chûtes et aux depenſes d'eau, par M. de Parcieux, Acad. Roy. Paris, 1754.

Jo. Alberti Euleri Enodatio queſtionis: quo modo vis Aquæ aliuſve fluidi cum maximo lucro ad Molas circumagendas, aliave opera perficienda impendi poſſit, praemio à Societate Regia. Sci. Gotting. 1754.

An experimental Enquiry concerning the Natural Powers of Wind and Water to turn Mills and other Machines depending on Circular Motion, by Mr. J. Smeaton, F.R.S. Phil. Tranſ. 1759.

This and Mr. Smeaton's other papers are republiſhed with his reports, 1813, in 4to.

Memoire dans lequel on prouve que les Aubes de Roues Mûes par les courans des grandes Rivières feroient beaucoup plus d'effet ſi elles etoient inclinees aux rayons, qu'elles ne ſont etant appliquees contre les rayons memes, comme elles ſont aux Moulins pendans et aux Moulins ſur Bateaux qui ſont ſur les Rivières de Seine, de Marne, de Loire, &c. par M. de Parcieux, Mem. Acad Roy. Paris, 1759.

Joh Albert Euler's Abhandlung von der bewegung ebener Flächen, wenn ſie vom Winde Getrieben Werden, 1765.

Schauplatz des mechaniſchen Mühlenbaues, Darinnen von Verſchiedenen Hand, Trett, Roſs, Gewicht, Waſſer, und Wind-mühlen Gehandelt Wird, durch Johann Georg Scopp, I. C. iter Theil, 1766.

Theatrum Machinarum Molarium, oder ſchauplatz der Mühlenbaukunſt, als der Neunte theil von des ſel hrn Jac. Leopolds, Theatro Machinarum, von Joh Mathias Beyern, 1767. 1788. 1802.

A Memoir concerning the moſt advantageous Conſtruction of Water-wheels, &c. by Mr. Mallet of Geneva. Phil. Tranſ. 1767.

Mémoire ſur les roues Hydrauliques, par M. le Chevalier de Borda, Mem. Acad. Roy. Paris, 1767.

Kurzer unterricht, allerley arten von Wind und Waſſermühlen auf die vortheilhafteſte weiſe zu erbauen, nebſt einigen gedanken über die verbeſſerung des räderwerks, an den mühlen, von Joh König, 1767.

G. G. Biſchoff's Beyträge zur Matheſis der Muhlen, 1767.

Determination generale de l'Effet des Roues mûes par le Choc de l'Eau, par M. l'abbé Boſſut, Mem. Acad. Roy. Paris, 1769.

Andreas Kaovenhöfer, Deutliche abhandlung von den rädern der Waſſermühlen, und von dem einrandigen werke der Schneidemühlen, 1770.

Manuel du Meuner et du Charpentier des Moulins, redigé par Edm. Bequillet, 1775.

Remarques ſur les Moulins et autres Machines, ou l'Eau tombe en deſſus de la Roue, par M. Lambert.

Experiences et Remarques ſur les Moulins que l'Eau meut par en bas dans une Direction horizontale, par M. Lambert.

Remarques ſur les Moulins et autres Machines, dont les Roues prennant l'Eau à une certaine Hauteur, par M. Lambert.

(The laſt three articles are inſerted in Mem. Acad. Roy. Berlin, 1775.)

Ausführliche erklärung der Vorſchläge für die Längere dauer de Muhlenwerk, nebſt ähnlichen gegenſtander, in ein geſpräch verfaſſet, von Johann Chriſtian Fullmann Muhlenmeiſter, 1780.

Tratado

Tratado de los Granos y Modo de Molelos con Economie de la Confervaçion de Aftos y de las Harinas; efcr. en Fr. par M. Beguillet, y extract. v trad. al Caft. con algun Notas y un Supplem. por Ph. Marefcaulchi, Madrid, 1786.

Suite de l'Architecture hydraulique, par M. Fabre, 1786.

Mémoires fur les Moyens de Perfectionner les Moulins, et la Mouture économique, par C. Bucquet, 1786.

Manuel ou Vocabulaire des Moulins à Pot, à Amft., 1786.

Die Nothigften Kenntniffe zur Anlegung, Beurtheilung, und Berechnung der Waffer-mühlen, and zwar der Mahl, Oehl, und Säge-Muhlen, für Anfänger und Liebhaber der Mühlenbaukunft, von Joh. Chrift. Huth, 1787.

An Effay proving Iron far fuperior to Stone of any Kind for breaking and grinding of Corn, &c. by W. Walton, 1788.

Mühlenpraktik, oder unterricht in dem Mahlen der Brodfrüchte, für Polizeybeamte, Gaverkfleute und Haufwirthe, von L. Ph. Hahn, 1790.

The young Mill-wright and Miller's Guide, by Oliver Evans, Philadelphia, 1790.

Manuel du Meûnier, et du Conftructeur des Moulins à Eau et à Grains, par C. Bucquet, 1791.

Praktifche anweifung zum Mühlenbau, von. Lr. Claufen, 1792.

Befchreibung zweir Machinen zur Reinigung des Korns, von Lr. Claufen, 1792.

Inftructions fur l'Ufage des Moulins à Bras, inventés et Perfectionnés par les Citoyens Durand, Père et Fils, Mechaniciens, 1793.

Theoretifch-praktifche abhandlung über die Befferung der Muhlräder, von dem Verfaffer der Zweckmäffigen, Luftreiniger, &c. 1795.

A Treatife on Mills, in four Parts, by John Banks, 1795.

Handbuch der Mafchinenlehre, fur prakiker und akademifche lehrer, von Karl Chriftian Langfdorf, 1797. 1799.

On the Power of Machines; including Barker's Mill, Weftgarth's Engine, Cooper's Mill, horizontal Water-Wheel, &c. by John Banks, 1803.

The experienced Mill-wright, by Andrew Gray, mill-wright, 1804.

The Tranfactions of the Society of Arts and Manufactures; feveral of the volumes of which contain improvements in Mill-work. See alfo the Repertory of Arts, firft feries 16 volumes, and fecond feries 31 volumes.

Hachette, Traité Elementaire des Machines, 4to. Paris, 1811.

Buchanan's Effays on Millwork, 1811, 8vo.

WATER, *Column of*, fignifies fo much of the mafs of water which is contained in a pipe, or any other veffel, as preffes againft any plane furface; which furface is called the bafe of the column.

All columns of water are confidered as if they were vertical prifms, of the fame fize and figure as the bafe, *i. e.* the furface upon which they prefs, and as high as the greateft height to which the water rifes in the pipe or other veffel.

This is demonftrable in hydroftatics, (fee FLUID,) and alfo that fluids prefs equally in all directions, fo that the preffure againft a vertical or inclined plane is the fame as againft an horizontal plane, provided that the planes are of the fame extent, and that the water which preffes upon them rifes to an equal height above them. This will be true whether the fize of the veffel which contains the water is greater or lefs than the furface upon which the preffure is exerted; the preffure will be neither more nor lefs than the weight of a perpendicular column or prifm of water, having a horizontal bafe, equal and fimilar to the plane or bafe upon which the preffure is exerted; and an altitude equal to the level of the furface of the water above the bafe.

Rule to find the Preffure or Weight of any Column of Water in Pounds Avoirdupois.—If the bafe of the column is of a circular figure, fuch as the pifton of a pump, take the diameter in inches, and alfo the perpendicular height of the furface of the water above the bafe of the column in feet; then fquare the diameter in inches, to obtain the area of the bafe in circular inches, and multiply this by the decimal .341 or by .34, this gives the weight of one foot in height of the column; laftly, multiply by the number of feet in the altitude of the column, and the refult is the weight of the whole column of water in pounds avoirdupois, or, what is equivalent, the preffure exerted by the water upon the bafe or plane againft which it acts.

If the bafe of the column is fquare or rectangular, it will be more convenient to find its area in fquare inches, and then the conftant decimal is .434.

The reafon of thefe rules is, that a cylindrical column of rain-water, of 1 inch in diameter and 1 foot high, weighs .3408853 lbs. avoirdupois; and a fquare prifm, 1 inch fquare, and 1 foot high, weighs .4340277 lbs. avoirdupois; the other multiplications are only to find how many of fuch cylinders or prifms are contained in the whole column.

Example 1.—It is required to find the weight which bears upon the pifton or bucket of a pump, whofe barrel is 9 inches diameter withinfide, and the height of the furface of the water above the pifton 67 feet. Diameter $9 \times 9 = 81$ circular inches of area $\times$ .341 lbs. $= 27.62$ lbs., which is the weight of every foot in height $\times$ 67 feet $= 1850.54$ lbs. which is the weight that bears upon the pifton, and which muft be overcome to draw it up.

Example 2.—It is required to find the weight which bears upon a rectangular valve, which is 7 inches by 5 inches, and the water rifes 67 feet above it. $7 \times 5 = 35$ fquare inches of furface $\times$ .434 lbs. $= 15.2$ lbs. for every foot of altitude $\times$ 67 feet $= 1018$ lbs.; the weight refting upon the valve.

Note.—In pumps it generally happens that there is a column of water contained in the pipe, beneath the pifton or valve, and is fufpended therefrom, becaufe the preffure of the atmofphere is taken off from fuch column by the valve or pifton, and the preffure of the atmofphere upon the furrounding water forces the water up the pipe until it touches the pifton, provided the height is not more than 33 feet. In all fuch cafes, the height of the column depending beneath the valve or pifton muft be added to the height of the column above the pifton, becaufe it is fo much additional burthen or preffure.

Rule to find the Preffure which any Column of Water exerts upon each fquare Inch or circular Inch of its Bafe, in Pounds Avoirdupois.—Multiply the height of the column in feet by .434, for the preffure on each fquare inch of the bafe, or by .34 lbs. for each circular inch.

In large works it is more convenient to take the area of the bafe in fquare feet, in which cafe the multiplier will be 62.5 lbs.; or, if it is circular feet, 49,0875 lbs.

Example.—A tank to contain water, ten feet deep, is lined with vertical walls of mafonry, each ftone of which is one foot fquare in its vertical face; required the preffure which

which will be exerted upon each ftone of the mafonry to thruft it outwards.

Depth beneath the Surface in Feet.	Preffure on each Stone, or on every fquare Foot, in Pounds.
1	62.5
2	125
3	187.5
4	250
5	312.5
6	375.
7	437.5
8	500
9	562.5
10	625.

The length and width of the tank does not influence the preffure upon each ftone ; becaufe, following our firft propofition, we are only to regard the magnitude of the plane againft which the water acts, and the depth at which it is fituated beneath the furface. But in all cafes when the plain is not horizontal, the depth of the water will be greater upon fome parts of the plane than upon others. The depths muft therefore be taken from the *centre of preffure* of the plane ; fee that article in Vol. VII.

The knowledge of the centre of preffure is required, in order to apply this calculation to wooden veffels, fuch as the large backs ufed by brewers ; or to find the preffure againft the gates of a fluice or lock, or in any other cafe where the wood planks, or the ftones of the mafonry are fo united together into one mafs, that the whole fide of the veffel muft be removed together. If the plane againft which the water acts rifes up as high as the furface of the water, and is of a rectangular figure ; that is, if all its horizontal dimenfions, whether taken at the bottom of the veffel or at the top, are equal, then the centre of preffure is fituated at $\frac{2}{3}$ds of the greateft depth beneath the furface.

Example.—A wooden vat is 18 feet long, and contains water 6 feet deep ; required the force which the water exerts againft the fide of the vat to force it outwards. Two-thirds of 6 feet is 4 feet, which is the depth of the centre of preffure : $4 \times 62.5 = 250$ lbs. is the mean preffure upon each fquare foot of the plane, 18 feet long $\times$ 6 feet deep $= 108$ fquare feet of area $\times$ 250 lbs. 27,000 lbs., which is the force exerted againft the fide of the veffel, and muft be refifted by the ftrength of the materials.

On the Means of meafuring or guaging the Quantity of running Water.—The ancients feem to have had no other meafure of running water than that uncertain and fallacious one, which depended wholly on the perpendicular fection of a ftream, without confidering the velocity of the motion. The firft who opened a way to the truth was Benedict Caftelli, an Italian, and friend of Galileo. He firft fhewed that the quantity of water, flowing through a given fection of a ftream, is proportional to the celerity with which the water is carried through that fection. This obfervation engaged philofophers to ftudy the doctrine of the motion of fluids with much diligence, and after Caftelli's time there was fcarcely any mathematicians who did not endeavour to add fomething thereto, either by experiments or by reafoning and argument.

But few of them, until the illuftrious fir Ifaac Newton, had any fuccefs, becaufe of the exceeding difficulty of the fubject.

Thofe who ftudied the theory laid down fuch theorems as were found to be falfe, when brought to the teft of experiments, and thofe who laboured in making experiments frequently omitted to obferve fome minute circumftances, the importance of which they had not yet perceived. Hence they differed greatly from one another, and almoft all of them erred from the real meafure.

The theory of hydraulics has never been carried to a very high degree of perfection upon mathematical foundation alone, nor has it hitherto, even with the affiftance of experiment, been rendered of much practical utility. Newton began the inveftigation of the motions of fluids on true principles. Daniel Bernouilli added much valuable matter to Newton's propofitions, both from calculation and experiment. D'Alembert, and many later authors, have exercifed their analytical talents in inquiries of a fimilar nature.

Dr. Robifon obferves that thefe, and other mathematicians of the firft order, feem to have contented themfelves with fuch views as allowed them to entertain themfelves with elegant applications of calculus. They rarely had any opportunity of doing more, for want of a knowledge of facts, but they have made excellent ufe of the few which have been given them.

It requires much labour, great variety of opportunities, and great expence, to learn the multiplicity of things which are combined, even in the fimpleft cafes of water in motion. Thefe advantages feldom fall to the lot of a mathematician, and he is without blame when he enjoys the pleafures within his reach, and cultivates the fcience of geometry in its moft abftracted form. Here he makes a progrefs which is the boaft of human reafon, being almoft infured from every error, by the intellectual fimplicity of his fubject. But were we to turn our attention to material objects, we know neither the fize and fhape of the elementary particles of water, nor the laws which nature has prefcribed for their action. We cannot, therefore, prefume to forefee their effects, calculate their exertions, or direct their actions, with any reafonable expectations of certainty.

A different and more practical mode of attaining hydraulic knowledge, has been attempted by a diftinct clafs of inveftigators. Thefe have begun from experiment alone, and have laborioufly deduced, from very ample obfervations of the actual refults of various particular cafes, the general laws by which the phenomena appear to be regulated, or at leaft the formulas by which the effect of new combinations may be predicted. But it muft be confeffed, that thefe formulas, however accurate, are almoft too intricate to be retained in the memory, or to be very eafily applied to calculations from particular data.

There are two gentlemen whofe labours in this refpect deferve very particular notice, profeffor Michelotti, at Turin, and abbé Boffut, at Paris. The firft made a prodigious number of experiments, both on the motion of water through pipes and in open canals. The experiments of Boffut are alfo of both kinds, and though on a much fmaller fcale than thofe of Michelotti, they feem to deferve equal confidence. The chevalier de Buat, who has taken up this matter where the abbé Boffut left it, has profecuted his experiments with great affiduity and fingular fuccefs.

Mr. Eytelwein, a gentleman honoured with feveral employments and titles relative to the public architecture of the Pruffian dominions, made a tranflation of Buat's works into German, with important additions of his own; and he alfo publifhed "Handbuch der Mechanik und der Hydraulik," Berlin, 1801. In this compendium of mechanics and hydraulics, he has collected the principal facts that have been afcertained, as well by his own experiments as by thofe of former authors, efpecially fuch as are the moft capable of practical application. He appears to have done this in fo judicious a manner, as to make his book a moft valuable

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abstract of every thing that can be deduced from theory, respecting natural and artificial hydraulics. The elegant concisenefs of his manner deserves so much the more praise, as his countrymen too often make a merit of prolixity.

In our article Discharge, we have given the general principles of the motion of spouting fluids; and under River the theory of water running in rivers. The object of the present article will be to lay down such rules as may be immediately applicable to the use of the engineer.

In all cases of gauging streams, the quantity which flows, in any given time, is obtained by measuring the area of the aperture, or channel, through which the water flows, and finding the velocity with which the water moves through that aperture. To find the area of the aperture is a simple operation of mensuration, but to ascertain the velocity is not so easy. There are two different methods of determining the velocity. The first is, by observing the rate of motion of the surface, either by means of small light bodies thrown into the stream, or by employing instruments adapted to measure the rate at which the stream moves. This method is only applicable in cases of open canals and rivers, where the water flows with a slow motion. The other method is more general, and is applicable to the greatest velocities; because it is derived from calculation, according to the depth of water, or height of column, which urges the flowing water, and occasions its motion.

To measure the Quantity of Water running in a River or Canal. First Method.—Choose a part of the channel where the banks are of a determinate figure, and where they continue of the same breadth and depth for a length of ten, twenty, or thirty feet, the longer the better, and the more regular the banks are, the better the observations will be. Measure the breadth and the depth, or other dimensions which may be necessary, to find the area, or section of the passage, through which the water flows. Take these measures at several different points, and if there is any difference at different places, find the area at each place, and take a mean between them.

Then proceed to find the velocity of the motion, by throwing in a cork, or other light body, and observing, by a stop-watch, or pendulum, what number of seconds it takes to flow through a given length of the channel; for instance, the length of ten, twenty, or fifty feet, which was chosen in the first instance for the experiment, and marked out by stretching two strings, parallel across the river. This trial must be repeated several times, and as the instant when the floating body arrives at the last string, can be very exactly noted, this method admits of considerable exactness. A mean of the different results must be taken for the true velocity.

It is true that this only gives the velocity of the water at the surface, and the water moves with different velocities at different depths, beneath the surface; (instead of a single light body to float upon the surface of the water), we are recommended to employ a cylindrical rod of wood, of a length something less than the depth of the water: this is to be ballasted by a weight at the lower end, so that it will swim just upright in standing water, and with the upper end of the stick about an inch above water. By using this, instead of a single cork, we are supposed to attain the mean velocity of the stream at its different depths, instead of the velocity of the surface.

Instead of a cylinder of wood, three or four apples, strung together by a string, will answer the purpose very well, the lower ones being loaded by putting nails in them till they are rather heavier than water, so that the apples, when put into standing water, will hang in a perpendicular line. Goosberries are very nearly the weight of water, and may be employed singly, to shew its velocity at different depths.

Example.—A canal measured eight feet in width, and four feet in depth, the sides being perpendicular; then the area of the section is thirty-two square feet. It was found, by experiments with three apples, that the current ran through a space of fifteen feet in five seconds, in another experiment six seconds, and in a third four seconds and a half. What is the quantity of water passing through this canal?

The mean of all these is five seconds and one-sixth, during which the water moved fifteen feet. Now as five seconds and one-sixth is to fifteen feet, so is sixty seconds to a hundred and seventy-four feet, which the stream flows in the space of a minute. Then thirty-two square feet (the area), multiplied by 174 feet, gives 5568 cubic feet, which is the quantity of water flowing through the canal every minute.

This is the method recommended by Desaguliers, and if carefully executed, and the trials frequently repeated, is tolerably exact. Several authors have supposed this method might be much improved, by employing some instrument to shew the velocity of the stream by inspection. There are many ingenious inventions for this purpose.

Stream-Measurers.—M. Pitot invented a stream-measurer of a simple construction, to find the velocity of any part of a stream. This instrument is composed of two long tubes of glass open at both ends, and placed in a perpendicular direction in the stream of water: one of these tubes is cylindrical throughout and straight; but the other has its lowest extremity bent nearly at right angles, so as to form a horizontal branch, which gradually enlarges like a funnel, or the mouth of a trumpet; both these tubes are fixed to the side of a triangular prism of wood, with the lengths of the tubes parallel to the length of the prism, and their lower extremities both on the same level; the horizontal branch of the tube is carried through the prism, so that the end of the trumpet-mouth opens in one of the angles of the prism. The upright parts of the tubes stand one beside the other, and are let into grooves in the prism, so as to be tolerably well preserved from accidents. The face of the prism in which these tubes stand, is graduated on the edges close by the sides of them into divisions of inches and lines.

To use this instrument, it is placed perpendicularly in the water in such a manner, that the opening of the trumpet-mouth at the bottom of one of the tubes, shall be completely opposed to the direction of the current, in order that the water may pass freely through the funnel up into the perpendicular tube. Then by observing to what height the water rises in each tube, it will he found to rise higher in the tube with the trumpet-mouth than the other, and the quantity of this difference will be the height due to the velocity of the stream.

It is manifest that the water will rise in the straight cylindrical tube to the same height as the surface of the stream: this is by the hydrostatic pressure. But the water of the current entering by the funnel into the other tube, will be compelled to rise above that surface to some certain height, at which height it will be sustained by the impulse of the moving fluid; that is, the momentum or impulse of the stream will be in equilibrio with the column of water sustained in one tube above the surface of that in the other. In estimating the velocity by means of this instrument, we must have recourse to the following rules: if the height of the column sustained by the stream, or the difference of heights in the two tubes be taken in feet, the velocity of the

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the ftream *per* fecond in feet will be 6.5 times the fquare root of the height.

If the height be meafured in inches, then the velocity in feet *per* fecond will be 1.88 times the fquare root of the height, nearly. It will be eafy to put the funnel into the moft rapid part of the ftream, by moving it about to different places, until the difference of altitude in the two tubes becomes the greateft. In fome cafes, it will happen that the immerfion of the inftrument will produce a little eddy in the water, and thus difturb the accuracy of the obfervation; but keeping the inftrument immerfed only a few feconds will correct this. The wind alfo would affect the accuracy of the experiments; it is therefore advifeable to make them when there is little or no wind.

By means of this inftrument, the velocity of water at various depths in a canal or river may be found with tolerable accuracy, and a mean of the whole drawn. Where great accuracy is not required, the bent tube with the funnel at bottom will alone be fufficient, becaufe the furface of the water will be indicated with tolerable precifion, by that part of the prifmatic frame for the tube which has been moiftened by the immerfion.

M. Pitot likewife propofed that a fimilar inftrument fhould be ufed inftead of a log, to determine the rate at which a fhip fails. For this purpofe, in the middle of a veffel, or as near as can be to the centre of its ofcillations, place two tubes of metal of three or four lines in diameter, one of them being ftraight, and the other bent at bottom and enlarged into a conical funnel. The lower ends of both are to dip into the water in which the veffel fails, and there will be no evil to apprehend from orifices fo minute. Into thefe metallic tubes, two others are clofely fitted at a convenient height for the obfervations. The water will rife, in the firft of thefe tubes, up to its level on the outfide of the fhip; and in the fecond, up to a certain height, which will indicate as above the velocity of the veffel. For the funnel being turned towards the prow of the fhip, it will, in confequence of the motion, be affected in like manner, as if it were plunged into the ftream of a running water. The actual velocity of the veffel is found by the fame rules as that of the current. This method has been repropofed in this country, without any acknowledgments to M. Pitot. We do not, however, recommend its adoption on board a fhip; for, notwithftanding its theoretical ingenuity, it is liable to many fources of error in practice, and would not, it is probable, furnifh more accurate meafures of a fhip's way, than thofe deduced from the common log.

In the practical ufe of M. Pitot's inftrument, a great difficulty is experienced from the ofcillations of the water in the tubes, which it is not eafy to prevent, and a mean height of the ofcillating water muft be taken.

M. Du Buat made trials of the inftrument, and found it could not be trufted for any other purpofes than to give the ratios of different velocities. He found the inftrument was better without the ftraight tube, and he employed only one tube with its lower end turned horizontally, in the direction of the ftream, it was made of tinned plate inftead of glafs, and fufficiently large to admit a float to fhew the height of the water in the tube. Inftead of making the end of the tube an open trumpet-mouth, he ufed to clofe it by a flat plate, with a fmall perforation in the centre to admit the water through it, or in fome cafes feveral fmall perforations. In this way, the water will rife in the tube, juft the fame as if it was open; but the ofcillations of the column will be avoided, or greatly diminifhed.

The hydraulic quadrant has been recommended by feveral authors, for meafuring the velocity of water.

It confifts of a fmall quadrant with a divided arch, and having two threads moving round its centre. One of thefe is fhort, and carries a plummet which always hangs in air, and ferves to place the quadrant in its true pofition. The other thread is longer, and carries a weight whofe fpecific gravity is greater than that of water, and which plunges more or lefs deep in the current as the thread is lengthened. The inftrument is held over the water, fo that the plummet of the long thread hangs in the water, and the force of the current will remove it from the perpendicular, whilft the angular diftance from the other thread, which is a vertical line can be afcertained by the divifions on the arch of the quadrant; the quantity of this deviation from the perpendicular is the meafure of the force, and confequently of the velocity of the current. Boffut has fhewn, that the force of the current is as the tangent of the angle which one thread makes with the other, and gives directions for ufing this inftrument to try a current at different depths.

Dr. Brewfter, in his edition of Fergufon's lectures, recommends a fmall and light wheel, like an underfhot waterwheel, with float-boards on its circumference. It is provided with an apparatus to afcertain and record the number of turns it makes, and is held in the ftream, fo that the water may act upon the float-boards to turn it round; and from the number of turns it makes in any given time, the velocity of the ftream may be computed. He directs the wheel to be made of the lighteft materials, and about ten or twelve inches in diameter: it is furnifhed with fourteen or fixteen float-boards. The centre of the wheel is perforated with a hole, and tapped to receive a delicate fcrew or wire, which forms the axis upon which it revolves, with as little friction as poffible. At each end of the fcrew or axis, is a handle to hold it by, and to fupport the wheel; and to one of thefe handles an index is fixed, pointing to divifions on the circumference of the wheel, which confift of 100 parts. This index fhews the aliquot parts of a revolution, whilft the number of threads which the wheel advances on the fcrew fhews the number of whole turns it makes.

To prepare this inftrument for ufe, the wheel muft be turned round upon the fcrew until it arrives quite at one end of it, and till the index points to zero of the divifions on the rim of the wheel; then hold the axis or fcrew horizontally by the two handles, fo that the floats dip in the water and turn the wheel round upon the fcrew.

By means of a ftop-watch, or a pendulum, find how many revolutions of the wheel are performed in a given time, a minute, for inftance. Multiply the mean circumference of the wheel, *i. e.* the circumference deduced from the mean radius, meafured from the centre of impulfion upon the float-boards to the centre of the wheel, by the number of revolutions, and the product will be the number of feet which the water moves through in the given time. On account of the friction of the fcrew, the refiftance of the air, and the weight of the wheel, its circumference, will move with a velocity a little lefs than that of the ftream; but the diminution arifing from thefe caufes, may be eftimated with fufficient precifion for all the purpofes of the practical mechanic.

This, we think, is one of the beft ftream-meafurers, becaufe it will give a correct meafure of the motion at the furface of the water; but it will not give the velocities at the different depths beneath the furface, nor do we know any machine which will effectually anfwer that purpofe.

By means of this inftrument, we can obtain the velocity of the furface with greater accuracy than perhaps by any other means; but to afcertain the quantity of water which fhall ſhall be diſcharged, we muſt know the mean velocity of the water.

Ratio between the mean Velocity of running Water and the Velocity of the Top and Bottom of a Channel.—M. Du Buat ſtates, that the ſuperficial velocity of a ſtream of water always bears a certain relation to the mean velocity, ſo that we can derive one from the other by an arithmetical rule.

From a great number of experiments, he diſcovered the following laws: 1ſt, That the velocity at the ſurface in the middle of the ſtream, (in ſlow motions,) is to the velocity at the bottom of the ſtream, in a ratio of conſiderable inequality. 2d, This ratio diminiſhes as the velocity increaſes, and in very great velocities approaches to the ratio of equality. 3d, What was moſt remarkable, was, that neither the magnitude of the channel, nor its ſlope, had any influence in changing this proportion, whilſt the mean velocity remained the ſame. Whether the ſtream ran in a channel with the bottom covered with pebbles, or coarſe ſand, the proportions between the two velocities was, as nearly as poſſible, the ſame as when it ran in a ſmooth channel. 4th, If the velocity at the ſurface in the middle of the ſtream be conſtant, the velocity at the bottom will be alſo conſtant, and will not be affected by the depth of water or magnitude of the ſtream. In ſome experiments, the depth was thrice the width, and in others the width was thrice the depth. This changed the proportion of the magnitude of the ſection, to the magnitude of the rubbing part, but made no change in the ratio between the velocities at the top and bottom.

The place of the mean velocity in the ſection of the ſtream could not be diſcovered with any preciſion. In moderate velocities, it was not more than one-fourth or one-fifth of the depth diſtant from the bottom. In very great velocities, it was ſenſibly higher, but never in the middle of the depth.

In all caſes he computed the mean velocity by meaſuring the quantities of water diſcharged in a given time. His method of meaſuring the bottom velocity was ſimple, and probably juſt; he threw in a gooſeberry, as nearly as poſſible of the ſame ſpecific gravity with the water; it was carried along the bottom without touching it. We have already obſerved, that the ratio between the velocity at the ſurface in the middle, and the velocity at the bottom, diminiſhed as the mean velocity was increaſed. This variation he was enabled to expreſs in a very ſimple manner, ſo as to be eaſily remembered, and to enable us to find any one of them from having obſerved another.

Dr. Robiſon ſtates, that if we take unity from the ſquare root of the ſuperficial velocity, in the middle of the ſtream, expreſſed in inches *per* ſecond, the ſquare of the remainder is the velocity at the bottom; and the mean velocity is the half ſum of theſe two. Thus, if the velocity of the ſurface in the middle of the ſtream be twenty-five inches *per* ſecond, its ſquare root is five; from which if we take unity, there remains four. The ſquare of this, or 16, is the velocity at the bottom, and $\frac{25 + 16}{2}$, or $20\frac{1}{2}$, is the mean velocity.

This is a very curious and moſt uſeful piece of information. The velocity of the ſurface in the middle of the ſtream, is the eaſieſt meaſured of all, by any light ſmall body floating down it, or by a ſtream-meaſurer; and the mean velocity is the one which regulates the diſcharge, and all the moſt important conſequences.

Dr. Robiſon gives the following table of theſe three velocities, which will ſave the trouble of calculation in ſome of the moſt frequent queſtions of hydraulics.

Velocity in Inches *per* Second.			Velocity in Inches *per* Second.		
Surface.	Bottom.	Mean.	Surface.	Bottom.	Mean.
1	0.000	0.5	51	37.712	44.356
2	0.172	1.081	52	38.564	45.282
3	0.537	1.768	53	39.438	46.219
4	1.	2.5	54	40.284	47.142
5	1.526	3.263	55	41.165	48.082
6	2.1	4.050	56	42.016	49.008
7	2.709	4.854	57	42.968	49.984
8	3.342	5.67	58	43.771	50.886
9	4.	6.5	59	44.636	51.818
10	4.674	7.337	60	45.509	52.754
11	5.369	8.184	61	46.376	53.688
12	6.071	9.036	62	47.259	54.629
13	6.786	9.893	63	48.136	55.568
14	7.553	10.756	64	49.	56.5
15	8.254	11.622	65	49.872	57.436
16	9.	12.5	66	50.751	58.376
17	9.753	13.376	67	51.639	59.319
18	10.463	14.231	68	52.505	60.252
19	11.283	15.141	69	53.392	61.196
20	12.055	16.027	70	54.273	62.136
21	13.674	16.837	71	55.145	63.072
22	13.616	17.808	72	56.025	64.012
23	14.202	18.701	73	56.862	64.932
24	15.194	19.597	74	57.790	65.895
25	16.	20.5	75	58.687	66.843
26	16.802	21.401	76	59.568	67.784
27	17.606	22.303	77	60.451	68.725
28	18.421	23.210	78	61.340	69.670
29	19.228	24.114	79	62.209	70.605
30	20.044	25.022	80	63.107	71.553
31	20.857	25.924	81	64.	72.5
32	21.678	26.839	82	64.883	73.441
33	22.506	27.753	83	65.780	74.390
34	23.339	28.660	84	66.651	75.325
35	24.167	29.583	85	67.568	76.284
36	25.	30.5	86	68.459	77.229
37	25.827	31.413	87	69.339	78.169
38	26.667	32.333	88	70.224	79.112
39	27.51	33.255	89	71.132	80.066
40	28.345	34.172	90	72.012	81.006
41	29.192	35.096	91	70.915	81.957
42	30.030	36.015	92	73.788	82.894
43	30.880	36.940	93	74.719	83.859
44	31.742	37.871	94	75.603	84.801
45	32.581	38.790	95	76.51	85.755
46	33.432	39.716	96	77.370	86.685
47	34.293	40.646	97	78.305	87.652
48	35.151	41.570	98	79.192	88.596
49	36.	42.5	99	80.120	89.56
50	36.857	43.428	100	81.	90.5

The knowledge of the velocity at the bottom is of uſe to an engineer, to enable him to judge of the action of a ſtream on its bed. Every kind of ſoil will bear a certain velocity without changing the form of the channel. A greater velocity would enable the water to tear it up, and a ſmaller velocity would permit the depoſition of more moveable mate-

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rials from above. It is not enough, then, for the permanency of a river, that the accelerating forces are ſo adjuſted to the ſize and figure of its channel, that the current may acquire an uniform velocity, and ceaſe to accelerate. It muſt alſo be in equilibrio with the tenacity of the channel.

It appears from obſervation, that a velocity of three inches *per* ſecond at the bottom, will juſt begin to work upon fine clay fit for pottery, and however firm and compact it may be, it will tear it up. Yet no beds are more ſtable than clay, when the velocities do not exceed this, for the water ſoon takes away the impalpable particles of the ſuperficial clay, leaving the particles of ſand ſticking by their lower half in the reſt of the clay, which they now protect, making a very permanent bottom, if the ſtream does not bring down gravel or coarſe ſand, which will rub off this very thin cruſt, and allow another layer to be worn off. A velocity of ſix inches *per* ſecond, will lift fine ſand; eight inches will lift ſand as coarſe as linſeed; twelve inches will ſweep along fine gravel; twenty-four inches will roll along rounded pebbles an inch in diameter; and it requires three feet *per* ſecond at the bottom to ſweep along ſhivered angular ſtones of the ſize of an egg.

Dr. Young gives an excellent ſimple rule for the ſame object, which is only a trifle different from Dr. Robiſon's; he ſtates, that from a mean of all the beſt experiments, he found that, if the ſquare root of the mean velocity of any ſtream (running in an uniform open channel) be added to ſuch mean velocity, it will give the ſuperficial or top velocity in the middle; or if deducted therefrom, it will leave the bottom velocity: whence we have deduced the following practical rule, *viz*.

1. Having found the top velocity, expreſſed in any convenient meaſure, which will correſpond with the reſult required.

To find the bottom velocity, add the conſtant number .25 (or $\frac{1}{4}$) to the top velocity; extract the ſquare root of the ſum, and double it; again add 1 to the top velocity, and from the ſum deduct the double root before found: the remainder is the bottom velocity of the ſtream.

2. To find the mean velocity from the top velocity, add the conſtant number .5, (or $\frac{1}{2}$) to the top velocity, and from their ſum deduct the ſquare root found in the firſt rule: the remainder is the mean velocity.

Or, 3. To find the mean velocity from the bottom velocity, add the conſtant number .25, (or $\frac{1}{4}$) to the bottom velocity, and extract the ſquare root of the ſum; then to this ſquare root add the bottom velocity, and the conſtant number, .5, and their ſum is the mean velocity.

Theſe are true in all caſes, provided the top and bottom velocities are related to each other, as Dr. Young ſtates. For example, Mr. Watt obſerved the ſurface of the water in an open canal to move with a velocity of 17 inches *per* ſecond: What was the bottom velocity?

By our firſt rule $17 + .25 = 17.25$, of which extract the ſquare root; it is 4.15; twice this is 8.3. Again, to the top velocity 17 add $1 = 18$, and deduct 8.3, it leaves 9.7 for the bottom velocity. Mr. Watt obſerved the bottom velocity to be 10 inches *per* ſecond.

2. To find the mean velocity, add .5 to the top velocity 17, it gives 17.5; deduct 4.18, and we get 13.32 inches *per* ſecond for the mean velocity.

3. If we take Mr. Watt's obſervation of the bottom velocity of 10 inches *per* ſecond, inſtead of the top; then to find the mean velocity $10 + .25 = 10.25$, of which the ſquare root is 3.201; and $10 + .5 = 10.5$; add theſe together, thus $(3.201 + 10.5) = 13.701$ inches *per* ſecond for the mean velocity; which only exceeds that deduced from the top velocity by little more than ⅓d of an inch in a ſecond.

By the aid of this rule, and the wheel ſtream-meaſurer before deſcribed, great accuracy may be obtained. Care muſt be taken to apply the wheel in the centre of the ſtream, on the ſurface, or rather at that place where the velocity of the ſurface is found to be the greateſt.

Second Method of meaſuring the Flowing of Water in an open Canal.—When a river flows with an uniform motion, and is neither accelerated nor retarded by the action of gravitation, it is obvious that the whole weight of the water muſt be employed in overcoming the friction of the water againſt the bottom and ſides.

The principal part of this friction is as the ſquare of the velocity, and the friction is nearly the ſame at all depths: for profeſſor Robiſon found, that the flow of the fluid through a bent tube was not increaſed by increaſing the preſſure againſt the ſides, being nearly the ſame when the bended part of the tube was ſituated horizontally, as when vertically, the ſame difference of level being preſerved.

The quantity of friction will, however, vary, according to the ſurface of the fluid which is in contact with the ſolid, in proportion to the whole quantity of fluid; that is, the friction for any given quantity of water will be, as the ſurface of the bottom and ſides of a river directly, and as the whole quantity of water in the river inverſely; thus, ſuppoſing the whole quantity of water to be ſpread on a horizontal ſurface equal to the bottom and ſides of the river, the friction is inverſely as the depth at which the river would then ſtand. This is called the hydraulic mean depth.

If the inclination or ſlope of the ſurface of water in a river varies, the deſcending weight, or the force that urges the particles down the inclined plane, will vary as the height of the fall in a given diſtance; conſequently, the friction, which is equal to the deſcending weight, muſt vary as the fall; and the velocity being as the ſquare root of the friction, muſt alſo be as the ſquare root of the fall. Suppoſing the hydraulic mean depth to be increaſed or diminiſhed, the inclination remaining the ſame, the friction would be diminiſhed or increaſed in the ſame ratio; and, therefore, in order to preſerve its equality with the deſcending weight, the friction muſt be increaſed or diminiſhed, by increaſing the velocity in the ratio of its ſquare to the hydraulic mean depth; that is, increaſing the velocity in the ratio of the ſquare root of the hydraulic mean depth.

Mr. Eytelwein's Rule is, that the velocity of a ſtream will be in the joint proportion of the ſquare root of the hydraulic mean depth, and the ſquare root of the fall in a given diſtance; or as a mean proportional between theſe two quantities.

Taking two Engliſh miles for a given length upon a ſtream, we muſt find a mean proportional between its hydraulic mean depth and its fall in two miles in inches, and inquire what relation this bears to the velocity in a particular caſe. We may thence expect to determine it in any other. According to Mr. Eytelwein's formula, this mean proportional is $\frac{11}{10}$ths of the velocity in a ſecond in inches.

In order to examine the accuracy of this rule, we may take an example, which could not have been known to Mr. Eytelwein. Mr. Watt obſerved, that in a canal 18 feet wide above, and 7 below, and 4 feet deep, having a fall of 4 inches in a mile, the velocity was 17 inches *per* ſecond at the ſurface, 14 in the middle, and 10 at the bottom. The mean velocity may be called $13\frac{3}{4}$ inches, in a ſecond. Now to find the hydraulic mean depth, we muſt divide the area of the

the fection $\left(\frac{18+7}{2} \times 4\right) = 50$ fquare feet, by the breadth of the bottom and length of the floping fides added together; whence we have $\frac{50}{20.6}$, or 29.13 inches: and the fall in two miles being 8 inches, we have $\sqrt{(8 \times 29.13)} = 15.26$ for the mean proportional; $\frac{10}{11}$ths of which is 13.9, agreeing nearly with Mr. Watt's obfervation. Profeffor Robifon has deduced from Buat's elaborate theorems 12.568 inches for the velocity, which is confiderably lefs accurate.

For another example we may take the river Po, which falls one foot in two miles, where its mean depth is 29 feet, and its velocity is obferved to be about 55 inches in a fecond. Our rule gives 58, which is perhaps as near as the degree of accuracy of the data will allow.

On the whole, we have ample reafon to be fatisfied with the unexpected coincidence of fo fimple a theorem with obfervation; and in order to find the velocity of a river from its fall, or the fall from its velocity, we have only to recollect that the velocity in inches *per* fecond is $\frac{10}{11}$ths of a mean proportional between the hydraulic mean depth and the fall in two Englifh miles in inches. This is, however, only true of a ftraight river flowing through an equable channel.

For the flope of the banks of a river or canal, Mr. Eytelwein recommends, that the breadth at the bottom fhould be $\frac{2}{3}$ds of the depth, and at the furface $\frac{10}{3}$ds; the banks will then be in general capable of retaining their form. The area of fuch a fection, is twice the fquare of the depth, and the hydraulic mean depth $\frac{2}{3}$ds of the actual depth.

M. Du Buat's Rule.—In our article RIVER, we have given the theorem of M. Du Buat for calculating the motion of water in a river or other regular channel, or through pipes. It has been obferved by the late Dr. Robifon, that the comparifon of the chevalier Du Buat's calculations with his experiments is very fatisfactory; that it exhibits a beautiful fpecimen of the means of expreffing the general refult of an extenfive feries of obfervations in an analytical formula; and that it does honour to the penetration, fkill, and addrefs of M. Du Buat, and of M. De St. Honore, who affifted him in the conftruction of his expreffions.

Dr. Young's Rule.—Dr. Young juftly remarks, in an excellent paper in the Philofophical Tranfactions for 1808, that the form of Du Buat's expreffions is not fo convenient for practice as they might have been rendered; and are liable to great objections, in particular cafes: for when the pipe is extremely narrow, or extremely long, they become completely erroneous. Dr. Young has, therefore, fubftituted for the formulæ of M. Du Buat others of a totally different nature; and he profeffes to have followed Du Buat only, in his general mode of confidering a part of the preffure, or of the height of a given fall, as employed in overcoming the friction of the pipe, through which the water flows out of it; a principle which, if not of his original invention, was certainly firft publifhed by him, and reduced into a practicable form. We find Mr. Smeaton ufed it in conftructing his MS. tables. By comparing the experiments which Du Buat has collected, with fome of Gerftner's, and fome of his own, Dr. Young difcovered a formula, which appears to agree fully as well as Du Buat's, with the experiments from which his rules were deduced, and at the fame time accords better with Gerftner's experiments; and which formula extends to all the extreme cafes with equal accuracy. It feems to reprefent more fimply the actual operation of the forces concerned; and it is direct in its application to practice, without the neceffity of any fucceffive approximations.

He began by examining the velocity of the water difcharged through pipes of a given diameter, with different degrees of preffure; and found that the friction could not be reprefented by any fingle power of the velocity, although it frequently approached to the proportion of that power of the velocity, of which the exponent is 1.8; but that it appeared to confift of two parts, the one varying fimply as the velocity, the other as its fquare. The proportion of thefe parts to each other muft, however, be confidered as different, in pipes of different diameters; the firft part being lefs perceptible in very large pipes, or in rivers, but becoming greater than the fecond in very minute tubes; while the fecond alfo becomes greater, for each given portion of the internal furface of the pipe, as the diameter is diminifhed.

If, with Dr. Young, we exprefs all the meafures in Englifh inches, calling the height employed in overcoming the friction f, the velocity in a fecond v, the diameter of the pipe d, and its length l; we may make $f = a\frac{l}{d}v^2 + 2c\frac{l}{d}v$: for it is obvious, that the friction muft be directly as the length of the pipe; and fince the preffure is proportional to the area of the fection, and the furface producing the friction to its circumference or diameter, the relative magnitude of the friction muft alfo be inverfely as the diameter, or nearly fo, as Du Buat has juftly obferved.

We fhall then find, that a muft be $.0000001\left(413 + \frac{75}{d} - \frac{1440}{d+12.8} - \frac{180}{d+.355}\right)$, and c muft be $.0000001\left(\frac{900dd}{dd+1136} + \frac{1}{\sqrt{d}}\left(1085 + \frac{13.21}{d} + \frac{1.0563}{dd}\right)\right)$.

Hence it is not difficult to calculate the velocity for any given pipe, open canal or river, with any given column of water: for the height required for producing the velocity, including friction, is, according to Du Buat, $\frac{v^2}{510}$; or rather, as it appears from almoft all the experiments which the doctor compared, $\frac{v^2}{586}$; and the whole height h is, therefore, equal to $f + \frac{v^2}{586}$, or $h = \left(\frac{al}{d} + \frac{1}{586}\right)v^2 + \frac{2cl}{d}v$; and affuming $b = \frac{1}{al \div d + .00171}$, and alfo affuming $e = \frac{bcl}{d}$, we have $v^2 + 2ev = bh$; whence, $v = \sqrt{(bh + e^2)} - e$; which is a general theorem.

In order to adapt this formula to the cafe of rivers, we muft make l (the length) infinite; by which b becomes $\frac{d}{al}$, and $bh = \frac{d}{a} \times \frac{h}{l} = \frac{ds}{a}$; s being the *fine* of the inclination of the water's furface, and $d = 4$ times the hydraulic mean depth. The hydraulic mean depth is the area of the fection of the moving water, divided by as much of the circumference of that area, as the water touches. And fince e is here $= \frac{c}{a}v = \frac{\sqrt{(ads + c^2)} - c}{a}$; and in moft rivers, v becomes nearly $\sqrt{(20000\,ds)}$.

Another ufeful rule by Dr. Young, is to find the fuperficial velocity of the water in a river by adding to the mean velocity

velocity of a river its ſquare root; this gives the velocity at the ſurface; and by ſubtracting the ſame ſquare root, we get the velocity at the bottom.

N. B. $2.618 - \sqrt{2.618} = 1$, and $.382 + \sqrt{.382} = 1$; which it may be uſeful to remember, with reference to this laſt rule.

Dr. Young made a compariſon of his general theorem, as above, with forty experiments extracted from the collection which ſerved as a baſis for Du Buat's calculations; and he found that the mean error of his formula is $\frac{1}{34}$th of the whole velocity, and that of his own $\frac{1}{36}$th only. But, omitting the four experiments, in which the ſuperficial velocity only of a river was obſerved, and in which he calculated the mean velocity by Du Buat's rules, the mean error of the remaining 36 is but $\frac{1}{35}$th, according to Dr. Young's mode of calculation, and $\frac{1}{37}$th according to M. Du Buat's; ſo that, on the whole, the accuracy of the two formulæ may be conſidered as preciſely equal with reſpect to theſe experiments.

In the ſix experiments which Du Buat has wholly rejected, the mean error of his formula is about $\frac{1}{24}$th, and that of Dr. Young's $\frac{1}{35}$th. In fifteen of Gerſtner's experiments, the mean error of Du Buat's rule is $\frac{1}{3}$d, that of Dr. Young's $\frac{1}{4}$th; and in the three experiments which Dr. Young made with very fine tubes, the error of his own rules is $\frac{1}{15}$th of the whole; while in ſuch caſes Du Buat's formulæ completely fail.

It would be uſeleſs to ſeek for a much greater degree of accuracy, unleſs it were probable that the errors of the experiments themſelves were leſs than thoſe of the calculations. But if a ſufficient number of extremely accurate and frequently repeated experiments could be obtained, it would be very poſſible to adapt Dr. Young's formula ſtill more correctly to their reſults.

In order to facilitate the computation, Dr. Young made tables of the co-efficients a and c for 44 different values of a, both in French and Engliſh inches, which may be ſeen in the Philoſophical Tranſactions for 1808; but inſtead of inſerting them, we ſhall give a far more extended table, which we have carefully deduced from Dr. Young's formula and table, and put it in a form more directly applicable to practice.

Let d repreſent four times the hydraulic mean depth of an open canal.

Note.—The hydraulic mean depth is the area of the ſection through which the water runs, divided by ſo much of the circumference of that ſection as is touched by the water.

Note alſo.—In caſe of cloſe pipes running a full bore of water, the diameter of the pipe is four times the hydraulic mean depth.

s repreſents the ſine of the inclination of the water's ſurface; that is, the height of the head or riſe, divided by the length or diſtance of the ſlope in which ſuch riſe takes place.

v, the mean velocity *per* ſecond, in inches.

The other ſymbols uſed in the theorem are ſhewn at the head of the different columns of the Table.

Dr. Thomas

Dr. Thomas Young's Theorem, with a new and enlarged Table deduced therefrom, exprefsly for our Work, for calculating the Velocity of Water flowing in Rivers, Channels, or Pipes.

THEOREM. The mean Velocity *per* Second, in inches or v, is $= \sqrt{\left(\frac{d}{a}s + \frac{c^2}{a^2}\right)} - \frac{c}{a}$.

d	$\frac{d}{a}$	$\frac{c^2}{a^2}$	$\frac{c}{a}$	d	$\frac{d}{a}$	$\frac{c^2}{a^2}$	$\frac{c}{a}$
0.5	20410	41.477	6.441	64	1629000	4.576	2.139
1.0	39840	19.171	4.379	65	1654000	4.611	2.147
1.5	56820	11.468	3.386	66	1679000	4.645	2.155
2.0	72730	7.922	2.815	67	1703000	4.678	2.163
2.5	88030	5.972	2.444	68	1728000	4.709	2.170
3	102700	4.729	2.175	69	1752000	4.739	2.177
4	131600	4.363	2.089	70	1777000	4.769	2.184
5	159700	2.624	1.620	71	1801000	4.796	2.190
6	186900	2.153	1.467	72	1826000	4.823	2.196
7	214100	1.885	1.373	73	1850000	4.848	2.202
8	241000	1.701	1.304	74	1875000	4.872	2.207
9	267900	1.570	1.253	75	1899000	4.894	2.212
10	295000	1.506	1.227	76	1923000	4.915	2.217
11	321600	1.469	1.212	77	1947000	4.936	2.222
12	347800	1.450	1.204	78	1971000	4.956	2.226
13	373600	1.443	1.201	79	1996000	4.976	2.231
14	398900	1.418 *	1.191	80	2020000	4.995	2.235
15	423700	1.476	1.215	81	2044000	5.013	2.239
16	449400	1.521	1.233	82	2068000	5.030	2.243
17	474900	1.566	1.251	83	2093000	5.046	2.246
18	500000	1.612	1.269	84	2117000	5.061	2.249
19	524900	1.664	1.290	85	2141000	5.076	2.253
20	549500	1.717	1.310	86	2165000	5.091	2.256
25	673900	2.010	1.418	87	2189000	5.106	2.259
30	795800	2.508	1.584	88	2213000	5.121	2.263
35	918600	2.929	1.711	89	2237000	5.135	2.266
40	1042000	3.304	1.818	90	2261000	5.149	2.269
45	1163000	3.636	1.907	91	2285000	5.162	2.272
50	1285000	3.939	1.984	92	2309000	5.175	2.275
51	1310000	3.988	1.997	93	2333000	5.188	2.277
52	1334000	4.041	2.010	94	2357000	5.200	2.280
53	1359000	4.093	2.023	95	2381000	5.212	2.283
54	1383000	4.144	2.036	96	2405000	5.224	2.286
55	1408000	4.194	2.048	97	2429000	5.236	2.288
56	1433000	4.243	2.060	98	2453000	5.248	2.291
57	1457000	4.290	2.071	99	2477000	5.260	2.293
58	1482000	4.335	2.082	100	2501000	5.272	2.296
59	1506000	4.380	2.093	200	4950000	5.541	2.354
60	1531000	4.423	2.103	300	7371000	5.460 *	2.337
61	1556000	4.465	2.113	400	9780000	5.372	2.318
62	1580000	4.504	2.122	500	12200000	5.301	2.302
63	1605000	4.541	2.131	Infinite	———	4.749	2.179

To

Uſe of the Table.—To render this theorem uſeful to thoſe who are not familiar with the uſe of algebraic expreſſions, we ſhall give an example of the manner of calculating a ſtream of water, all the operations being performed by common arithmetic, with the help of the preceding Table.

1. If it is a ſtream of water running in an uniform channel, take a ſufficient number of dimenſions of the tranſverſe ſection of the channel, and by the rules of menſuration calculate *the area* of its croſs ſection in ſquare feet. Calculate alſo, how much of the *circumference* of ſuch croſs ſection is touched by the water, not including its level top.

Then divide the area in ſquare feet by that portion of the circumference in feet, in order to obtain the *hydraulic mean depth;* this muſt be multiplied by 12, to reduce it to inches. Multiply the quotient by 4, and the reſult is d, the number which is to be ſought in the firſt column of the preceding Table.

If it is a circular pipe of uniform bore, running full of water, its internal diameter, taken in inches, is already equal to four times the hydraulic mean depth, without any computation; and accordingly the diameter of the pipe in inches is to be ſought for in column 1.

2. By a ſpirit-level or otherwiſe, aſcertain the perpendicular fall or difference of level, between any two diſtant points on the ſurface of the water, if it is an open ſtream, and find the diſtance between theſe points of levelling, by meaſuring upon a parallel to the ſurface of the ſtream. Theſe may be taken in any convenient meaſures; but the fall and the diſtance muſt be reduced to the ſame meaſures: then divide the fall by the diſtance, and the quotient is s, or a decimal number, which is the *ſine* of the inclination of the ſtream.

If it be a cloſe pipe, the perpendicular fall muſt be the difference of level between the ſurface of the reſervoir and the place of diſcharge; divide this by the length of the pipe.

3. Having found d, in column 1 of the Table, take out the number oppoſite to it in the ſecond column, entitled $\frac{d}{a}$ (that is, d divided by a), and multiply this tabular number by the decimal number s.

Note.—It will ſometimes happen that the exact amount of d is not to be found in column 1, but it will fall between two of the numbers therein; then take out the leaſt of thoſe numbers before d, and find how much is to be added thereto, by the following rule: Take the difference of the two numbers in col. 1. between which d falls; alſo the difference of the numbers oppoſite to them in col. 2.; alſo take the difference between the number d, and the leaſt of the two numbers between which it falls. Now, by the Rule of Three, ſay, as the whole difference of the two numbers in col. 1. is to the ſame in col. 2., ſo is the difference between d and the number above it in col. 1. to a fourth number, which is the proportional part to be added to the number of col. 2. before d.

4. Take out the tabular number from col. 3. which is entitled $\frac{c^2}{a^2}$; (that is, the ſquare of c divided by the ſquare of a).

But here *note*, in caſe of calculating a proportional part, (as directed in the laſt rule,) it is not always to be added (as in col. 2.); but ſometimes, on the contrary, it is to be ſubtracted, accordingly as the numbers in that part of col. 3. are increaſing or decreaſing; and for greater eaſe of diſcovering this, a * is placed oppoſite 14, and between 200 and 300 of col. 1., to ſhew the places where theſe changes take place, from decreaſe to increaſe, and the contrary.

5. Multiply s, the reſult of the ſecond operation, and $\frac{d}{a}$, the reſult of the third operation, together, and to the product add $\frac{c^2}{a^2}$, as found by the fourth operation: then extract the ſquare root of this ſum.

6. Take out $\frac{c}{a}$ from col. 4., and apply the proportional part as before, if neceſſary; deduct this number $\frac{c}{a}$ from the ſquare root laſt found, and the remainder or reſult is the *mean velocity* of the ſtream in *inches per ſecond*, which was required.

Should this reſult be afterwards wanted in *feet per minute*, the numbers laſt obtained muſt be multiplied by 60, and divided by 12; or rather, multiplied at once by 5, which is the ſame thing.

To obtain *the quantity* of water diſcharged in a minute, multiply *the area* of the ſection of the ſtream by *the velocity* now found; taking care, if the area is in ſquare feet, to expreſs the velocity of the water in feet; or if the area is in ſquare inches, the velocity muſt be expreſſed in inches, and the product or reſult will be in cubic feet or cubic inches, accordingly.

Example 1.—The Academy of Sciences at Paris were occupied, during ſeveral months, with an examination of a plan propoſed by M. Parcieux, for bringing the water of Yevette into Paris; and, after the moſt mature conſideration, gave in a report of the quantity of water which M. De Parcieux's aqueduct would yield. Their report was afterwards found erroneous in the proportion of at leaſt 2 to 5; for when the waters were brought in, they exceed the report in this proportion. Indeed, long after the giving in the report, M. Perronet, the moſt celebrated engineer in France, affirmed, that the dimenſions propoſed were much greater than were neceſſary; and ſaid that an aqueduct of $5\frac{1}{2}$ feet wide, and $3\frac{1}{2}$ deep, with a ſlope of 15 inches in a thouſand fathoms, would have a velocity of 12 or 13 inches *per* ſecond, and would bring all the water furniſhed by the propoſed ſources. The great diminution of expence occaſioned by the alteration, encouraged the community to undertake the work. It was accordingly begun, and partly executed. The water was found to run with a velocity of near 19 inches, when it was $3\frac{1}{2}$ feet deep.

M. Perronet founded his computation on his own experience alone, acknowledging that he had no theory to inſtruct him.

Let us examine this caſe by our theorem.

Firſt, The area of the ſection is 3.5 feet deep $\times$ by 5.5 feet wide $= 19.25$ ſquare feet.—The circumference which the water touches, conſiſts of the two ſides of 3.5 feet each, added to 5.5 feet, the bottom $= 12.5$ feet. The area 19.25 ſquare feet divided by 12.5 feet gives 1.54 feet, for the hydraulic mean depth $\times\ 12 = 18.48$ inches; four times this is $d = 73.92$, which we are to ſeek in the firſt column of the table; and may take 74.

Secondly, To find s, take the fall 15 inches, or 1.33 feet, and divide it by the diſtance, 1000 fathoms, or 6000 feet; the reſult is .00022, for s, or the ſine of the inclination.

Take out from the table the numbers correſponding to 74.

d	$\frac{d}{a}$	$\frac{c^2}{a^2}$	$\frac{c}{a}$
74	1875000	4.872	2.207

We

We now have all the neceſſary quantities for making the calculation thus: multiply $\frac{d}{a} = 1875000$ by $s = .00022$, and we have 416.25. To this add $\frac{c^2}{a^2} = 4.872$, and it makes 421.122, of which extract the ſquare root, and it is 20.52; deduct $\frac{c}{a} = 2.207$ from this, and it leaves 18.313 inches *per* ſecond for the mean velocity of the water.

This agrees pretty well with the obſervation of 19 inches, and Dr. Robiſon made very nearly the ſame reſult by a different mode of calculation.

The velocity of 18.313 inches *per* ſecond × 5 gives 91.56 feet *per* minute, and again multiplied by 19.25 ſquare feet, (the area of the ſection,) gives 1761.6 cubic feet of water which flow through this canal every minute.

This example is comparatively eaſy, becauſe the table affords the numbers required; but in ſome caſes the exact numbers cannot be found in the table, we ſhall therefore give another example.

Example 2.—Mr. Watt meaſured a canal in the neighbourhood of Birmingham, which was 18 feet wide at the ſurface of the water, 7 feet wide at the bottom, and 4 feet deep. The water had a declivity of four inches in a mile;—required the velocity with which the water moved, and the quantity which the canal afforded.

To have a complete knowledge of the ſection, find the length of each ſloping ſide, thus take the projection of the top width over the bottom width on each ſide, that is, half the difference between the top and bottom width $(18 - 7) \div 2 = 5.5$ feet: now the ſquare of 5.5 is 30.25, and the ſquare of 4 feet the depth is 16, the ſum of the two is $(30.25 + 16 =)$ 46.25; and the ſquare root of this is 6.8, the length of each ſloping ſide.

Firſt, To find the area and the hydraulic mean depth.—The mean between the widths of the top and bottom is $(18 + 7) \div 2$ 12.5 × 4 feet deep = 50 ſquare feet for the area of the ſection. To find the circumference which the water touches, add the two ſloping ſides, each 6.8 feet, to 7 feet, the width of the bottom, and it makes 20.6 feet.

The area, 50 ſquare feet, divided by 20.6 feet, gives 2.4272 feet = 29.126 inches for the hydraulic mean depth; 4 times this is 116.504, which is d, and muſt be found in the firſt column of the table. The neareſt which can there be found is 100 inches.

Secondly, The fall is 4 inches in the diſtance of a mile, = 63360 inches, divide 4 by 63360, and it gives .00006313 for s, the ſine of the inclination.

Thirdly, The value of $\frac{d}{a}$, in the ſecond column, oppoſite to 100 in the firſt column, is 2501000, to which ſomething muſt be added for the 16.5 inches. To find this quantity, take the difference between the adjacent numbers in column two, *viz.* 2501000 and 4950000 = 2449000, and, laſtly, the difference between 100 and 116.5 = 16.5; then ſay, as 100 is to 2449000, ſo is 16.5 to 404085, which number is to be added to 2501000, = 2905085, which is $\frac{d}{a}$ for 116.5.

Fourthly, The value of $\frac{c^2}{a^2}$, in column third oppoſite to 100, is 5.272, to which add .0043, as found by a rule of proportion ſimilar to the above, and it gives 5.276, which is $\frac{c^2}{a^2}$ for 116.5.

Fifthly, Multiply $s = .00006313$ by 2905085, and it gives 183.395; add $\frac{c^2}{a^2}$, or 5.276, as found by the preceding operation, and it gives 188.671; and the ſquare root of this number is 13.736.

Sixthly, The value of $\frac{c}{a}$, in column fourth, is 2.296 for 100, or for 116.5 it is 2.297; deduct this from 13.736, the reſult of the laſt operation, and we have 11.439, which is the velocity of the ſtream in inches *per* ſecond, and this × 5 = 57.195 feet *per* minute. To find the quantity, multiply the velocity, 57.19 feet *per* minute, by 50 ſquare feet the area, and we ſhall have 285.97 cubic feet, which quantity will flow every minute through this canal.

The velocity here found is conſiderably ſmaller than what was obſerved by Mr. Watt; he found the velocity at the ſurface 17 inches *per* ſecond, and at the bottom 10 inches, the mean velocity we have already calculated at 13.32.

Dr. Robiſon, in the Encyclopædia Britannica, gives a calculation of this ſame caſe by Du Buat's formula, which we have given in the article River. He makes the velocity 11.85 feet *per* ſecond, which differs ſo little from our computation, that the two theorems may be conſidered equally accurate; but both appear, by Mr. Watt's obſervation, to be rather too ſmall in very ſmall declivities of rivers and canals. This is not ſurpriſing when we conſider, that the experiments, which are the foundation of both theſe formulæ, were made on ſmall canals; but for this reaſon, we may expect they will be more accurate when applied to ſmaller channels, ſuch as mill-courſes, aqueducts, &c.

In taking obſervations to apply this method of calculation to practice, it muſt be recollected that it always proceeds on the ſuppoſition, that the canal is of a regular width and depth, and of an uniform ſlope throughout. If this is not the caſe, the canal muſt be conſidered in different portions, and each calculated ſeparately. We think greater accuracy will be attained by meaſuring and carefully levelling 100 yards in which the width and depth are quite regular, than by taking a mile in length, if there are any irregularities in the dimenſions, or in the ſlope in that diſtance.

On the other hand, the theorem cannot apply at all, unleſs the length of the channel is ſuch, that the water in it will arrive at an uniform motion without any acceleration of the motion, as it proceeds down. In ſhort and rapidly inclined channels, the water accelerates in conſequence of deſcending further down the fall; but when the canal is long, the velocity arrives at a certain point, and then the friction prevents any farther acceleration; in this caſe, the theorem applies. We ſhall not err ſenſibly in uſing this theorem for canals of 30 yards in length, or leſs, if the fall is ſmall.

Method of gauging the Water running through cloſe Pipes.—Dr. Young's theorem and our table, apply with equal, perhaps greater accuracy, to the caſe of cloſe pipes than to open canals.

All that is neceſſary is, to meaſure the internal diameter of the pipe in inches, the length of the pipe, and the difference of the level between the water in the reſervoir and the place at which the water is diſcharged, and proceed as in the former inſtance; but to render it more clear we ſhall give two examples.

Example 1.—The city of Edinburgh is ſupplied with water,

water, from ſprings at Comiſton, which is a conſiderable diſtance; this is conveyed by two pipes, the firſt of which was laid in 1720, under the direction of Deſaguliers. Dr. Robiſon mentions one of them, which is 5 inches diameter, 14,637 feet in length; the reſervoir at Comiſton is forty-four feet higher than the reſervoir on the Caſtle-Hill, in the town of Edinburgh.

Firſt, to find the ſine of the inclination, or s, divide the fall 44 feet by 14,637, and it gives .00301, which is s.

Now take five inches, the diameter of the pipe in col. 1., and oppoſite to it in col. 2. find $\frac{d}{a} = 159700$, which multiply by .00301, gives 479.1; to this add $\frac{c^2}{a^2} = 2.624$ taken from the third column, and the ſum is 481.724.

Extract the ſquare root of this, and it is 21.948, from which deduct $\frac{c}{a}$, or 1.620, taken from col. 4., and the reſult is 20.328, which is the velocity in inches *per* ſecond, and this × by 5 = 101.64 feet *per* minute.

To find the quantity, find the area of the ſection of the pipe in ſquare feet, by dividing the ſquare of the diameter 25 by 183.3, and it gives .1364 ſquare feet, and this × by 101.64 feet velocity, gives 13.86 cubic feet *per* minute for the diſcharge from the pipe.

Dr. Robiſon's calculation of this ſame caſe by Du Buat's formula, gives a velocity of 20.08 inches *per* ſecond.

In Mr. Smeaton's Reports, we find the other pipe ſtated at four and a half inches bore, and that it yielded 160 Scots pints *per* minute, each 103.4 cubic inches = 9.58 cubic feet. Mr. Smeaton's own calculation was 159 pints.

Example 2.—Mr. Smeaton ſtates, that this pipe was improved by obtaining an increaſe of fall, making it 51 feet, and that it then yielded 200 Scots pints = 11.98 cubic feet *per* minute, the bore being $4\frac{1}{2}$ inches, and the length 14,637 feet as before. Mr. Smeaton's calculation was 173 pints = 10.36 cubic feet *per* minute. What would it be by Dr. Young's theorem? *viz.* velocity = $\sqrt{\left(\frac{d}{a} \times s + \frac{c^2}{a^2}\right)} - \frac{c}{a}$.

To find s, divide the fall 51 feet by the length 14,637 feet; it gives .003484.

To find $\frac{d}{a}$, anſwering to 4.5 inches in col. 1., take half the difference between the numbers in the ſecond col. oppoſite to 4 and 5, and add it to the number anſwering to 4; thus, $\frac{d}{a}$ for 4 is 131560, and $\frac{d}{a}$ for 5 is 159700, difference 28200, which ÷ 2 = 14100, and this × 131500 = 145600, which is $\frac{d}{a}$ for 4.5. Multiply this 145600 by s, or .003484, and it is = 507.67: to this add $\frac{c^2}{a^2}$.

To find $\frac{c^2}{a^2}$ for 4.5, take half the difference between the numbers in the third column for 4 and 5, which is .869, and ſubtract it from 4.363, the number anſwering to 4; the reſult is 3.494, which is $\frac{c^2}{a^2}$ for 4.5; this added to 507.67 is 511.164.

The ſquare root of that number is 22.609, from which deduct $\frac{c}{a}$, = 1.854, and it leaves 20.755, which is the velocity *per* ſecond in inches.

(*Note.* $\frac{c}{a}$ is found by ſubtracting half the difference between the numbers for 4 and 5 in the fourth column, from the number anſwering to 4.)

20.755 inches *per* ſecond × 5 = 103.775 feet *per* minute, for the velocity. The area of the pipe is 4.5 × 4.5 = 20.25 circular inches, which ÷ by 183.3, the circular inches in a ſquare foot, is = .1104 ſquare feet for the area of the pipe. Multiply this by 103.775 feet *per* minute, and we get 11.46 cubic feet *per* minute for the diſcharge, which agrees very nearly with the experiment.

Dr. Brewſter, in his Encyclopædia, has calculated this ſame pipe, except that he ſtates it 300 feet longer; he makes the velocity by Du Buat's theorem 20.385 inches *per* ſecond, and ſays that on an average of five years, from 1738 to 1742, its maximum diſcharge was 11.3 cubic feet *per* minute; he has alſo calculated the ſame caſe by five different formulæ; thus,

	Scot's Pints *per* Minute.	Cubic Feet *per* Minute.
The quantity of water actually diſcharged	200 189.4	11.968 11.333
Calculated by Eytelwein's formula	189.77	11.355
Calculated by Girard's formula	188.26	11.265
Calculated by Du Buat's formula	188.13	11.257
Calculated by M. Prony's ſimple formula	192.32	11.502
Calculated by M. Prony's table	180.7	10.813
To which we may add Mr. Smeaton's calculation	173.	10.352
And by Dr. Young's theorem	191.5	11.459

It is ſatisfactory to find the reſults of ſo many different proceſſes agree ſo nearly, and gives us great confidence in the truth of the principles. There is in this caſe ſo little difference amongſt theorems that any one may be taken; but we think it needleſs to enter into farther particulars, as the one which we have given effects all that can be deſired, and by the help of the table, is the moſt ready in the application.

We ſhall only add Mr. Smeaton's table on the friction of water running through pipes, which we find in his manuſcript papers, and which he computed from his own obſervations alone, without knowing the experiments on which the other theorems are founded. They will give rather leſs than the theorems, and perhaps may approach more nearly to actual practice, in which pipes are not laid with the ſame care, to avoid roughneſs withinſide and ſudden bends, as when prepared purpoſely for experiments; we may conſider the theorems as the maximum diſcharge, and Mr. Smeaton's table as the fair average of practice.

Uſe of the Table.—Find the velocity of the water *per* minute in feet and decimals in the firſt column, or in feet *per* ſecond in the next column, and on the ſame line underneath the diameter of the bore in inches, you will find the perpendicular height of a column of water in inches and 10ths, neceſſary to overcome the friction of that pipe for 100 feet in length, and obtain the given velocity.

Mr.

Mr. Smeaton's TABLE for shewing the Friction of Water in Pipes; the Bore of the Pipe being given, and the Velocity of the Water therein; the Column or Height of Head necessary to overcome the Friction, and produce that Velocity, is shewn by this Table for 100 Feet in Length.

Velocity.		Bore of the Pipes in Inches.										
		½	¾	1	1¼	1½	1¾	2	2¼	2½	3	3½
In Feet *per* Minute.	In Feet *per* Second.	Depths of Water necessary to overcome the Friction of the Water in a Pipe 100 feet long, and produce the Velocities marked in the two first Columns.										
		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
5	.083	0.2	0.16	0.12	0.1	0.08	0.07	0.06	0.06	0.05	0.04	0.04
10	.166	0.7	0.5	0.4	0.3	0.25	0.2	0.2	0.17	0.15	0.12	0.10
15	.25	1.2	0.8	0.6	0.5	0.4	0.4	0.3	0.3	0.25	0.2	0.18
20	.33	2.0	1.3	1.0	0.8	0.7	0.6	0.5	0.4	0.4	0.3	0.3
25	.416	3.2	2.1	1.6	1.3	1.1	0.9	0.8	0.7	0.6	0.5	0.5
30	.5	4.5	3.0	2.2	1.8	1.5	1.3	1.1	1.0	0.9	0.7	0.6
35	.58	6.0	4.0	3.0	2.4	2.0	1.7	1.5	1.3	1.2	1.0	0.8
40	.666	8.0	5.3	4.0	3.2	2.7	2.3	2.0	1.8	1.6	1.3	1.1
45	.75	9.5	6.3	4.7	3.8	3.2	2.7	2.4	2.1	1.9	1.5	1.4
50	.833	11.7	7.8	5.9	4.7	3.9	3.4	2.9	2.6	2.3	1.9	1.7
55	.916	14.2	9.5	7.1	5.7	4.7	4.1	3.6	3.2	2.8	2.4	2.0
60	1.	16.7	11.1	8.4	6.7	5.6	4.8	4.2	3.7	3.3	2.8	2.4
65	1.083	19.5	13.0	9.7	7.8	6.5	5.6	4.9	4.3	3.9	3.2	2.8
70	1.166	22.2	14.8	11.1	8.9	7.4	6.4	5.6	4.9	4.4	3.7	3.2
75	1.25	25.0	16.6	12.5	10.0	8.3	7.1	6.2	5.5	5.0	4.2	3.6
80	1.33	28.5	19.0	14.2	11.4	9.5	8.1	7.1	6.3	5.7	4.7	4.1
85	1.416	31.5	21.0	15.7	12.6	10.5	9.0	7.9	7.0	6.3	5.2	4.5
90	1.5	35.0	23.3	17.5	14.0	11.7	10.0	8.7	7.8	7.0	5.8	5.0
95	1.583	38.5	25.6	19.2	15.4	12.8	11.0	9.6	8.6	7.7	6.4	5.5
100	1.66	42.0	28.0	21.0	16.8	14.0	12.0	10.5	9.3	8.4	7.0	6.0
105	1.75	45.7	30.5	22.9	18.3	15.3	13.1	11.4	10.2	9.1	7.6	6.5
110	1.833	49.5	33.0	24.7	19.8	16.5	14.1	12.4	11.0	9.9	8.2	7.1
115	1.916	53.7	35.8	26.9	21.5	17.9	15.4	13.4	11.9	10.7	9.0	7.7
120	2.	57.7	38.5	28.9	23.1	19.2	16.5	14.4	12.8	11.5	9.6	8.2
130	2.166	66.5	44.3	33.2	26.6	22.1	19.0	16.6	14.8	13.3	11.1	9.5
140	2.333	75.7	50.5	37.9	30.3	25.2	21.6	18.9	16.8	15.1	12.6	10.8
150	2.5	85.7	57.2	42.9	34.3	28.6	24.5	21.4	19.0	17.1	14.3	12.2
160	2.33	96.5	64.3	48.2	38.6	32.1	27.6	24.1	21.4	19.3	16.1	13.8
170	2.83	108.5	72.3	54.2	43.4	36.1	31.0	27.1	24.1	21.7	18.1	15.5
180	3.	121.0	80.6	60.5	48.4	40.3	34.6	30.2	26.9	24.2	20.2	17.3
190	3.166	134.5	89.6	67.2	53.8	44.8	38.2	33.6	29.9	26.9	22.4	19.2
200	3.333	149.0	99.3	74.5	59.6	49.7	42.6	37.2	33.1	29.8	24.8	21.3
210	3.5	164.0	109.3	82.0	65.6	54.7	46.9	41.0	36.4	32.8	27.3	23.4
220	3.666	180.0	120.0	90.0	72.0	60.0	51.4	45.0	40.0	36.0	30.0	25.7
230	3.833	196.5	131.0	98.2	78.6	65.5	56.1	49.1	43.7	39.3	32.7	28.1
240	4.	214.0	142.6	107.0	85.6	71.3	61.1	53.5	47.6	42.8	35.7	30.6
255	4.25	241.2	160.8	120.6	96.5	80.4	68.9	60.3	53.6	48.2	40.2	34.5
270	4.5	270.7	180.5	135.4	108.3	90.2	77.4	67.7	60.1	54.1	45.1	38.7
285	4.75	301.5	201.0	150.7	120.6	100.5	86.1	75.4	67.0	60.3	50.2	43.1
300	5.	336.2	224.1	168.0	134.5	112.1	96.1	84.0	74.7	67.2	56.0	48.0
		½	¾	1	1¼	1½	1¾	2	2¼	2½	3	3½
		Bore of the Pipes in Inches.										

Mr. Smeaton's Table for the Friction in Water in Pipes—*Continued.*

Velocity.		Bore of the Pipes in Inches.									
		4	4½	5	6	7	8	9	10	11	12
In Feet *per* Minute.	In Feet *per* Second.	Depths of Water neceſſary to overcome the Friction of the Water in a Pipe 100 feet long, and produce the Velocities marked in the Two firſt Columns.									
		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
5	.083	0.03	0.03	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01
10	.166	0.09	0.08	0.07	0.06	0.05	0.05	0.04	0.04	0.03	0.03
15	.25	0.15	0.14	0.12	0.10	0.09	0.08	0.07	0.06	0.05	0.05
20	.33	0.25	0.2	0.2	0.17	0.14	0.12	0.11	0.10	0.09	0.08
25	.416	0.4	0.4	0.3	0.3	0.2	0.2	0.18	0.16	0.15	0.14
30	.5	0.6	0.5	0.4	0.4	0.3	0.3	0.25	0.2	0.20	0.19
35	.58	0.8	0.7	0.6	0.5	0.4	0.4	0.3	0.3	0.27	0.25
40	.666	1.0	0.9	0.8	0.7	0.6	0.5	0.4	0.4	0.36	0.3
45	.75	1.2	1.1	0.9	0.8	0.7	0.6	0.5	0.5	0.4	0.4
50	.833	1.5	1.3	1.2	1.0	0.8	0.7	0.6	0.6	0.5	0.5
55	.916	1.8	1.6	1.4	1.2	1.0	0.9	0.8	0.7	0.6	0.6
60	1.	2.1	1.9	1.7	1.4	1.2	1.0	0.9	0.8	0.8	0.7
65	1.083	2.4	2.2	1.9	1.6	1.4	1.2	1.1	1.0	0.9	0.8
70	1.166	2.8	2.5	2.2	1.9	1.6	1.4	1.2	1.1	1.0	0.9
75	1.25	3.1	2.8	2.5	2.1	1.8	1.6	1.4	1.2	1.1	1.0
80	1.33	3.6	3.2	2.8	2.4	2.0	1.8	1.6	1.4	1.3	1.2
85	1.416	4.0	3.5	3.1	2.6	2.2	2.0	1.7	1.6	1.4	1.3
90	1.5	4.4	3.9	3.5	2.9	2.5	2.2	1.9	1.7	1.6	1.5
95	1.583	4.8	4.3	3.8	3.2	2.7	2.4	2.1	1.9	1.7	1.6
100	1.66	5.2	4.7	4.2	3.5	3.0	2.6	2.3	2.1	1.9	1.8
105	1.75	5.7	5.1	4.6	3.8	3.3	2.9	2.5	2.3	2.1	1.9
110	1.833	6.2	5.5	4.9	4.1	3.5	3.1	2.7	2.5	2.2	2.1
115	1.916	6.7	6.0	5.4	4.5	3.8	3.4	3.0	2.7	2.4	2.2
120	2.	7.2	6.4	5.8	4.8	4.1	3.6	3.2	2.9	2.6	2.4
130	2.166	8.3	7.4	6.6	5.5	4.7	4.2	3.7	3.3	2.9	2.8
140	2.333	9.5	8.4	7.6	6.3	5.4	4.7	4.2	3.8	3.4	3.2
150	2.5	10.7	9.5	8.6	7.1	6.1	5.4	4.8	4.3	3.9	3.6
160	2.33	12.1	10.7	9.6	8.0	6.9	6.0	5.4	4.8	4.4	4.0
170	2.83	13.6	12.1	10.8	9.0	7.7	6.8	6.0	5.4	4.9	4.5
180	3.	15.1	13.4	12.1	10.1	8.6	7.6	6.7	6.0	5.5	5.0
190	3.166	16.8	15.0	13.4	11.2	9.6	8.4	7.5	6.7	6.1	5.6
200	3.333	18.6	16.6	14.9	12.4	10.6	9.3	8.3	7.4	6.8	6.2
210	3.5	20.5	18.2	16.4	13.7	11.7	10.2	9.1	8.2	7.5	6.8
220	3.666	22.5	20.0	18.0	15.0	12.9	11.2	10.0	9.0	8.2	7.5
230	3.833	24.6	21.8	19.6	16.4	14.0	12.3	10.9	9.8	9.0	8.2
240	4.	26.7	23.8	21.4	17.8	15.3	13.4	11.9	10.7	9.7	8.9
255	4.25	30.1	26.8	24.1	20.1	17.2	15.1	13.4	12.0	11.0	10.1
270	4.5	33.8	30.1	27.1	22.6	19.3	16.9	15.0	13.5	12.3	11.3
285	4.75	37.7	33.5	30.1	25.1	21.5	18.9	16.7	15.1	13.7	12.6
300	5.	42.0	37.4	33.6	28.0	24.0	21.0	18.7	16.8	15.3	14.0
		4	4½	5	6	7	8	9	10	11	12
		Bore of the Pipes in Inches.									

We

We have fearched in Mr. Smeaton's papers for the experiments by which this table was made, and we find an inveftigation, from the experiments of M. Couplet, as recorded by Belidor, on the flow of water through a large pipe at Verfailles. From thefe he deduced the following rule, to find the height of column in inches, correfponding with the velocities in inches *per* fecond, through a pipe of any diameter given in inches, and 100 feet long.

$$\frac{48 \times (\text{velocity}) + \text{velocity}^2}{52.66 \times (\text{diameter})} = \text{depth of column};$$

or, ftill more nearly, taking 47.873 for the conftant number inftead of 48.

It appears that he found this rule did not agree with his own obfervations; and, in confequence, he made the following experiments himfelf with a pipe of $1\frac{1}{4}$ inch bore and 100 feet in length; and we believe he arranged them into the table, by projecting and drawing a curve, at leaft we find that was his ufual method in like cafes.

Velocity *per* Second.	Depth of the Column.	
	By the Table.	By Experiment.
Inches.	Inches.	Inches.
$6\frac{1}{2}$	2.1	2.0
$7\frac{3}{4}$	3.0	2.8
$8\frac{3}{4}$	3.7	3.8
10	4.7	4.8
$11\frac{1}{2}$	6.2	6.2
13.4	7.9	7.8
$15\frac{1}{2}$	10.4	10.7
$18\frac{1}{4}$	14.7	14.5
21	18.3	18.1
$23\frac{3}{4}$	22.7	23.0
27	28.4	27.6
$28\frac{1}{4}$	30.8	30.5
$29\frac{3}{4}$	33.8	34.3
$30\frac{1}{4}$	34.8	35.6
35.5	47.2	47.0
$43\frac{3}{4}$	71.2	71.0

This is ufeful information, becaufe it fhews what part of the table may be depended upon. He affumed, that the depth of the column in pipes of other dimenfions, was as the length of the pipe directly, and as the diameters inverfely.

The form of this table renders it immediately applicable to a great variety of purpofes; for inftance, an engine is required to pump water to a height of 60 feet; but the water muft pafs through 1800 feet of horizontal pipe of 5 inches bore, and with a velocity of 140 feet *per* minute. The table fhews, that for every 100 feet of this pipe the friction will be equal to a column of 7.6 inches; multiply this by 18.6, and we find the whole friction will be 141.36 inches, this added to 60 feet makes 71.78 feet for the real column which the pump muft overcome.

Rules for meafuring the Quantity of Water flowing through Sluices or Apertures.—In this, like the former inftances, we muft multiply the area of the aperture by the velocity with which the water rufhes through it.

Sir Ifaac Newton, in his Principia, book ii. theo. 8. prob. 36. has demonftrated, that the velocity of water, flowing through holes in the bottom or fide of a veffel, ought to be equal to the velocity which a heavy body would acquire, in falling through a fpace equal to the diftance between the furface of the water and the place where it is difcharged.

Hence, at the depth of $16\frac{1}{12}$ feet, a ftream of $32\frac{1}{6}$ feet in length, ought to flow out in a fecond of time. And from the laws of falling bodies, it follows, that as the fquare root of $16\frac{1}{12}$ is to the velocity of the ftream flowing out at that depth, fo is the fquare root of any other depth to the velocity of that depth.

Hence, the velocity of water flowing out of a horizontal aperture, in the bottom of a ciftern or refervoir, is as the fquare root of the height, or the depth of water above the aperture.

That is, the preffure, and confequently the depth, is as the fquare of the velocity; for the quantity flowing out in any given time is as the velocity, and the force required to produce a velocity in a certain quantity of matter in a given time, is alfo as that velocity; therefore, the force muft be as the fquare of the velocity.

The propofition is fully confirmed by Boffut's and Michelotti's experiment; the proportional velocities, with a preffure of 1, 4, and 9 feet, being 2722, 5436, and 8135, inftead of 2722, 5444, and 8166; very inconfiderable differences.

There is another mode of confidering this propofition, which is a very good approximation. Suppofe a very thin cylindrical plate of water, like a wafer, fituated in the orifice; and fuppofe a conftant fucceffion of fuch plates to be put in motion, one at every inftant, by means of the preffure of the whole cylinder ftanding upon it; let all the gravitating force of the column be employed in generating the velocity of each fmall cylindrical plate, (neglecting the motion of the cylinder itfelf,) this plate would be urged by a force as much greater than its own weight, as the column is higher than itfelf, and this through a fpace fhorter in the fame proportion than the height of the column. But where the forces are inverfely as the fpaces defcribed, the final velocities are equal: therefore, the velocity of the water flowing out muft be equal to that of a heavy body falling from the height of the head of water.

This velocity may be found very nearly by the rule which we have before given in underfhot water-wheels, or by extracting the fquare root of the depth in feet, and multiplying it by 481.2: the product is the velocity *per* minute in feet.

In practice it is more convenient to take the depth in inches, inftead of feet; then to obtain the velocity in feet *per* minute.

Extract the fquare root of the depth in inches, and multiply it by 138.88: the product is the velocity in feet *per* minute.

As this rule is the foundation of all calculations for velocities, when friction is not confidered, it is conftantly wanted: we fhall, therefore, give a table, calculated by Mr. Smeaton from the above rule, fhewing the theoretic velocities correfponding with different depths.

A Table

A Table ſhewing the Velocity in Feet *per* Minute, or *per* Second, with which Water ſhould iſſue from an Aperture at any given Depth beneath the Surface, from ¼ Inch to 20 Feet, calculated according to the Theory of falling Bodies.

Depth.	Velocity *per* Minute.	Diff.	Velocity *per* Second.	Diff.	Depth.	Velocity *per* Minute.	Diff.	Velocity *per* Second.	Diff.	Depth.	Velocity *per* Minute.	Diff.	Velocity *per* Second.	Diff.
Inches.	Feet.		Feet.		Inches.	Feet.		Feet.		Inches.	Feet.		Feet.	
¼	69.7	28.9	1.16	.48	17½	580.8	8.5	9.68	.14	56	1039.2	9.6	17.32	.16
½	98.6	21.4	1.64	.36	18	589.3	8.3	9.82	.14	57	1048.8	9.0	17.48	.15
¾	120.0	18.6	2.00	.31	18½	597.6	7.8	9.96	.13	58	1057.8	9.0	17.63	.15
1	138.6	16.5	2.31	.27	19	605.4	7.8	10.09	.13	59	1066.8	9.3	17.78	.15
1¼	155.1		2.58		19½	613.2		10.22		60	1076.1		17.93	
		15.0		.25			7.9		.13			26.7		.45
1½	170.1	13.7	2.83	.23	20	621.1	7.7	10.35	.13	63	1102.8	25.1	18.38	.42
1¾	183.8	12.4	3.06	.21	20½	628.8	7.8	10.48	.13	66	1127.9	25.4	18.80	.42
2	196.2	12.0	3.27	.20	21	636.6	7.8	10.61	.13	69	1153.3	25.7	19.22	.43
2¼	208.2	11.4	3.47	.19	21½	644.4	7.2	10.74	.12	72	1179.0	24.0	19.65	.40
2½	219.6		3.66		22	651.6		10.86		75	1203.0		20.05	
		10.4		.18			7.2		.12			24.0		.40
2¾	230.0	10.6	3.84	.17	22½	658.8	7.3	10.98	.12	78	1227.0	23.4	20.45	.39
3	240.6	9.9	4.01	.16	23	666.1	7.1	11.10	.12	81	1250.4	22.8	20.84	.38
3¼	250.5	9.3	4.17	.16	23½	673.2	7.3	11.22	.12	84	1273.2	22.8	21.22	.38
3½	259.8	9.0	4.33	.15	24	680.5	13.7	11.34	.23	87	1296.0	21.9	21.60	.36
3¾	268.8		4.48		25	694 2		11.57		90	1317.9		21.96	
		9.0		.15			13.8		.23			22.0		.37
4	277.8	8.5	4.63	.14	26	708.0	13.8	11.80	.23	93	1339.9	21.2	22.33	.35
4¼	286.3	8.3	4.77	.14	27	721.8	13.2	12.03	.22	96	1361.1	21.3	22.68	.36
4½	294.6	7.9	4.91	.13	28	735.0	13.2	12.25	.22	99	1382.4	20.6	23.04	.34
4¾	302.5	7.8	5.04	.13	29	748.2	12.7	12.47	.21	102	1403.0	19.7	23.38	.33
5	310.3		5.17		30	760.9		12.68		105	1422.7		23.71	
		7.8		.13			12.5		.21			21.0		.35
5¼	318.1	7.7	5.30	.13	31	773.4	12.6	12.89	.21	108	1443.7	19.7	24.06	.33
5½	325.8	7.2	5.43	.12	32	786.0	12.1	13.10	.20	111	1463.4	19.9	24.39	.33
5¾	333.0	7.2	5.55	.12	33	798.1	11.9	13.30	.20	114	1483.3	19.1	24.72	.32
6	340.2	13.8	5.67	.23	34	810.0	12.0	13.50	.20	117	1502.4	19.4	25.04	.32
6½	354.0		5.90		35	822.0		13.70		120	1521.8		25.36	
		13.4		.22			12.0		.19			19.0		.32
7	367.4	13.0	6.12	.22	36	834.0	10.8	13.89	.19	123	1540.8	18.6	25.68	.31
7½	380.4	12.3	6.34	.21	37	844.8	11.4	14.08	.19	126	1559.4	18.6	25.99	.31
8	392.7	12.3	6.55	.20	38	856.2	11.4	14.27	.19	129	1578.0	18.1	26.30	.30
8½	405.0	12.0	6.75	.20	39	867.6	10.8	14.46	.18	132	1596.1	17.9	26.60	.30
9	417.0		6.95		40	878.4		14.64		135	1614.0		26.90	
		11.4		.19			10.8		.18			18.0		.30
9½	428.4	10.9	7.14	.18	41	889.2	10.8	14.82	.18	138	1632.0	17.4	27.20	.29
10	439.3	10.8	7.32	.18	42	900.0	10.8	15.00	.18	141	1649.4	17.7	27.49	.29
10½	450.1	10.7	7.50	.18	43	910.8	10.8	15.18	.18	144	1667.1	34.5	27.78	.58
11	460.8	10.2	7.68	.17	44	921.6	10.3	15.36	.17	150	1701.6	33.6	28.36	.56
11½	471.0		7.85		45	931.9		15.53		156	1735.2		28.92	
		10.2		.17			10.1		.17			33.0		.55
12	481.2	10.2	8.02	.17	46	942.0	10.2	15.70	.17	162	1768.2	32.4	29.47	.54
12½	491.4	9.6	8.19	.16	47	952.2	10.2	15.87	.17	168	1800.6	31.9	30.01	.53
13	501.0	9.6	8.35	.16	48	962.4	10.2	16.04	.17	174	1832.5	31.3	30.54	.52
13½	510.6	9.0	8.51	.15	49	972.6	9.6	16.21	.16	180	1863.8	30.8	31.06	.52
14	519.6		8.66		50	982.2		16.37		186	1894.6		31.58	
		9.6		.16			9.9		.16			30.2		.50
14½	529.2	9.1	8.82	.15	51	992.1	9.9	16.53	.17	192	1924.8	59.7	32.08	.99
15	538.3	8.9	8.97	.15	52	1002.0	9.6	16.70	.16	204	1984.5	57.3	33.07	.96
15½	547.2	8.4	9.12	.14	53	1011.6	9.2	16.86	.15	216	2041.8	55.8	34.03	.93
16	555.6	8.4	9.26	.14	54	1020.8	9.4	17.01	.16	228	2097.6	54.6	34.96	.91
16½	564.0	8.6	9.40	.14	55	1030.2	9.0	17.17	.15	240	2152.2		35.87	
17	572.6	8.2	9.54	.14										

If

If we were to calculate the expence or difcharge for any orifice by this table, we fhould in every inftance find it much greater than nature really gives us.

It muft be recollected, that this table is not calculated from experiment, but from the theory of falling bodies, which makes no allowance for the lofs of velocity, which arifes from the friction of the particles of water againft the edges of the aperture, and againft the neighbouring particles of water which are not put in motion.

Sir Ifaac Newton, in making experiments, found the velocity thus determined to be too great, which in one cafe he corrected. The friction againft the fides of the aperture, and the oblique direction of the particles of water before they reach the aperture, both tend to diminifh the velocity of the ftream; and if thefe caufes could be removed, efpecially the latter, the Newtonian theory would be confirmed by experiment, or rather experiment would exactly agree with theory.

For, if we fuppofe water running into the top of a cylindrical tube, and that there is no attraction or friction between the particles of water and the interior of the tube, the velocity of the water, or of each of the particles at the bottom, would be the fame, or equal to that which they would have acquired in falling through the fame fpace without the tube, towards the earth.

Hence, to obtain the true velocity, under different circumftances, we muft correct the computed velocity by experiments.

It is ftated in fome elementary works on hydroftatics, that the velocity of the water at the orifice is only equal to that which a heavy body would acquire by falling through half the height of the fluid above the orifice. This was firft maintained by fir Ifaac Newton, who found that the diameter of the ftream is contracted, after it has quitted the orifice; and at the fmalleft part, the diameter was to that of the orifice as 21 to 25. The area, therefore, of the one was to the area of the other as 21^2 to 25^2, which is nearly the ratio of 1 to the fquare root of 2. By meafuring the quantity of water difcharged in a given time, and alfo the area of the vena contracta, fir Ifaac found, that the velocity at the vena contracta was that which was due to the whole altitude of the fluid above the orifice. He, therefore, concluded, that fince the velocity of the orifice was to that at the vena contracta as 1 to the fquare root of 2, the velocity in the vena contracta was that which was due to the whole altitude of the fluid; and that the velocity at the orifice muft be that which is due to one half that altitude, becaufe the velocities are as the fquare roots of the heights. From this, fir Ifaac ftated the actual velocity of flowing water to be $\frac{707}{1000}$, or .707 of the theoretic velocities.

But the real quantity of the reduction varies in different cafes, according to the nature of the aperture: hence, it is neceffary to confider all different forms of apertures, and make a different allowance for each cafe. To do this, the circumftances of the aperture muft be carefully examined.

A, *fig.* 8. *Plate* II. *Water-works*, explains the manner in which the filaments of water may be fuppofed to move, when a ftream flows through an aperture in a thin plate.

B fhews the motion, when a tube of about two diameters in length is added to the orifice, and when the water flows through the tube with a full ftream. This does not always happen in fo fhort a pipe, and never in one that is fhorter; but the water will frequently detach itfelf from the fides of the pipe, and flow through it with a contracted jet.

C fhews the motion, when the pipe projects into the infide of the veffel. In this cafe, it is difficult to make the tube flow full.

D reprefents a mouth-piece fitted to the hole, and formed agreeably to that fhape which a jet would affume of itfelf. In this cafe all contraction is avoided, becaufe the mouth of this pipe may be confidered as the real orifice; and nothing now diminifhes the difcharge but a trifling friction of the fides.

When water iffues through a hole in a thin plate, the lateral columns, preffing into the hole from all fides, caufe the iffuing filaments to converge to the axis of the jet, and contract its dimenfions after it has quitted the hole, and at a little diftance from the hole; and it is in this place of greateft contraction that the water acquires that velocity which we affume as equal to that acquired by falling from the furface: therefore, that our computed difcharge may beft agree with obfervation, it muft be calculated on the fuppofition that the orifice is diminifhed to the fize of this fmalleft fection. But the contraction is fubject to variations, of which the reafons are not apparent.

The following are the meafures of the contracted vein, as afcertained by different authors; the area of the aperture being 1000, the area of the contracted vein at the fmalleft will be as follows:

Sir Ifaac Newton - - -	707
Poleni - - - - - -	714
Greateft found by Boffut - -	667
Mean of fix experiments by Boffut	664
Loweft found by Boffut - -	666
Bernouilli - - - - - -	641
Michelotti - - - -	641
Du Buat - - - - - -	666
Venturi - - - - -	636
Eytelwein - - - - - -	642

The meafures given by Boffut were taken by a pair of fpherical compaffes, with which he meafured directly the diameter of the contracted vein, which he found to preferve the fame diameter for fome lines. The altitude of the water in the refervoir which Boffut ufed was 12 feet 6 inches. He meafured the vena contracta alfo, when the water iffued by vertical orifices placed 4 feet 3 inches below the furface of the fluid, and he obtained the very fame refults. The ratio between the area of the orifice and the area of the vena contracta appears from the above, to be by no means conftant. It undergoes perceptible variations, by varying the form and pofition of the orifice, the thicknefs of the plate in which the orifice is made, the form of the veffel, and the velocity of the iffuing fluid.

The dimenfions of the fmalleft fection of the contracted vein are at all times difficult to be afcertained with precifion. It is, therefore, much more convenient to compute from the real dimenfions of the orifice, and to correct this computed difcharge by means of an actual comparifon of the computed and effective difcharges, in a feries of experiments made in fituations refembling thofe cafes which moft frequently occur in practice.

We have made a collection of experiments by various authors, and from them we have deduced the following rule for the real velocity with which water iffues from an aperture in a thin plate.

Rule.—Meafure the depth of the centre of the orifice beneath the furface of the water in the refervoir in inches, extract its fquare root, and multiply it by the conftant number 85.87: the product is the velocity in feet *per* minute.

If the velocity, as marked in the preceding table, is multiplied by .618, the fame refult will be obtained. For the contraction of the ftream or vein of water, running out of a fimple orifice in a thin plate, reduces the area of its fection,

at

at the diſtance of about half its diameter from the orifice, from 1 to .665, according to the mean different ſtatements above quoted: hence the diameter is reduced to .815.

The quantity of water diſcharged is very nearly, but not quite, ſufficient to fill this ſection with the velocity due, or correſponding to the height. For finding accurately the quantity diſcharged, the area of the orifice muſt be ſuppoſed to be further diminiſhed to .619 on account of friction.

In regard to the accuracy of this rule, we muſt refer to the following table, which contains the reſults of 35 experiments, and alſo the calculation for each. We have been obliged to reject about 12 other experiments, becauſe they would not accord with the theorem; but in nearly all of them, the velocity was greater than the rule, and thoſe which are leſs we have preſerved. This was done, becauſe we ſuſpect that many of the caſes were not apertures in thin plates; but in wood planks of conſiderable thickneſs, ſuch as ſluices, the diſcharge would then be greater than our rule ſuppoſes, and ſuch caſes ſhould be claſſed with another deſcription of aperture.

Table of Experiments on the Efflux of Water from Apertures on thin Plates.

Authors.	Depth in Inches of the Centre of the Orifice beneath the Surface.	Velocity of the effluent Water *per* Minute in Feet.	Velocity calculated, by multiplying the Square Root of the Depth by 85.87.	Deſcription of the Aperture.
Smeaton and Brindley - - -	12.5	307 +	304	1 inch ſquare.
Boſſut - - - - - - -	12.8	307 =	307	
Poleni - - - - - - -	22.7	381 —	410	$2\frac{1}{8}$ circular
Smeaton - - - - - - -	24.5	432 +	425	1 inch ſquare.
Deſaguliers - - - - - -	25.	432 +	429	1 inch ſquare.
Boſſut - - - - - - -	25.6	434 =	434	
Venturi - - - - - - -	29.3	460 —	464	$1\frac{6}{16}$ inch ſquare.
	34.	515 +	500	$\frac{4}{16}$ inch circular.
	34.6	508 +	505	$1\frac{1}{2}$ inch circular.
Boſſut - - - - - - -	38.4	531 =	532	
Venturi - - - - - - -	42.6	553 —	560	$1\frac{6}{16}$ circular.
Smeaton - - - - - - -	48.5	608 +	598	1 inch ſquare.
Boſſut - - - - - - -	51.2	613 =	615	$\frac{1}{2}$ an inch circular.
Smeaton - - - - - - -	60.5	680 +	668	
Boſſut - - - - - - -	64.	685 =	687	1 inch ſquare.
Boſſut - - - - - - -	76.8	751 =	752	
Michelotti - - - - - -	84.5	790 =	790	3 inches ſquare.
	86.5	807 +	798	1 inch ſquare.
	87.8	805 =	804	3 inches ſquare.
Boſſut - - - - - - -	87.9	803 =	805	
	89.6	810 =	813	
	102.5	866 =	869	1 inch circular.
	115.	918 =	920	
	128.	967 =	971	
	141.	1014 =	1019	
Michelotti - - - - - -	148.3	1031 =	1045	3 inches circular
	149.2	1035 —	1049	3 inches ſquare.
Boſſut - - - - - - -	150.	1047 — 1050 =	1051	
Michelotti - - - - - -	150.2	1055 =	1053	1 inch circular.
	275.1	1438 +	1425	1 inch ſquare.
	276.4	1414 —	1428	3 inches circular.
	277.4	1416 —	1430	3 inches ſquare.
	277.7	1417 —	1431	
	280.1	1404 —	1437	2 inches circular.
	281.6	1446 +	1441	1 inch circular.

Theſe are the reſults of the diſcharge through orifices in a thin plate. If we apply to the orifice the ſhorteſt cylindrical pipe, that will cauſe the ſtream to adhere every where to its ſides, we ſhall find that its length muſt be twice its diameter. The diſcharge through ſuch a tube will be about $\frac{13}{16}$ths of the full quantity, and the velocity may be found by multiplying the full velocities marked in our firſt Table by .8125.

The greateſt diminution of velocity is produced by inſerting the pipe ſo as to project within the inſide of the reſervoir; probably becauſe of the greater interference of the motions of the particles approaching its orifice in all directions: in this caſe, the velocity is reduced nearly to half of the full velocity.

It was one great aim of the experiments of Michelotti and Boſſut to determine the effects of contraction in different caſes. Michelotti, after carefully obſerving the form and dimenſions of the natural jet, made various mouth-pieces reſembling

ſembling it, till he obtained one which produced the ſmalleſt diminution of the computed diſcharge, or till the diſcharge computed for the area of its ſmaller end approached the neareſt to the effective diſcharge. And he at laſt obtained one, which gave a diſcharge of 983, when the natural diſcharge would have been 1000. This piece was formed by the revolution of a trochoid round the axis of the jet, and the dimenſions were as follow:

Diameter of the outer orifice	= 36
——— inner orifice	= 46
Length of the axis	= 96

Eytelwein ſtates that a conical tube, approaching to the figure of the contraction of the ſtream, procured a diſcharge equal to .92 of the full velocity; and when its edges were rounded off, of .98, calculating on its leaſt ſection.

Venturi has aſſerted, that the diſcharge of a cylindrical pipe may be increaſed by the addition of a conical tube at the end of it nearly in the ratio of 5 to 2. (See his experiments in our article DISCHARGE.) But Mr. Eytelwein finds this aſſertion ſomewhat too ſtrong, and obſerves, that when the pipe is already very long, ſcarcely any effect is produced by the addition of ſuch a tube. He made a number of experiments with different pipes, where the ſtandard of compariſon was the time of filling a given veſſel out of a large reſervoir, which was not always kept full, becauſe it was difficult to avoid agitation in repleniſhing it; but this circumſtance was rendered indifferent to the reſults of the experiments by the application of an ingenious theorem. They prove that a compound conical pipe may increaſe the diſcharge to twice and a half as much as through a ſimple orifice, or to more than half as much more as would fill the whole ſection with the velocity due to the height; but where a conſiderable length of pipe intervenes, the additional orifice appears to have little or no effect.

The reſults of the inveſtigations of Boſſut, Michelotti, and Eytelwein, agree in a very ſatisfactory manner reſpecting the diminution of the diſcharge in different caſes; and we have arranged them in the following Table, which we recommend to engineers, as affording all the neceſſary information to calculate the diſcharge from ſluices and orifices.

Deſcription of the Aperture through which the Water flows. *Note.*—In taking the meaſure for the depth of the column which produces the velocity, we may in general take it from the ſurface of the water to the centre of the aperture; but if the aperture is in a perpendicular plane, and of a height greater than one-fourth of the whole depth, then the velocity muſt be found for the top of the aperture and alſo for the bottom of the aperture, and the mean of both taken for the mean velocity of the water.	Ratio between the real velocity and the theoretic velocity, or that which is due to the whole Depth, as ſhewn by our firſt Table.	To find the Velocity of the iſſuing Water. *Rule.*—Extract the Square Root of the Depth, (meaſured from the Centre of the Orifice to the Surface of the Water,) and multiply by ſome One of the following Numbers, according to the Circumſtances of the Caſe.				To find the Number of Cubic Feet of Water which flow *per* Minute through each Square Inch of the Area.	
		I. When it is required to know the Velocity in Feet *per* Second.		II. When it is required to know the Velocity in Feet *per* Minute.			
		If the Depth is in Feet multiply by	If the Depth is in Inches multiply by	If the Depth is in Feet multiply by	If the Depth is in Inches multiply by	If the Depth is in Feet extract the Square Root and multiply by	If the Depth is in Inches extract the Square Root and multiply by
For orifices in a thin plate -	.618	4.957	1.431	297.45	85.87	2.065	.59633
For the openings of ſluices or apertures in the ſide or internal walls of the reſervoir, without any ſide walls which can ſerve to conduct the particles of water in a ſtream to the aperture	.636	5.1	1.472	306.	88.32	2.125	.6133
For a ſhort cylindrical pipe from two to four times as long as the bore, 1. When it projects withinſide the veſſel and does not run with a full bore of water, but in form of a contracted vein within the tube	.5137	4.119	1.190	247.14	71.40	1.716	.4958
For a ſhort cylindrical pipe from two to four times as long as the bore, 2. When it projects withinſide the veſſel but runs with a full bore of water -	.681	5.46	1.576	327.6	94.56	2.275	.6566
For a ſhort cylindrical pipe from two to four times as long as the bore, 3. When it does not project withinſide of the veſſel -	.8125	6.515	1.881	390.9	112.86	2.729	.7837
For narrow openings, of which the bottom is on a level with that of the reſervoir. Alſo for ſmaller openings of ſluices, when provided with ſide walls to conduct the water to the aperture; alſo for the water-paſſage under bridges which have ſquare piers with abrupt projections, which do not conduct the water regularly into the paſſage -	.860	6.9	1.992	414.	119.52	2.875	.830
For wide openings, of which the bottom is on a level with that of the reſervoir; alſo for large ſluices with conducting walls in the direction of the ſtream and for the water-way beneath bridges with pointed piers, which conduct the water into the paſſage	.960	7.7	2.223	462.	133.38	3.208	.9262
For a circular orifice or tube formed correſpondent to the contracted ſtream - - - - -	.983	7.884	2.276	473.04	136.56	3.285	.9483
For the whole velocity due to the height according to the theorems for falling bodies -	1.000	8.019	2.3148	481.14	138.888	3.349	.9645

To apply thefe rules for gauging fluices, the following meafures muft be taken. 1. The perpendicular depth of the bottom of the aperture beneath the furface of the water. 2. The perpendicular depth of the top of the aperture. 3. The horizontal width of the opening. Then, taking the difference between the two firft meafures leaves the height of the opening.

Note.—If the aperture is not in a vertical plane, but inclined, as is frequently the cafe in mill-fluices, then the width of the opening muft be meafured on the flope; but the depths muft always be taken perpendicularly beneath the furface of the water.

To make the calculation, find the mean velocity of the effluent water, by calculating the velocity due to the depth of the top of the aperture, and alfo for the bottom of the aperture, and take a mean of the two.

Note.—When the height of the aperture is lefs than one-fourth of the whole depth, then the velocity due to the depth of the centre of the aperture will be very near the truth.

Having found the mean velocity in feet, multiply it by the number of fquare feet in the area of the aperture, and it will give the quantity difcharged, in cubic feet.

Example 1.—A fluice, which is four feet wide, is opened or drawn feven inches, and the depth of water above the centre of the orifice is ten feet. The edges of the fluice are cut fharp, fo that the borders of the orifice are like a thin plate. What is the velocity and difcharge *per* minute in cubic feet?

The fquare root of 10 is 3.162, which × 297.45 from the table, gives 940.6 feet *per* minute, for the mean velocity of the water.

The area of the aperture is 4 feet, which × 7 inches, = 28 ÷ 12 = 2.333 fquare feet, for the area of the aperture; therefore, multiply 940.6 by 2.333, and we have 2194 cubic feet *per* minute, for the quantity difcharged.

If the depth had been expreffed in inches, it would have been 120. The fquare root of this is 10.95, and this multiplied by 85.87, gives 940.6 feet *per* minute for the velocity, as before. In like manner, the table gives the proper multipliers for finding the velocity in feet *per* fecond, if it is required.

If it was only required to obtain the quantity difcharged, we may proceed more directly, thus. The depth is 10 feet, and the fquare root is 3.162, × by 2.065, the number taken from the laft column but one of the table, and we have 6.529 cubic feet, which are difcharged *per* minute from every fquare inch of the aperture. The aperture is 48 inches, this × 7 = 336 fquare inches, this × 6.529 = 2194 cubic feet difcharged as before.

If the depth had been 120 inches, then the fquare root of that number = 10.95, and this × .5963, the number in the laft column gives 6.529, as the laft.

Another method is, to calculate the theoretic difcharge, and then make a proper reduction, by multiplying by the decimal number in the firft column. Thus, by our firft table of velocities, 120 inches deep = 1521.8 feet *per* minute, this × by 2.333 fquare feet, the area of the aperture gives 3550 cubic feet *per* minute for the theoretic difcharge.

The firft column of the prefent table fhews that the real difcharge is only .618 of the theoretic difcharge; therefore, multiply 3550 cubic feet by .618 = 2194 cubic feet for the real difcharge, as in all the former cafes.

This latter method is very convenient, becaufe we can apply a different correction in different cafes, according to difcretion, and the table of velocities facilitates the calculation very much.

Example 2.—A flour-mill was worked by the water which ran through a fhuttle four feet wide, the depth to the bottom of the aperture was 22 inches, and the fhuttle was drawn up one inch and one-quarter, fo that the depth to the top of the aperture was 20.75 inches; what is the expenditure *per* minute?

The full velocity due to 22 inches depth is by the table } 651.6 feet *per* minute.
Ditto - - for $20\frac{3}{4}$ 632.7

2)1284.3

642.15 mean velocity *per* min.

Note.—As 20.75 is not to be found in the table, take $20\frac{1}{2}$ = 628.8, and add to it half the difference between $20\frac{1}{2}$ and 21, *viz.* 3.9 = 632.7 feet *per* minute velocity for 20.75, as above.

The area of the aperture 48 inches, × 1.25 inches = 60 fquare inches, ÷ 144 = .4166 fquare feet. Multiply this by the velocity = 642.15 feet, and it gives 267.5 cubic feet *per* minute difcharged according to theory.

To reduce this to the practical difcharge, multiply by fome of the numbers in the firft column of the Table oppofite, according to the nature of the aperture. The fluice was in a trough, nearly of its own dimenfions; fo that the bottom and fides nearly correfponded with the aperture; therefore, take .860, and × 267.5 gives 238 cubic feet *per* minute.

It is very convenient to an engineer to be able to calculate the difcharge of water by means of the flide-rule. This he may do by means of the two lines ufually marked C and D; C being a line of logarithms, and D a line fimilarly divided on a fcale twice as large. By means of thefe, the fquare root of any number can be extracted and multiplied by any number at one operation. To ufe it, find the multiplier which is to be ufed, upon the line D, and fet the flider fo that 10 upon C will correfpond with it; then feek for the depth upon C, and oppofite to it upon D, the required velocity will be found.

Thus,

Line on the flider marked C, depth in inches, 10

Line on the rule marked D, velocity in feet *per* minute, 85.8

And in like manner for any other multipliers: for inftance,

Line on the flider marked C, depth in inches 10

Line on the rule marked D, cubic feet *per* minute difcharged through a fquare inch, } .596

Mr. Eytelwein obferves, from Du Buat, that the difcharge through an orifice communicating between two refervoirs, and fituated beneath the furface of the water in the lower refervoir, is the fame as if the water run into the open air, taking the difference of level between the two furfaces, for the depth of the column; he calculates the difcharge when the water has to pafs through feveral orifices in the fides of as many refervoirs open above. In fuch cafes, where the orifices are fmall, the velocity in each may be confidered as generated by the difference of the heights in the two contiguous refervoirs; and the fquare root of the difference will therefore reprefent the velocity which muft be generated in the feveral orifices, inverfely as their refpective areas, fo that we may calculate from hence the heights of the different refervoirs when the orifices are given. Mr. Eytelwein alfo confiders the cafe of a lock, which is filled from a canal of an invariable height, and determines the time required, by comparing it with that of a veffel emptying itfelf by the preffure of the water that it contains, obferving, that the motion is retarded in both cafes in a fimilar manner, and he finds the calculation agree fufficiently well with experiments made on a large fcale.

Rules for meafuring the Quantity of Water which flows over a Weir, or through an Aperture in the Edge of a Board, the Stream being open at Top.—If we fuppofe water running in a regular fheet over the edge of a large ciftern or refervoir, or through a rectangular aperture made in the perpendicular wall or fide of the ciftern, but open at top, we may take the area of the aperture, and proceed to find the velocity by calculation.

When this fubject has been confidered theoretically, it has been affumed, that the furface of the water at the place where it runs through the aperture, is without motion, becaufe it ftands at the fame level with the ftagnant water in the refervoir, and that the velocity of the water at different depths will always be as the fquare root of the depth; that is, beginning at nothing at the furface, the velocity at different depths will increafe by that law.

We can find the velocity at the bottom of the aperture, or at any intermediate depth, by the rules and table we have already given; but what we require is the mean velocity of the whole fheet of water. We could obtain this nearly by calculating the velocities for a great number of different depths, increafing by regular intervals, and taking a mean of the whole; but we can effect the fame with exactnefs, if we take two-thirds of the velocity at the bottom, and confider it as the mean velocity of the whole body of water; or, the velocity due to four-ninths of the depth, will give the fame refult.

In practice we muft make allowance for lofs of motion by the friction of the water in paffing through the aperture, and alfo becaufe the water does not fill the aperture to the fame level as the ftagnant water in the refervoir. The motion of the water extends fome diftance into the refervoir, and the water will confequently have a floping furface from that part of the furface where the motion begins; the flope will continually increafe as the motion of the water accelerates, fo as to form a convex furface, which is a portion of a parabolic curve; hence the furface of the water where it is paffing through the aperture will be in rapid motion, inftead of being motionlefs as the theory fuppofes, and the furface will be much lower than the furface of the ftagnant water, fo that the aperture will only be half full of water; at leaft this is the affertion of M. Du Buat. But Dr. Robifon ftates, that he always found the depth of the water in the aperture about .715 of the whole depth from the bottom of the aperture to the level of the water in the refervoir.

M. Du Buat's theorem for the difcharge through an open aperture, when reduced to Englifh meafures, is this: having given the depth from the level furface of the water to the bottom of the aperture, and alfo the width of the aperture in inches, to find the difcharge in cubic inches *per* fecond.

Let it be remembered that 11.4491 cubic inches of water, or 11.5, will be difcharged in a fecond, through every inch in width of the aperture, when the bottom of it is exactly one inch beneath the level furface of the refervoir. To obtain the difcharge for any other depths, this number muft be multiplied by the fquare root of the cube of the depth in inches, and it will give the cubic inches difcharged *per* fecond through each inch in width of the aperture.

Example.—Suppofe the depth of the bottom of the aperture beneath the level furface of the water in the refervoir to be 4 inches. The cube of this is 64, the fquare root of which is 8; therefore, at that depth each inch in width will difcharge $8 \times 11.5 = 92$ cubic inches *per* fecond; if the width of the aperture was 3 feet, then 92×36 inches $= 3312$ cubic inches, or 1.917 cubic feet, which $\times$ 60 feconds $= 11.502$ cubic feet *per* minute.

Dr. Robifon gives the following table, which is rather greater than from the above theorem, and will be found very exact, when the aperture is made in a plank or board half an inch or an inch thick, and fo fituated that the fides and bottom of the refervoir do not correfpond with the edge of the aperture, to lead the particles of water in a current to the aperture.

Depth from the Bottom of the Aperture to the level Surface of the Water, in Inches.	Cubic Feet difcharged *per* Minute through each Inch of the Width of the Aperture.	
	In fmall Apertures of lefs than 18 Inches wide.	In larger Apertures than 18 Inches.
1	0.403124	0.428
2	1.140	1.211
3	2.095	2.226
4	3.225	3.427
5	4.507	4.789
6	5.925	6.295
7	7.466	7.933
8	9.122	9.692
9	10.884	11.564
10	12.748	13.535
11	14.707	15.632
12	16.758	17.805
13	18.895	20.076
14	21.117	22.437
15	23.419	24.883
16	25.800	27.413
17	28.258	30.024
18	30.786	32.710

In taking the depth, if it does not exceed four inches, it will not be exact enough to take proportional parts for the fractions of an inch. The following method is exact: if there be odd quarters of an inch, look in the table for as many inches as the depth contains quarters, and take the eighth part of the anfwer. Thus, for $3\frac{3}{4}$ inches take the eighth part of 23.419, which correfponds to 15 inches. This is 2.927.

If the aperture is not in the fide of a large refervoir, but in a running ftream, we muft augment the difcharge, by multiplying the fection by the velocity of the ftream. But this correction can feldom occur in practice, becaufe in this cafe the difcharge is previoufly known.

The amount of the allowance for friction and lofs of motion muft be different in different cafes, according to the kind of aperture, or board over which the water flows; but will always be very nearly the fame as the allowance, for lofs in an aperture or orifice of fimilar nature. For inftance, if the edges of the aperture through which the water runs be a thin plate, then we may find the velocity in feet *per* minute due to the whole depth from the bottom of the notch to the level furface of the water in the refervoir; multiply the fquare root of the depth in inches by 85.87, as we have

have before directed, and take two-thirds of the product for the mean velocity; this multiplied by the number of ſquare feet in the area of the ſection of the aperture, will give the cubic quantity of water which flows *per* minute in cubic feet. Note, in taking the area of the ſection, we muſt meaſure the whole depth from the level ſurface, and multiply it by the horizontal width of the aperture, and not ſimply the ſection of the water. This is becauſe, the theory upon which the rule is founded ſuppoſes the water in the aperture to have no velocity at the ſurface, and to be upon the level of the ſtanding water. Neither of theſe ſuppoſitions is true in reality, but the reſult is very nearly true, becauſe the ſection of the moving water is diminiſhed in proportion to the velocity which the water has at the ſurface, and in conſequence the errors of the two aſſumptions always correct each other.

We have therefore only to apply a correct theorem to obtain the velocity due to the whole depth, according to the nature of the aperture, and take two-thirds of the product. All the neceſſary information for this purpoſe may be taken from the table of multipliers laſt given, for the velocity of the diſcharge through apertures; or otherwiſe, if we take the velocity at the bottom, and multiply it by the depth, and take two-thirds of the product, we ſhall have the mean velocity. But to make the ſubject clear we ſhall give another table for this object.

Rules for obtaining the Velocities and Quantities of Water diſcharged through rectangular Apertures, which are open at Top.

Deſcription of the Aperture. *Note.*—The depths are ſuppoſed to be meaſured from the level ſurface of the water to the bottom of the aperture, in inches.	To find the mean Velocity of the Water running through the Aperture in Feet *per* Minute. *Rule.*—Multiply the Square Root of the Depth in Inches, by ſome one of the following Numbers, according to the Caſe.	To find the Number of Cubic Feet diſcharged *per* Minute through each Inch in Width of the Aperture. *Rule.*—Multiply the Square Root of the Cube of the Depth in Inches; by ſome One of the following Numbers, according to the Caſe.
For a ſmall aperture in one ſide of a large reſervoir, the bottom and ſides of which do not correſpond with the aperture, ſo as to lead the particles of water thereto in a ſtream; the edges of the aperture againſt which the water runs is ſuppoſed to be ſharp and made of thin plate; the aperture not to exceed 18 inches long and nine inches deep - - - - -	57·246	·39754
For an aperture under the ſame circumſtances as the former, but made in a plank with edges from half to one inch thick - -	58.0493	·40312
For an aperture of great breadth and more than nine inches deep, ſuch as the weir or dam in a river; it is ſuppoſed that the water runs over the edge of a plank or waſte board, one or two inches thick - - - - -	58.88	.40886
For an aperture of which the bottom is on a level with the bottom of the reſervoir, or for a weir which occupies the whole breadth of a river, and where the water flows over the top of a broad ſtone-wall ſo ſloped as to conduct the water to the paſſage -	88.92	.6174
For the full diſcharge according to theory, ſuppoſing no loſs from friction. Very large and deep weirs will come near to this -	92.592	.6430

When the aperture occupies nearly or the whole width of the reſervoir, there is no level ſurface of the water above the aperture, becauſe the water is continually running towards the aperture in a ſtream; ſuch is the caſe of a weir acroſs a river, or when water ſpouts out of the open end of a rectangular trough.

It is extremely difficult to meaſure the exact height of the water above the bottom of the aperture, for the curvature of the ſurface of the water will begin ſeveral feet up the ſtream before it arrives at the aperture; and there muſt be ſomething arbitrary in the meaſurement, becauſe the ſurface of the water, even where there is no curvature, is not horizontal but ſloping, when the water is in motion. In ſuch caſes, the depth muſt be taken beneath the inclined ſurface of the water, if we ſuppoſe the ſame prolonged until it reaches the aperture, which can eaſily be done, by ſtretching a line along the ſurface of the water ſo as to correſpond therewith, at the part above where the curvature commences.

We muſt alſo make ſome addition to the diſcharge, on account of the motion which the water poſſeſſes before it comes to the aperture; to do this with accuracy, we may meaſure the regular velocity of the ſtream, by throwing in floating bodies, and obſerving the diſtance they paſs through in a given time, taking care that we make this obſervation at a part of the channel, where the ſurface is in a regular motion and not in a ſtate of acceleration, becauſe what we want is the velocity of the water at that point where the curvature begins, in conſequence of the deſcent through the aperture. Now when the channel is not of an uniform breadth and depth, as in a mill-dam for inſtance, the velocity of every part of the ſtream is different, we ſhall then find difficulty in meaſuring

measuring the velocity by floating bodies, and muſt apply the wheel ſtream-meaſure before deſcribed; this will give the preciſe velocity of the ſurface at any given ſpot, and we ſhould chooſe that place where the curvature begins. The velocity ſo obtained we muſt add to the mean velocity, and find the diſcharge by multiplying the ſum by the area of the aperture.

Example.—Suppoſe the depth of the bottom of the aperture to be eight inches beneath the line of the ſurface of the water; that the width of the aperture is four feet, and that the aperture is in a thin plate with ſharp edges. Alſo that the ſtream is found by the wheel to move with a velocity of thirty feet *per* minute, at the place where the ſurface of water begins to deviate from its regular ſlope, and to aſſume a curvature.

Then take the numbers 57.246 from the firſt caſe in our laſt table, and multiply it by 2.83, which is the ſquare root of eight (the depth); thus $57.246 \times 2.83 = 162$ feet *per* minute, for the mean velocity of the water; to this add 30 feet for the previous motion $= 192$ feet *per* minute. The area of the aperture is 8 inches, or .66 feet $\times$ 4 feet $=$ 2.66 ſquare feet. Multiply 192 feet velocity by 2.66, and we have 510.72 cubic feet *per* minute, for the quantity diſcharged.

Water-Gauge for meaſuring the Quantity of Water afforded by any Spring or Brook.—The moſt accurate and convenient method for this purpoſe, is to conſtruct a temporary bank or dam to intercept the ſtream, and pen it up into a pond, then in the bank or dam fix a board with an aperture in it for the water to flow through. By meaſuring the width and depth of the aperture as before explained, the quantity can be calculated by the rules already given.

This is what Mr. Smeaton called the water-gauge, and is of moſt important uſe, to aſcertain the quantity of water which can be procured to ſupply a canal, or for a town, or a mill, or any other purpoſe: it is the neceſſary prelude for undertaking any ſuch kind of work, and all perſons employed in ſuch purſuits, ſhould underſtand the manner of fixing up a gauge, and making the neceſſary obſervations.

The dam muſt be of ſuch a height as to pen up the water into a tolerable large pond compared with the aperture, ſo that the ſurface of water ſhall have no ſenſible inclination or run towards the aperture; and to avoid this, the larger the pond is the better. The water muſt have ſo much fall down from the aperture, as to flow away in a clear ſtream perfectly free from all obſtruction of the water below; but it ſhould not ſpout out ſo as to fall far in the air.

The aperture ſhould be a rectangular notch cut in the edge of a broad plank; it will be beſt to make the length of the notch ſome even number of inches, as 6, 8, 12, or 24, and the depth correſpondent to the quantity expected to flow through the aperture.

We recommend that the edges of the aperture be cut ſharp, or even faced with a ſlip of metal plate, and then our firſt rule in the laſt table will apply with great accuracy. The more common practice is, to uſe a plank of one inch thick, and leave the edges of the aperture of that thickneſs, only rounding off the ſharp angles: in this caſe, the ſecond theorem in our table muſt be uſed; but this is leſs certain, becauſe the loſs of motion from reſiſtance will not bear a conſtant portion in different depths, for the thickneſs of the plank is a conſtant quantity, and therefore bears a different proportion to the quantity diſcharged, in every caſe of a different depth.

The accuracy of our rules, when applied to water-gauges, will appear from the following table.

Reſults of Thirteen Experiments on the Diſcharge of Water through an Aperture open at Top, made by Meſſrs. Smeaton and Brindley, and M. Du Buat.

Depth, in Inches, from the level Surface to the Bottom of the Notch, Inches.	Cubic Feet diſcharged *per* Minute, aſcertained by Obſervation,		Cubic Feet diſcharged *per* Minute by each Inch in Width, as aſcertained by Calculation,	
	the Notch being ſix Inches wide.	by each Inch in Width.	by the Number .403124.	by the Number .39754.
1.	2.75	.4583	.403	.397
1.25	3.68	.613	.56	.554
1.375	4.07	.678	.646	.64
1.625	5.1	.85	.83	.825
* 1.778	5.75	.958	.958	.94
2.312	8.63	1.438	1.42	1.40
3.125	12.9	2.15	2.22	2.2
* 3.2	13.9	2.316	2.3	2.26
* 4.665	24.4	4.066	4.05	4.90
5.	26.1	4.35	4.5	4.45
5.625	28.5	4.75	5.35	5.30
6.5	40.	6.66	6.7	6.57
* 6.753	42.6	7.083	7.06	7.

The two laſt columns of the table are deduced from calculation, and agree ſo well with the obſervations as to give every confidence in the rules. The laſt column is calculated on the ſuppoſition that the aperture is made in a thin plate; but the laſt column but one is according to Dr. Robiſon's number, and agrees more nearly with the truth. We believe that Mr. Smeaton's experiments were made on an aperture in a board one inch thick; the aperture was ſix inches wide. M. Du Buat's four experiments, denoted by * in the table, were in an aperture $18\frac{1}{4}$ inches wide, which we have reduced to ſix inches, in order to compare them with Mr. Smeaton's. In making this compariſon, we have not rejected any experiment, as we were obliged to do in the caſe of diſcharge through the apertures beneath the ſurface.

Self-regiſtering Water-Gauge.—When the produce of a ſpring or ſtream is required with great accuracy, the depth of the water flowing through the gauge muſt be taken very frequently during a whole ſeaſon, and a mean of all the reſults obtained. This would require the conſtant attendance of an intelligent perſon, and would be liable to miſtakes; but a ſmall machine may be made to ſhew the depth by inſpection, ſo that any careful perſon can keep the account. Thus, at the ſide of the water-gauge, fix up a wooden or tin cylinder or trunk, which is open at the bottom, ſo that the water can enter freely. In this trunk, or tube, let a float be placed, having a ſmall light rod attached to the float that will riſe up from it, and appear above the top of the trunk; this part muſt be divided into inches and tenths, and muſt have ſome index fixed to the trunk to read the diviſions by. This apparatus muſt be carefully adjuſted; in the firſt inſtance, by the perſon who fixes the gauge, ſo that its diviſions will correſpond with the depth of water meaſured very exactly in the way we have directed; then the float will ever after riſe and fall with the ſurface of the water, and will ſhew the depth without any neceſſity of referring to the original mode of meaſurement, unleſs it be to verify the adjuſtment. It is obvious that ſuch an apparatus muſt be fixed ſo, that it cannot be deranged either by deſign or accident. The tube

in

in which the float acts ſhould be in the ſtill water ſome feet above the plank in which the aperture is made, and have a proper box, or cover, which can be locked up, to ſecure the whole. The float ſhould be a hollow copper ball, or a glaſs bottle, becauſe wood or cork floats abſorb the water, and ſink deeper therein; and the rod of wood ſhould be well painted.

A ſtill more perfect water-gauge is obtained by a ſmall machine to keep the regiſter; for this purpoſe, let an eight-day clock of the ordinary conſtruction be fixed up in a kind of centry-box, or ſmall houſe, over the gauge; this is to be connected by wheel-work, with a cylindrical barrel, which is to be placed in a perpendicular direction, and made to turn round once in a week by the clock; a ſheet of paper is wrapped round the barrel, and faſtened upon it in the ſame manner as paper is faſtened on a drawing-board.

The perpendicular ſtem of the float muſt have a ſmall pencil attached to it, with a ſlight ſpring to cauſe it to bear againſt the paper on the circumference of the cylinder, ſo as to mark upon it: in this way the pencil marks, at a different part of the length of the cylinder whenever the float riſes or falls, and the cylinder turning regularly on its axis by means of the clock, cauſes theſe riſings and fallings to be marked on different parts of the ſheet of paper, ſo that when it is removed from the cylinder it will have a curved line traced upon it, which ſhews all the increments and decrements of riſe and fall, and affords an exact regiſter of the flow of water, which may be reduced to cubic meaſure, by our rules already given.

A different kind of water-gauge has been propoſed by M. De Baader: two large caſks or other veſſels are to be fixed ſide by ſide, in ſuch poſition, that the ſtream of water may be poured into either of them by a ſpout or trough. The ſpout is ſo contrived, as to turn the ſtream into one or other of the veſſels at pleaſure, with the greateſt eaſe, but the ſtream cannot run into both at once. In each veſſel is a large float which is connected with a perpendicular ſtem, ſo that the ſtem riſes or falls with the float, as the veſſels fill or empty; alſo at the bottom of each veſſel is a valve, or ſluice, to allow the water to run out from it, and the perpendicular ſtem from the float is provided with means to open this ſluice, whenever the veſſel is full of water, and the float riſes to the top, or to ſhut the ſluice whenever the veſſel is empty; and the ſame action turns the ſtream of ſupply from the veſſel which is full, into that which is empty. In this way, the two veſſels act alternately to receive the water, and meaſure it, for while the ſpout runs into one veſſel its float riſes until the veſſel is quite full; the float then turns the ſpout and ſtream into the other veſſel, which we ſuppoſe to be already empty, and at the ſame moment it will open the valve in the bottom of the full veſſel; the water then begins to run out of the full veſſel and to fill the other, which becoming full in turn, its float opens the valve in its bottom. In this way the machine continues to meaſure the water, and is provided with a ſmall counting machine to regiſter the number of reciprocations it has made.

We have now, as far as our limits will allow, given all the moſt uſeful and practical rules for meaſuring flowing water; and ſhall conclude by obſerving, that this is one of the moſt intricate and difficult ſubjects in hydraulics, and that no engineer can be fully competent to direct the execution of large works without ſtudying the ſubject much farther than we have been able to enter into it. Many untried caſes, and combinations of caſes, will continually ariſe, which cannot be decided by any previous knowledge. As a reſource for ſuch occaſions, he ſhould be well verſed in the theory of the ſubject, ſo as to modify the rules laid down for ſimple caſes, and adapt them to his particular caſe, as far as theory can aſſiſt him.

If he only purſues the rules laid down by others, without any knowledge of theory, and without entering into the reaſon and origin of the rules, his experience will not be of much avail, becauſe he will be unable to correct and improve the rules by his own obſervations, or if he attempts to do ſo, he may completely ſpoil them, by making them falſe in many caſes, in order to obtain truth in ſome one caſe.

To attain the knowledge to which we allude, the following authors may be conſulted.

Julius Frontinus, De Aquæductibus urbis Romæ Commentarius; written about the year 100, in the time of the emperors Nerva and Trajan. This contains all the knowledge of the ancients on this ſubject. It is printed in Grævii Theſaurus Antiquitatum Romanorum, vol. iv. 1630 and 1780. A new edition was alſo publiſhed.

Caſtelli, a diſciple of Galileo, Della Meſura dell' acque correnti, 1628.

Torricelli De Motu Gravium Naturaliter Accelerato, 1643. In this work we find the origin of the propoſition, that the velocities of iſſuing fluids are as the ſquare roots of the depths.

Raphel Fabrettus de Aquis et Aqueductibus veteris Romæ, 1679.

Marriotte, Traite du Mouvements des eaux, 1686. This work contains a great number of experiments on the motion of fluids, and particularly on jets of ſpouting fluids; but the reaſoning is frequently erroneous.

Guglielmini, La Meſura dell' acque correnti.—Alſo, Della Natura dell Fuimi, Bologn. 1697.

Guglielmini de Fluviis et Caſtellis Aquarum. Theſe contain a theory which has long ſince been exploded. He firſt attempted to apply the principles of falling bodies to the motion of waters in open canals and rivers.

Polenus, De Motu aquæ Mixto, Patav. 1697, 1718, 1723.

Parent Mem. Acad. Par. 1700.

Newton's Principia, 1687. This work contains the doctrine, that the velocity of a ſpouting fluid is equal to that which a heavy body acquires in falling through half the depth of the column; but which is not correct. And in the ſecond edition, 1713, Newton firſt points out the contracted vein, and the proportion of its area to that of the orifice to be, as .707 to 1.

Polenus De Caſtellis per quæ derivantur fluviorum aquæ, Padua, 1718. He ſtates the area of the contracted vein to be .571 of the area of the orifice, and he diſcovered, that more water is yielded by a cylindrical pipe than by a ſimple orifice.

Michelotti, De Separatione Fluidorum in Corpore Animale, 1719.

Dr. Jurin, "On the Motion of running Water," publiſhed in the Philoſophical Tranſactions for 1718 and 1722. Lowthorp's Abridgment, vol. vi. p. 341.

Raccolta De Autori che Trattano dell Moto dell' acque, 3 tom. 4to. Florence, 1723. This moſt valuable collection contains the writings of Archimedes, Albizi, Galileo, Caſtelli, Michelini, Borelli, Montanari, Viviani, Caſſini, Guglielmini, Grandi, Manfredi, Picard, and Narducci; and an account of the numberleſs works which have been carried on, in the imbankment of the river Po in Italy.

M. Couplet, Des Recherches ſur le Mouvement des eaux dans les tuyaux de conduit. Memoires de l'Acad. 1732. This is on the motion of water in pipes, and is given by Belidor in his Arch. Hydraulique.

Architecture Hydraulique ou l'Art de Conduire d'elever et de ménager les eaux pour les differens beſoins de la vie, in 4 vols. 4to. par M. Belidor, Commiſſaire Provincial d'Artillerie, Paris, 1739.

Daniel

Daniel Bernouilli, Hydrodynamica feu de viribus et motibus Fluidorum Commentarii, Strafbourg, 1738. He gives a beautiful mathematical theory.

John Bernouilli fupported the fame theory in his Hydraulica mine primum detecta et directè ex demonftrata ex principiis puré mechanicis.

Maclaurin, in his Fluxions, Edin. 1742, has followed the fame tract.

D'Alembert difputes the theory of Bernouilli in his Dynamics, 1743, and gives a new theory in his Traité de l'Equilibre et du Mouvement des Fluides, 1744, which he has farther improved in his Effai fur la Refiftance des Fluides, 1752.

Euler, in his Opufcules Mathematiques, has brought the theory of d'Alembert to perfection, 1752.

Lecchi Idroftatica efaminata ne fuoi principi e ftabilita nellæ fue regole della mefura delle acque correnti, 1765.

Nuova Raccolta di autori che trattano del moto dell' acque, 7 vols. Parma, 1766. This extenfive work contains the experiments and theorems of a vaft number of the preceding authors on the fubject of running waters, the courfes of rivers, &c. &c. and in a great meafure fuperfedes all the Italian books of older date.

Michelotti, Sperimenti Idrauliche, 1767 and 1774. — Alfo, Mem. Taurinens, 1788. This work contains a moft valuable feries of experiments made at Turin, fome of which we have quoted.

Silberfchlag Theorie des Fleuves avec l'art de batir dans leur eaux et de prevenir leur ravages, 1769. Tranflated from the German.

Boffut Traité Theorique et Experimental d'Hydrodynamique, 2 vols. 8vo. 1771, 1786, 1796.

Du Buat, engineer to the French king, Principes d'Hydraulique, 1779. His theory was firft founded on the experiments of Boffut and others; but in 1786 he gave another edition containing many experiments of his own, and that valuable theory of the motion of water in rivers, which we have given in our article River, and which has made the firft approach to accuracy. The honour of this difcovery is in part due to M. S. Honoré, an officer of engineers.

Dr. Robifon's Syftem of Mechanical Philofophy; and the articles Hydrodynamics, River, Resistance, and Water-*Works*, which he prepared for the Encyclopædia Britannica. Thefe are the moft valuable collection of experiments, theories, and practical rules of any in the Englifh language: the learned profeffor took the trouble to collect and arrange all the experiments of Boffut, Du Buat, and others, into one fyftem.

Ximenes, Nuova Sperienze Idrauliche fatte ne canali e né fiumi per verificare le principale leggi e fenomeni delle acque correnti, Siena, 1780. Id. Act. Sien. iii. 16. iv. 31. vii. 1.

Lorgna, Memorie intorno all' acque correnti, Veron. 1777.

Lorgna, Ricerche intorno alla diltributione delle velocita nella fectione de Fiumi. Id. Soc. Italian, iv. p. 369. v. 313. vi. 218.

Dr. Matthew Young, Irifh Tranfactions, 1788, vol. ii. p. 81. and vol. vii. p. 53.

Prony, Recherches Phyfico-Mathematiques fur la Theorie des Eaux Courantes, 4to. Paris, 1804. This work contains a valuable collection of experiments and theorems.

M. Venturi of Modena, Recherches experimentales fur la Communication lateral du Mouvement dans les Fluides, 1797, contains fome important difcoveries and experiments on the lateral communication of motion in fluids. It was tranflated by Mr. Nicholfon, in his 4to. Philofophical Journal, 1798, vol. ii. and iii. It has been reprinted.

Fabre, Sur les Torrens et les Rivières, Paris, 1797.

Eytelwein Handbuch der Mechanick und der Hydraulik, Berlin, 1801. This is principally known in England by the abftract, publifhed by Dr. Young in the Journals of the Royal Inftitution, from which it appears to be a moft valuable work.

Dr. Thomas Young's Elements of Natural Philofophy, 2 vols. Lond. 1807.

Dr. Thomas Young's Hydraulic Inveftigations on the Friction and Difcharge of Fluids running in Pipes, and of the Velocity of Rivers. Phil. Tranf. 1808. Valuable papers, of which we have largely availed ourfelves.

Water, *Weight of.* It is neceffary to afcertain the weight or abfolute gravity of fome known quantity or meafure of water with great precifion, becaufe we ufually exprefs the weight of different bodies by their fpecific gravity, that is, their relative weight to the weight of water. Hence, by knowing the weight of any required quantity of water, we may obtain the weight of the fame quantity of any other fubftance, by means of the fpecific gravity of fuch fubftance.

It is recorded in the Philofophical Tranfactions, N° 169, that fome gentlemen at Oxford, in 1685, determined the weight of a cubic foot of fpring-water to be 1000 ounces avoirdupois. It was not obferved at that time that the denfity of water would increafe or diminifh according to the temperature. By a recent experiment by Dr. Wollafton and Mr. Playfair, the cubic foot was found to weigh 1000 ounces, or $62\frac{1}{2}$ pounds avoirdupois, at the temperature of $56\frac{1}{2}$ degrees of Fahrenheit. This we have made the foundation of the following tables.

Tables of the Weights of different Quantities of diftilled Water, the Cubic Foot being affumed $62\frac{1}{2}$ Pounds Avoirdupois, or 1000 Ounces, which is the exact Weight, when at the Temperature of $56\frac{1}{2}°$ of Fahrenheit.

Cubic Inches.	Pounds Avoirdupois.	Cubic Feet.	Pounds Avoirdupois.
1	.03616898	1	62.5
2	.07233796	1.792	112.0
3	.10850694	2	125.0
4	.14467592	3	187.5
5	.18084490	4	250.0
6	.21701388	5	312.5
7	.25318286	6	375.0
8	.28935184	7	437.5
9	.32552082	8	500.0
10	.36168980	9	562.5
12	.43402777	10	625.0
24	.86805554	20	1250.0
36	1.30208331	30	1875.0
		35.84	2240.0 equal 1 ton

A Prifm whofe Bafe is 1 Inch fquare.	Pounds Avoirdupois.	A Cylinder whofe Bafe is 1 Inch Diameter.
10 feet high	4.3402777	3.4088532
6 feet high	2.6041666	2.04531210
3 feet high	1.3020833	1.022265605
1 foot high	.43402777	.34088535
1 inch high	.03616898	.0284071

A Prifm

A Prifm whofe Bafe is 1 Foot fquare.	Pounds Avoirdupois.	A Cylinder whofe Bafe is 1 Foot Diameter.
1 inch high	5.208333	4.090625
1 foot high	62.5	49.0875
3 feet high	187.5	147.2625
6 feet high	375.0	294.5250
10 feet high	625.0	490.8750
20 feet high	1250.0	981.7500

Weight of different Quantities of diftilled Water.

Wine Meafure.

Denomination.	Weight in Pounds Avoirdupois.	Contents in Cubic Inches.	Contents in Cubic Feet.
A pint -	1.044	28.875	
A gallon -	8.355	231	.13368
A rundlet -	150.390	4158	2.40625
A barrel -	263.182	7276.5	4.2109375
A tierce -	350.910	9702	5.614533
A hogfhead -	526.365	14553	8.421875
A puncheon -	701.823	19404	11.229166
A butt or pipe	1052.734	29106	16.843749
A tun -	2105.469	58212	33.687498

Ale Meafure.

Denomination.	Weight in Pounds Avoirdupois.	Contents in Cubic Inches.	Contents in Cubic Feet.
A pint -	1.2749	35.25	.020398
A gallon -	10.1996	282	..16319
A firkin -	81.597	2256	1.3055
A kilderkin -	163.194	4512	2.6111
A barrel -	326.388	9024	5.2222
A hogfhead -	489.583	13536	7.8333

Beer Meafure.

Denomination.	Weight in Pounds Avoirdupois.	Contents in Cubic Inches.	Contents in Cubic Feet.
A pint -	1.275	35.25	.0203987
A gallon -	10.1996	282	.16319
A firkin -	91.796	2538	1.46875
A kilderkin -	183.593	5076	2.9375
A barrel -	367.187	10152	5.875
A hogfhead -	550.781	15228	8.8125
A butt -	1101.562	30456	17.625

Thefe tables ferve to afcertain the weight of any required quantity of any fubftance whofe fpecific gravity is known. Thus by our tables of fpecific gravities, in the article Gravity, we find the proportion which the weight of any required fubftance bears to that of water. Then to obtain the weight in pounds avoirdupois of any given quantity of fuch fubftance, multiply the number which expreffed the fpecific gravity of the fubftance, by the number of pounds weight in the given quantity of water, as fhewn by the prefent tables, and we have the weight of the fubftance in queftion.

For example, it is required to know the weight of a piece of caft-iron, which contains feven cubic inches: the fpecific gravity of caft-iron, or its weight compared with that of water, is as 7.207 to 1; alfo by the above table we find 7 cubic inches of water weigh .253 pounds avoirdupois: now multiply 7.207 by .253 pounds, and we have 1.823371 pounds weight for 7 cubic inches of caft-iron.

What is the weight of a block of Portland-ftone, which is found by meafurement, to contain 9 cubic feet? The weight of 9 cubic feet of water is by the table 562.5 pounds, multiply this by 2.570, the fpecific gravity of Portland-ftone, and we have 1445.6250 pounds for the weight required.

What is the weight of a wrought iron bar, 1 inch fquare, and 10 feet long? The above table fhews that a prifm of water of that fize weighs 4.340 pounds, multiplied by 7.788, the fpecific gravity of bar iron, gives 33.7999.

In like manner, if it was a round bar of 1 inch diameter, and 3 feet long, the fame table fhews fuch a quantity of water weighs 1.0226 pounds; or, if it was a round plate of metal, 1 foot diameter, and 1 inch thick, the table fhews the weight of its bulk in water is 4.090 pounds.

The fourth, fifth, and fixth table is equally ufeful for commercial purpofes, to determine the weight of different quantities of liquids, as wine, oil, fpirits, &c.

Required the weight of an ale gallon of linfeed oil. The fpecific gravity of linfeed oil is .9403; the weight of an ale gallon of water is 10.1996 pounds, (as appears from the foregoing table,) multiply that number by .9403, and we have 9.5907, which is the weight of an ale gallon of linfeed oil.

What is the weight of a pipe of Bourdeaux wine? The weight of as much water is 1052.73 pounds, multiplied by .994, the fpecific gravity, gives 1046.41362 pounds.

On the conducting of Water from a Diftance for the Supply of Towns.—This is a fubject of the utmoft importance, and involves much curious inveftigation.

It frequently happens that the only fupply of frefh water for a town is from a diftant fpring, or that the quality of water which can be brought from a diftance is fo fuperior to the water on the fpot, as to induce the inhabitants to expend vaft fums in procuring good water. The Romans were famous for their works of this kind, and many ruins ftill remain as monuments of the enterprifing fpirit of that people; the moft celebrated of thefe we have mentioned in our article Aqueduct.

The works of modern times are more numerous, though on a lefs fcale; every great city has its water-works; of all others, London is the moft plentifully fupplied. The New River, which conducts water from Ware, in Hertfordfhire, is a great work, which was executed in the reign of James I.; fince that time a great many water-work companies have been eftablifhed, and moft of them draw their water from the river Thames by hydraulic machines. We believe that there are 16 large fteam-engines, befides the water-wheels at London-bridge, employed in this work, and almoft every ftreet has water-pipes laid in it.

The city of Paris is fupplied by the Canal de L'Ourcq, and by three fteam-engines; but the pipes are only laid to the palaces and public fountains, and in grand houfes.

Edinburgh is fupplied by water conveyed a vaft diftance from

from Comiston and Swanston, in leaden and iron pipes; but the supply is very inadequate to the size of the city.

When water is to be conveyed in an open canal, like the New River, the manner of setting out and executing the work is so nearly the same as for a navigable canal, that it is unnecessary to say more than we have already given in our article CANAL, except the rules for calculating the necessary slope or descent to produce the required velocity of the water; and the best theorem for this purpose we have already given in the preceding part of the present article.

We shall only add a few particulars of some of the largest modern aqueducts for conveying water.

Aqueducts.—Belidor states, in his Architecture Hydraulique, that one of the finest subterraneous aqueducts in France is that of Arcueil, which conducts the water from many collecting channels in a stone channel. It is situated in the countries of Rungis, Paret, and Coutin. This aqueduct is 14,920 yards in length, and is constructed in free-stone; it extends from the valley d'Arcueil to an elevated water-cistern, or chateau d'eau, which is at the Porte St. Jaques. The channel has an inclination of 6 inches in 400 yards, or 1 in 2400.

On each side of the water-course is a raised foot-path 19 inches wide, upon which a person can walk as far as the village d'Arcueil. The height of the passage from the bottom of the water-trough to the under side of the arch is $6\frac{1}{2}$ feet, except in some places where they have been obliged to make them less, in consequence of the high roads beneath which it passes.

Another subterraneous aqueduct of this kind is that of Rocquancourt, which conveys water to Versailles; it is 3623 yards in length, and in all the length has an inclination of only $3\frac{1}{2}$ feet, which was the utmost that could be given it. To construct this aqueduct, they were obliged in many places to dig to a depth of 30 yards, which rendered the execution of it very difficult. One hundred and fifty shafts were made in the length of this aqueduct. They were not made at equal distances, but only in such places as would facilitate the conveyance of materials; eighty of them were lined with stone, and the other seventy, which were not required to last longer than during the construction, were only lined with wood, and stopped up afterwards with a dome of masonry, and filled up with earth to the level of the surface.

This aqueduct cost 325,000 livres. From 1675 to 1678 it never yielded more than 6 pouces of water, and some times gave only 5, 4, 3, or even 2 pouces, according as the dry seasons were of greater or less duration. The pouce de fontainier is a measure of running water used by French engineers, which amounts to about .48 English cubic feet *per* minute; hence the 6 pouces would be 2.88 cubic feet *per* minute.

A pond was made in 1685 at the head of this aqueduct, to drain a country called Trou d'Enfer; and since then it has given 10 and 12 pouces, *i. e.* 4.8 and 5.76 cubic feet *per* minute.

When water is conducted in an open channel, it frequently becomes necessary to cross deep valleys; in this case, the channel must be supported on arches like a bridge. This was the object of those vast Roman aqueducts, of which we find the remains at Nimes, Arles, Frejus, &c. The greatest modern works of this kind are those constructed in the time of Louis XIV. to conduct water to Versailles and Marly. One of these is the aqueduct of Maintenon, for conveying the river Bure to Versailles: it consists of three courses of arches, raised one above the other, to support the water-course, which is a channel of stone, and on each side of it is a narrow path with a parapet, which renders it safe to walk along the side of the aqueduct when it requires cleaning or repairing.

In the Philosophical Transactions, it is stated that this aqueduct is 2560 fathoms in length, and consists of 242 arches; the span of each is $6\frac{1}{2}$ fathoms, and the thickness of each pillar to sustain the arches 4 fathoms. On the side of the valley next to Maintenon, there are thirty-three single arches, afterwards seventy-one double ones, (that is, having one arch upon another,) then forty-six treble ones; at this part the water-course is generally 216 feet 6 inches high from the ground up to the floor of the water channel; afterwards there are seventy-two double arches, then twenty single ones, which last reach to a mound of earth, which is raised 50 feet high above the ground for a great distance.

The general height from the ground up to the second arcade or row of arches is 16 fathoms; from the second row to the third or upper arcade 14 fathoms; in the upper arcade, the arches are double the number of those they stand upon; above this is 6 fathoms 6 inches more to the floor of the channel, which is at least 7 feet high besides the parapet.

The pillars at the ground are 8 fathoms thick, but with the slopes and shortenings, which are made in every story; the top where the channel runs is reduced to 20 feet broad. There is likewise at each pillar a buttress projecting one fathom, and two fathoms wide to strengthen the pillars.

There is another great aqueduct raised on arches in the Plaine de Bue, which conducts water to Versailles from the Plaine de Scale. This is built with two ranks of arches, and the lower ones are so much wider than the upper, as to afford room for a carriage-way across the valley about half as high up as the water-course. Drawings of these great works are given by Belidor.

It is difficult to determine the exact slope which should be given to a water-course, in order to conduct a given quantity of water; it can only be known by calculation according to the rules we have already given, and which are founded upon experience. Vitruvius recommended a slope of 1 foot fall in 200 feet in length; but Belidor says this is much more than is necessary, and that 1 foot fall in 3600 feet of length is quite sufficient, when the channel is straight without elbows, or sudden angles, or if the bends at such angles are by easy curves, so that the water is not retarded in changing its direction. He remarks, that the canal from the pool of Trappes, made by M. Picard to conduct the water to Versailles, had 9 inches slope in 1000 fathoms, or 1 foot fall in 7998 feet long. When the water was run into this, it took four hours to run 8526 yards, though it was urged by a pressure of 38.3 inches. Also that the aqueduct of Rocquancourt before mentioned has only 3 pieds fall in all its length, which is 1700 toises, that is, 1 foot fall in 3400 feet of length. Whence Belidor directs as a general rule to make the fall 1 inch in 100 yards, that is, 1 foot in 3600 feet, provided the bottom of the trough is of smooth stone, and not muddy. This is the least which can be allowed, and more may be given when the relative levels between the two places will admit of a more rapid descent.

On the Conveyance of Water in Pipes.—This is an object of great importance. The ancients conducted water in pipes only down hill; but never carried it up agaio, not knowing that water would rise to its own level; but we can conduct water to very great distances, and bring it from one mountain to another in pipes, which descend into the intermediate valleys and rise again, provided that the spring or place from which

which the water comes is ſomewhat higher than the other end where the water is to be delivered. The water would indeed ſhew itſelf at the ſame level at one end of the pipe as at the other, but it would not run out; and in all caſes with the ſame ſize pipe, the quantity of water given will increaſe in proportion as the receptacle at the diſcharge is below the ſpring at the other end of the pipe. Hence, if there is a great deal of water to be conveyed to a place ſituated but little lower than the level of the original ſpring, a very large pipe muſt be uſed to convey any given quantity. But the ſame quantity may be conveyed in a ſmaller pipe, and conſequently at leſs expence, if the reſervoir is much below the original level.

If the diſtance is great, the length of the pipes will conſiderably diminiſh the quantity of water brought through them, in conſequence of the friction of the water againſt the ſides of the pipes; this cannot be prevented, and we muſt make the bore of the pipe larger, in proportion to the length, if the water be in ſuch quantity and ſo much wanted as to make it worth the expence. The rules for calculating the proper ſize of pipes we have already given.

Deſaguliers mentions an experiment which he made upon a leaden pipe, whoſe inward diameter was $1\frac{1}{8}$ inch, and found that at 1400 yards diſtance from the ſpring of water that ſupplied it, it did not give a tenth part of the water that it would have given at thirty yards from the ſpring, though both places were at the ſame depth below the ſurface.

All care ſhould be taken in the conſtruction of a conduit-pipe, to avoid obſtructions occaſioned by lumps of ſolder hanging in the inſide of the pipes, or by roughneſs at the joints, if the pipes are put together by ſcrew-joints. All the cocks and plugs in the pipe ſhould have water-ways fully equal to the ſection of the pipe.

Thoſe who execute water-works are moſt tempted to fail in this point by making the cocks too ſmall, becauſe large cocks are very expenſive.

The engineer ſhould be ſcrupulouſly attentive to this, for a ſingle contraction of this kind may occaſion the extra expence of many hundred pounds in making a large pipe to be thrown away, becauſe if the pipe will yield no more water than can paſs through the ſmall cock, it would have been as well to have laid a ſmall pipe all the length.

It is of the moſt material conſequence that there be no contraction in any part of a conduit, and it is alſo prudent to avoid all unneceſſary enlargements; for when a pipe is full of water moving along it, the velocity in every ſection muſt be inverſely proportional to the area of the ſection: hence the velocity is diminiſhed wherever the pipe is enlarged; and it muſt again be increaſed where the pipe contracts.

This cannot be done without expending force in the acceleration; and conſuming part of the impelling power, whether it be that of a column of water, or the force of a machine.

No advantage can be gained by the ſlow motion which takes place at every enlargement in a pipe; but every contraction, by requiring a reſtoration of the former velocity, employs a part of the impelling force; this force muſt be equal to the weight of a column of water whoſe baſe is the contracted paſſage, and whoſe height is ſufficient to produce that velocity with which the water muſt paſs through the contraction.

This point has often been overlooked by engineers of the firſt eminence; and has, in many inſtances, impaired the performance of their beſt works.

Another point, which muſt be attended to in the conducting of water through pipes is, that the motion of the water ſhould not be by pulſations, but continuous. When the water is to be driven along a pipe by the ſtrokes of a reciprocating engine, it ſhould firſt be forced into an air-veſſel, that the elaſticity of the confined air may preſerve an uniform motion along the whole length of pipe. If the water is ſuffered to reſt at every ſucceſſive ſtroke of the piſton, the whole maſs muſt again be put in motion through all the length of the pipe. This requires a uſeleſs expenditure of power, over and above the force which may be neceſſary for raiſing or conveying the water to its deſtination. By employing an air-veſſel and double or treble acting pumps we remove this imperfection, becauſe it keeps up the motion in the intervals between the ſtrokes of the piſton. The compreſſion of the air by the active ſtroke of the piſton muſt be ſuch as to continue the impulſe during the momentary inactivity of the pump.

Pipes are ſubject to obſtructions from the depoſition of ſand or mud in the lower parts of the pipes, and from the collection of air in the upper parts of their bendings. The velocity of the water ſhould always be very moderate, and then ſuch depoſitions of heavy matters are unavoidable; care ſhould therefore be taken to have the water freed from all impurities, before it enters the pipe by proper filtration; and to diſcharge the ſediment which is unavoidable, there ought to be cleanſing plugs at the lower parts of the bendings, or rather a very little way beyond them. When theſe are opened, the water will iſſue with greater velocity, and carry the depoſitions with it.

It is much more difficult to get rid of the air which chokes the pipes, by lodging in their upper parts. This air is ſometimes taken in along with the water at the reſervoir, when the entry of the pipe is too near the ſurface; but it is eaſy to avoid this ſource of the air, by making the water enter the pipe beneath the ſurface. For if the entry of the pipe is two feet under the ſurface of the water at the ſpring, no air can ever get in, and a float may be placed over the entry, with a lid hanging from it to ſhut the pipe before the water runs too low.

Air is diſengaged from ſpring-water by the motion of the water in paſſing along the pipe. When pipes are ſupplied by an engine, air is very often drawn in by the pumps. It is alſo diſengaged from its ſtate of chemical union, when the pumps have a ſuction-pipe of ten or twelve feet, which is very common. In whatever way it is introduced, it collects in all the upper part of bendings, and accumulates till it will choke the paſſage, ſo that ſcarcely any water will be delivered.

To illuſtrate this, ſuppoſe that the water of a ſpring, or collection of ſprings, is to be conveyed through a pipe to the place of delivery, at a mile or half a mile diſtant from the ſpring; and that the ground, over which the pipe is carried, has many undulations, and aſcents and deſcents, where it paſſes over ſmall intermediate hills and valleys. We will ſuppoſe the place of declivity to be but a little lower than the water at the ſpring, for example 9 or 10 feet. If the ſurface of the water in the ſpring comes down to the entrance-mouth of the pipe, or only near it, much air will run down with the water into the pipe; and wherever the ground riſes in the courſe of the pipe, this air will lodge itſelf in the upper parts of the bends of the pipe, and thereby diminiſh the water-way ſo as to force the water to paſs through a paſſage of one-fifth or one-ſixth, ſometimes one-tenth of the proper bore of the pipe when full.

Sometimes, though no air ſhould get into the mouth at the ſpring, there will be theſe lodgments of air from the firſt running of the water; for when the water firſt enters into the pipe, if after coming down from the ſpring it has

 to

to riſe again, to paſs the ſummit of a ſmall hill, it will run over the eminence without carrying all the air before it, as it had done in other parts of the pipe, before it arrived at ſuch eminence. Hence ſome air is left in the higheſt part of the bend, but the water which paſſes by the air runs forward and fills the pipe again in the deſcending part, and ſo goes on in a full bore, till it comes to the next eminence, where it again runs over the higheſt part of the riſing pipe, leaving a ſpace of air at top, which diminiſhes the water-way. Then filling the pipe full again, it proceeds till its next riſing, and there the water-way is again contracted by the air.

To clear the pipe of this air, if the pipe is of lead, the common way, as practiſed by plumbers, is thus: at every riſing ground the pipe is laid bare at the higheſt place, and a nail is driven into the upper ſide of the pipe, ſo as to make a hole through the metal. Whilſt the nail is ſticking in, the lead is hammered all round the nail, with the pen of the hammer, ſo as to make a little button or ſpout. When the nail is withdrawn, the air will blow out violently, till at laſt the water will ſucceed the air; and with a ſtroke or two with the face of the hammer the hole can be quite ſtopped up.

This is done at every eminence of the pipe, until all the air is diſcharged, and the full quantity of water will be delivered at the oppoſite end of the pipe. If the mouth of the pipe at the ſpring never receives any air, by the deſcent of the ſurface of the water, the pipe may give its full quantity for years.

The way to know when the whole water is delivered is to meaſure it, when the pipe has been fully cleared of air, as above-mentioned; and when by meaſure, the quantity of water appears to be deficient, the pipe muſt again be cleared of air or other obſtructions.

If the ſpring is much higher than the place of delivery, the places where the air will accumulate in the pipe will not be juſt at the higheſt part of the pipe, but a little beyond it; becauſe the water running with more velocity and force, drives the lodged air ſtill forward down the pipe, and it muſt lodge in the part where the pipe begins to deſcend again, its own tendency to aſcend to the top being counteracted by the motion of the water. In this caſe, the nail-hole muſt be made beyond the greateſt elevation, or elſe the run of the pipe muſt be ſtopped for ſome time, ſo that the water may ceaſe to be in motion, the air will then go back gradually to the higheſt part of the pipe, where it may be let out.

Suppoſe that the water, inſtead of coming from an elevated ſpring, be forced up its whole way from a place much lower by an engine, and up the conduit, then the places where the air will lodge will be beyond the eminences of the pipes, but nearer to the upper end. In theſe caſes, it will not be ſufficient to prick the pipe with a nail, becauſe air will be continually forced in with the water, and will refill thoſe places in the pipe from which the air had been emptied. The obſtructions thus happening often occaſion the burſting of the pipe, or it gives too ſmall a quantity of water, and does damage to the engine.

In ſuch a caſe, the following contrivance muſt be uſed: a ſmall leaden pipe, about thirty feet in length, which is called a rider or air-pipe, is laid at the higheſt part of the main-pipe, and extends along the top thereof. It communicates with the main at the top of the eminence, and alſo at two other places, at fifteen feet on each ſide of the eminence. This air-pipe has a little branch and cock. Now if the cock is opened when the engine is working, the air will be puſhed forward till it is diſcharged by the air-pipe and cock. If the air goes beyond the eminence, the pipe of communication will certainly diſcharge it. When water comes out at the cock it muſt be ſhut, and the main-pipe will then be full of water, but after ſome time, the cock being left ſhut, air will gather again in the eminence of the main-pipe and lodge; but, if the air-cock is again opened, the air will be diſcharged.

When water is forced up by an engine into an elevated ciſtern, from which it is to run down a main-pipe to the reſervoir where it is wanted, this air-cock will alſo be very neceſſary, becauſe the water in the ciſtern ſometimes covers the entrance-mouth of the deſcending pipe, and ſometimes not. In that caſe, air goes down with the water.

In leaden or iron pipes of conduit, the diſcharge of air is abſolutely neceſſary if there are any riſes in the pipe. In wooden pipes the air often paſſes through the wood and eſcapes; but if the pipes are tight and thoroughly ſoaked, the air-pipes and cocks are very uſeful. When water runs from a raiſed ciſtern through a diſtance of a mile or two, ſome perſon ſhould turn the air-cocks two or three times a day.

This trouble may in ſome caſes be avoided, by carrying the air-pipe perpendicularly upwards, to an equal or greater height than the entrance mouth of the main-pipe. In this caſe, the water will riſe up in the air-pipe to near the ſame level as the water at the entrance, but cannot run over. Neverthelefs, if any air paſſes along the main-pipe, when it arrives at the air-pipe, it will riſe up therein in bubbles through the water contained in the perpendicular air-pipe and eſcape. By taking advantage of ſome tall building, or large tree to ſupport the perpendicular air-pipe, this expedient may in general be applied.

Deſaguliers contrived a valve which ſhould open to let out the air, and ſhut again when the water came. It was an inverted braſs valve ſhutting upwards, and falling down by its own weight, with cork fixed to the under ſide of it, to make it riſe and ſhut when the water came. This ſucceeded in firſt clearing the pipe of air, but it did not anſwer to keep it clear; becauſe, when the valve had been ſhut ſome time, if air ſhould extricate itſelf from the water, it would be denſe air, whoſe force would be equal to that of the water, and would keep the valve ſhut as well as the water did before, although the air at firſt could not ſhut the valve. The only remedy for this difficulty is to make the valve very ſmall, and make a hollow copper veſſel for a float. This will riſe with conſiderable force to ſhut the valve, when the water acts upon it; and it will be ſufficiently heavy, when the water forſakes it, to pull open the valve.

The ſame author afterwards made a better contrivance. It is a ſmall ſquare box of caſt-iron, made tight on all ſides, except where the air-pipe communicates with the bottom of it, and alſo where a ſpout is fixed on the top to let out the air. This ſpout is provided with a cock, ſituated withinſide of the box, and to the plug of the cock a ſmall arm or lever is fixed, having a hollow ball of copper at the extremity of the arm or lever. This ball floats on the ſurface of the water in the box, and when it riſes opens the cock, or ſhuts it when it falls. When the air in the pipe accumulates, it paſſes along the air-pipe and enters into this box, and as the quantity increaſes, the ſurface of the water in the box ſubſides, until the float at the end of the lever, opens the cock and allows the air to eſcape, and this it will always do before any air can accumulate in the pipe.

It is beſt to place the air-box near to the main-pipe, but it muſt have communication by an air-pipe with the main-pipe, at two or three different places, in order that it may certainly receive all the air which gathers in the great pipe.

On the Diſcharge of Water by lateral Branch-Pipes from a Main-

Main-Pipe.—It is a common cafe in water-works, that water is required to be drawn off through a fmall pipe, from the fide of a main-pipe, in which the water is not at reft, but in motion, with a much greater velocity than the flow occafioned by the water which is drawn off through the fmall pipe. It is often required to know what quantity fuch fmall pipe will yield. When water is paffing along a pipe, its preffure on the fides of the pipe is diminifhed in confequence of its velocity; and if a pipe is derived from it, the quantity drawn off muft alfo be lefs than if the water in the great pipe was motionlefs. It is therefore of great importance to determine what is the diminution of preffure which arifes from the motion along the main-pipe.

It is plain, that if the water fuffered no refiftance in the main-pipe, its velocity would be that which is due to the height through which it had defcended, and it would pafs along without exerting any preffure. Alfo, if the pipe were fhut at the end, the preffure within the pipe would be equal to the whole depth of water. Between thefe limits we fhall find what we feek. If the head of water remains the fame as when the pipe was ftopped, and the end of the tube be contracted, but not ftopped entirely, the velocity in the pipe will be fmall; and the natural velocity due to the defcent being checked, the particles will re-act on what obftructs their motion. This action will be uniformly propagated through the fluid in every direction, and will exert preffure on the fides of the pipe. Now obftructions of any kind, arifing from friction or any other caufe, will produce a diminution of velocity in the pipe. The refiftance, therefore, which we afcribe to friction, produces the fame lateral preffure which a contraction of the orifice would do, provided that it would diminifh the velocity in the pipe, in an equal degree.

We will firft confider the cafe of an horizontal pipe, in which the whole impelling force is applied at one end of the pipe, either by a pump or by a column in a perpendicular pipe at that end. This force muft be tranfmitted or carried by the water through the whole length of the pipe, wherein part of it will be abforbed in overcoming the obftruction and friction, and the remaining force will produce the velocity with which the water iffues at the open end of the pipe. It is evident that every part of the horizontal length of fuch a pipe muft bear a different degree of preffure, when the water is in motion; thus, at the end where it is difcharged, there is no preffure exerted on the pipe to burft it open, becaufe the water can efcape freely; but at every other part a force muft be exerted, which is fufficient to overcome all the refiftance which the water will meet with, in running from fuch part to the open end, where it is difcharged.

In fhort, whatever part of the column of water in the refervoir, or of the preffure which impels it along the pipe, is not employed in producing velocity, muft be employed in acting againft fome obftruction; and by the re-action of this obftruction, an equal preffure is tranfmitted to all parts of the pipe. The chief queftions will be, in what part of the pipe are thefe obftructions fituated, and at what part is the force applied which is to overcome them; becaufe that part of the pipe which is between the two, muft bear the ftrain of tranfmitting the force from the place where it is applied, to the place where it is to operate.

In the cafe where the impelling force is all applied at one end of the pipe, and the only refiftance is the friction of the water in running through the horizontal pipe, the preffure to burft the pipe, will begin at nothing at the open end of the pipe, and regularly increafe from that to the other end. Its quantity for 100 feet in length may be afcertained for any given bore of the pipe, and velocity of the water, from Mr. Smeaton's table of friction already given, and may be adapted to all other lengths by a fimple rule of proportion.

If in addition to the refiftance by friction, which takes place equally in all parts of the length of the pipe, there are any particular caufes of obftruction at the extreme end or at any other part, the force neceffary to overcome fuch refiftance muft be added to that required to overcome the friction, as found by the table; and all this tends to burft open the pipe, or that part which is between the impelling force and the obftruction, which may arife either from a perpendicular column or lift, up which the water is to be forced, or from a contraction.

Example 1.—A fteam-engine with a forcing-pump is employed to force water through a pipe, which proceeds horizontally for 1800 feet, and then rifes up 60 feet perpendicular, to a ciftern at the top of a tower; the diameter of the pipe is five inches, and the motion of the engine is fuch, that the water moves with a velocity of 140 feet *per* minute through the pipe. It is neceffary to fupply a ciftern in a houfe from the middle of the main-pipe, by a fmall branch-pipe of one inch bore and 100 feet long; this ciftern is 55 feet above the great horizontal-pipe, or five feet beneath the elevated ciftern; required the velocity with which the water will flow through the fmall branch-pipe, when the engine is not at work, and when it is at work.

When the water in the great pipe is motionlefs, there is the preffure of a column of five feet to force the water through the branch-pipe. Mr. Smeaton's table fhews, that for one inch bore and 100 feet long, a preffure of five feet, or fixty inches, will produce a velocity of 180 feet *per* minute; but when this pipe is running, the water in the great pipe muft move alfo. The area of the pipe of five inches, is twenty-five times as great as the pipe of one inch; therefore, the motion of the water in the great pipe, will be only one twenty-fifth of 180 feet, or 7.2 feet *per* minute. Find the neareft velocity to this in the table, or ten feet *per* minute, and under five inches bore, we find .07 inches the height neceffary to produce that motion, if the pipe was 100 feet long; but as it is 960 feet, the height required will be $.07 \times 9.6 = .672$ of an inch. This fhould be deducted from the five feet preffure which urges the water through the fmall pipe; but fo fmall a quantity is not worth notice: hence we may ftate the velocity when the engine is not at work at 180 feet *per* minute, and the difcharge from a bore of one inch, will be .98 of a cubic foot *per* minute.

When the engine is at work, the fame preffure will be exerted with the addition of all the preffure neceffary to overcome the friction of the water, in running along the great pipe with a velocity of 140 feet *per* minute. Look for this velocity in the table, and for five inches bore it fhews, that a column of 7.6 inches muft be allowed for every 100 feet of the pipe. The length of the pipe meafured from the place where the branch-pipe proceeds to the ciftern at the top of the tower, is 900 feet horizontal, and 60 perpendicular, *viz.* 960; therefore, multiply 7.6 by 9.6, and we have 73 inches for the height, which muft be added to the five feet, and makes 133 inches for the whole column or force, which urges the water to flow through the branch-pipe, when the engine is at work: laftly, by referring to the table in the column of one inch bore, we find that 135 inches will produce a velocity of 270 feet *per* minute, and the difcharge will be 1.47 cubic feet *per* minute.

The fame inveftigation fhews us, that the main-pipe at the place where the branch-pipe proceeds from it, muft bear the preffure of a column equal to 66 feet one inch when the engine

engine is at work, although it bears only 60 feet when it is at reft. But if we confider the whole length of 1860 feet, the friction will be equal to a column of eleven feet ten inches, fo that the preffure, when the engine is at work, will be near 72 feet, at that end of the pipe which joins to the pump.

Example 2.—We will now confider the reverfe of this cafe, that is, take away the pump and fteam-engine, and let the water be propelled through the great pipe, by the water defcending from the ciftern, with a fall of 60 feet. What will be the preffure which caufes the water to flow through the fmall branch-pipe?

To find this, we muft calculate with what velocity the water will flow through the whole length of the great pipe, by the theorem and example we have already given for water in pipes. Having found this, calculating on the whole length of the pipe, we muft make another calculation, reckoning only as much length of the pipe as is contained between the ciftern of fupply, and the place where the branch-pipe joins the main-pipe.

Then take the difference between thefe two velocities, and it fhews what refiftance or friction the water muft overcome in running along the remainder of the pipe, *viz.* from the place where the branch-pipe joins to the open end of the pipe, where the water is difcharged. Now if a fimple orifice was to be made at that part of the great pipe where the branch-pipe joins, the water would flow out with a velocity equal to the difference of the two velocities, making the proper deduction for the friction of the water in paffing through the orifice.

But if we wifh to know the velocity with which the water will flow through the branch-pipe, we muft find the depth of column neceffary to produce the velocity equal to the difference of the velocities of which we have before fpoken, calculating according to theory, without regard to friction; and then with the depth fo found, we can feek in the table of friction in pipes, for the refult or flow of water through the fmall branch-pipe.

The cafe of a regularly inclined pipe is confiderably different, becaufe the impelling force is not all applied at one end of the pipe; but every portion of the pipe having a defcent, has alfo a portion of the impelling power applied to it. When this pipe is of a certain length, the water arrives as its maximum velocity without accelerating as it proceeds further down the flope; becaufe the accelerating power of the water is in equilibrio with the obftruction, that is, the power of defcent acquired in a foot or an inch of the flope, is juft equal to the refiftance in the fame diftance; confequently, the water exerts no preffure on the pipe to burft it open, any part of the water would continue to flide down the flope with its uniform velocity, even if it was detached from that water which followed or which preceded, and it derives no impelling power from any column of water. The effect would be juft the fame, if the pipe was fplit down the middle and converted into two open troughs.

It is clear, that in this cafe, no water can be obtained from any lateral branch-pipes, unlefs they defcend from the pipe.

Let us confider the fame pipe when the inclination is not a regular flope, but when fome parts flope more rapidly than others. In this cafe, the impelling force is not applied regularly upon every part of the length of the pipe, as in the former inftance; the confequence is, that in thofe parts which have a more rapid flope than the inclination of a line drawn from one end of the pipe to the other, the water will have a tendency to accelerate beyond the regular velocity which is due to the regular flope, and with which it muft ultimately flow out of the pipe; and on the other hand, in places where the flope is lefs rapid than this line, the tendency of the water will be to flow more flowly than the regular velocity. Now the pipe being clofe and of an equal bore, the water muft flow with the fame velocity in every part of the length; and although fome portions of the contained water tend to run forwards fafter than the regular velocity, yet other portions tend to hang back; by means of the pipe, the force is tranfmitted from one place to another, and thefe forces become all combined together to produce an uniform velocity.

We fhall find, on farther confideration of thefe actions, that fome parts may be fubjected to a preffure or ftrain to force or burft it open, and other parts may at the fame time be ftrained in an oppofite direction, *viz.* to crufh the metal of the pipe inwards.

Thus at every point where the pipe fuddenly changes its flope or rate of inclination, from an eafy flope to a very rapid defcent, then the water will have a tendency to run down fuch floping part of the pipe, and pafs away fafter than other water can come down the eafy flope; the confequence is, that a fuction or afpiration takes place within the pipe, and if a fmall branch-pipe were applied in fuch a fituation, water may actually be drawn up from a confiderable depth. This has been fhewn by M. Venturi, who calls it the lateral communication of motion between fluids.

This is a certain proof that the bore of the pipe is too fmall at fuch places. An attentive confideration of thefe circumftances, will fhew the propriety of making a long pipe with different bores at different places, where the flope is different; for, by judicioufly increafing the bore of the pipe where the flope is lefs, the action may be made uniform throughout. But this cannot be done in cafes where the changes of flope are exceffive; for inftance, when the pipe defcends rapidly into a deep valley, and muft rife again with a rapid flope in an oppofite direction. This is the cafe with the pipes which fupply Edinburgh, and in many fituations is unavoidable.

The refiftance arifing from friction is greater or lefs according to the velocity of the motion; but whatever is the inclination of a pipe, provided it is long enough, the velocity with which the water runs through it will fo adjuft itfelf, that the fum of all the refiftance in the whole length of the pipe, will exactly balance the fum of all the forces, which the water exerts by its defcent. But if the pipe is too fhort, the forces of defcent down the pipe may overbalance all the refiftances. In this cafe, the water will tend to accelerate, and the water which has defcended near to the bottom of the pipe, will draw after it that water which has juft entered the upper part of the flope, inftead of the water in the upper part, forcing forwards that water which is beneath it.

Dr. Robifon obferves that there are fome curious circumftances in the mechanifm of thefe motions, which makes a certain length of pipe neceffary, for bringing it into the equilibrium of motive force, and refiftance, which he calls *train.* A certain portion of the interior furface of the pipe muft act in concert in obftructing the motion. We do not completely underftand this circumftance, but we can form a pretty diftinct notion of its mode of acting. The film of water contiguous to the pipe is withheld by the obftruction of friction, but glides along; the film immediately within this is withheld by the outer film, but glides through it, and thus all the concentric films glide within thofe around them, fimilar to the tubes of a telefcope, when we draw it out by taking hold of the end of the innermoft. Thus the ſecond film paſſes beyond the firſt or innermoſt, and becomes the outermoſt, and rubs along the tube. The third does the ſame in its turn, and thus the central filaments will at laſt come to the outſide, and ſuſtain their greateſt poſſible obſtruction. When this is accompliſhed, the pipe is in train.

This requires a certain length of pipe which we cannot determine by theory; but it is evident that pipes of greater diameter muſt require a greater length, and this is probably in proportion to the number of filaments, or as the ſquare of their diameter.

Du Buat found this ſuppoſition agree with his experiments. A pipe of one inch in diameter ſuſtained no change of velocity by gradually ſhortening it, until it was reduced to ſix feet, and then it diſcharged a little more water. But a pipe of two inches in diameter gave a ſenſible augmentation of velocity, when ſhortened to twenty-five feet; he therefore ſays, that the ſquares of the diameter in inches, multiplied by 72, will expreſs the length in inches neceſſary for putting the water in any pipe in *train*.

When pipes are of any conſiderable length, the waters of a larger pipe will run with a greater velocity than thoſe of a ſmaller pipe having the ſame ſlope. A pipe of two inches diameter will give much more water than four pipes of one inch diameter; it will give as much as five and a half of ſuch pipes, or more, becauſe the ſquares of the diſcharges are very nearly as the fifth powers of the diameters.

On the requiſite Strength for Water-Pipes.—We have ſhewn that, in certain caſes, the water running through a pipe will exert little or no ſtrain to burſt the pipes. This may be the caſe in great portions of the length, or even in the whole length; nevertheleſs we may obſerve, that at all parts ſo ſituated, an open canal would anſwer all purpoſes as well as a cloſe pipe. It is not neceſſary to employ a cloſe pipe in any caſe, except where it is ſubjected to a ſtrain. We may alſo obſerve, that it is prudent in all caſes to make the pipe ſufficiently ſtrong to reſiſt the full preſſure of the impelling column, when the motion of the water is ſtopped; becauſe this may happen accidentally, and then the pipe will burſt.

In order to adjuſt the ſtrength of a pipe to the ſtrain, we may conceive it as conſiſting of two half cylinders joined by ſeams, parallel to the axis or length of the pipe; the ſtrength of ſuch ſeams to reſiſt the ſeparation of the two half cylinders will be equal to the ordinary ſtrength of the materials of which the pipe is made. The inſide preſſure tends to burſt the pipe by tearing open theſe ſeams, and the force which acts upon any given length of the pipe (as an inch or a foot), is the weight of a column of water whoſe baſe is the diameter of the pipe, by the given length (as an inch or a foot), and whoſe height reaches up to the ſurface of the water in the reſervoir. This follows from the common principles of hydroſtatics, and may be calculated by the rules for columns of water already given.

Suppoſe the pipe to be of lead, one foot in diameter, what will be the force to burſt open one inch in length, at the depth of 100 feet under the ſurface of the reſervoir? Water weighs $62\frac{1}{2}$ pounds *per* cubic foot, the baſe of the column is 1 foot by 1 inch, or $\frac{1}{12}$th of a ſquare foot, and the tendency to burſt open an inch long of the pipe is $100 \times$

$$62\tfrac{1}{2} \times \tfrac{1}{12} = \frac{6250}{12} = 521 \text{ pounds nearly.}$$

Therefore, an inch long of each ſeam is ſtrained by $260\frac{1}{2}$ pounds. A rod of caſt lead, one inch ſquare, is pulled aſunder by 860 pounds. (See STRENGTH *of Materials.*) Therefore, if the thickneſs of the ſeam is $= \frac{260}{860}$ inches, or one-third of an inch, it will juſt withſtand this ſtrain. But we make it much thicker than this, eſpecially if the pipe leads from an engine which ſends the water along it by ſtarts.

M. Montgolfier ſtates, that a pipe one inch in diameter, and one line in thickneſs, will bear a column of 50 feet, French meaſure, from which if we deſire to know the proper thickneſs for any other diameter, with the ſame preſſure, we ſhall find it by ſimple proportion. Thus, if the diameter be 4 inches, the thickneſs muſt be four lines; or if the preſſure is augmented we proceed in the ſame manner, by direct proportion, ſo that for 100 feet it muſt be two lines thick for one inch diameter, and 8 lines thick for 4 inches diameter.

To make full uſe of this mode of reckoning, he gives the following table of the preſſure which pipes of different ſubſtances will ſuſtain.

	Feet high.
Copper pipe, 1 inch bore, and 1 line thick, will ſupport a column of water - - -	400
Braſs pipe of good quality, and the former dimenſions	300
Lead pipe, made of ſheet lead - - -	50
Caſt-iron pipe, 2 inches bore, and 4 lines thick, will ſuſtain at leaſt - - - - -	500
Elm wood $1\frac{1}{2}$ inch diameter, and 2 inches thick,	30 or 40

That is, they may ſafely be made of that ſize, but will bear ſometimes 110 feet preſſure.

Lead Pipes.—The plumbers uſe caſt pipes of lead, and alſo make pipes of tough ſheet lead turned up, and burned or melted together in the longitudinal joints; the different lengths of lead pipe are ſometimes burned together with lead at the joints, when they are laid in the field, inſtead of ſoldering, becauſe this is much cheaper. Leaden pipes may be turned up of any ſize, but are not uſually caſt of more than four inches bore. Unleſs the caſt pipes are very ſound, they are not ſo good as turned-up pipes; hence it is not adviſable to uſe caſt pipes of more than $2\frac{1}{2}$ inches bore. There muſt be great care taken in making the turned-up pipes, that they may be perfectly cylindrical.

Small lead pipes are made by caſting and drawing them through a plate, like wire. See our article PIPES.

The proper thickneſs for lead pipes, according to Deſaguliers, is as follows: a pipe, 7 inches diameter, ſituated from 140 to 80 feet below the reſervoir, muſt be $\frac{3}{4}$ of an inch thick; that part which is from 80 to 60 feet beneath the reſervoir, muſt be half an inch and an eighth thick; from 60 to 30 feet $\frac{1}{2}$ an inch; and the remainder from 30 feet up to the reſervoir $\frac{3}{8}$ of an inch.

For pipes of four inches diameter, half an inch will do from a depth of 200 feet to 100 feet; from 100 to 40 feet depth $\frac{3}{8}$ of an inch thick; and from 40 feet deep up to the reſervoir $\frac{1}{4}$ of an inch in thickneſs.

Deſaguliers deſcribes a method of proving the ſtrength of pipes experimentally, by a ſmall forcing-pump, to inject water into a piece of the pipe at one end, whilſt a valve is applied to the other, which valve is loaded with ſuch a weight as will equal the weight of the intended column of water; therefore, if the pipe bears this preſſure, it will bear the column of water.

Lead pipes are very improper for water-works, where the water is forced by an engine; for at every ſtroke or puſh from the engine, the water raiſes the ſtop-valve of the pump, and

and when the valve ſhuts again, the water falls with it, and gives a ſudden blow againſt all the ſides of the pipe. By the lateral preſſure, this force acts in a direction perpendicular to the ſides of the pipe, with the weight of a pillar of water whoſe baſe is the ſection of the pipe, at the place of the ſtroke, and the height is equal to the whole height of the water above that place; and it ſtrikes with the ſame velocity that the valve falls. Now if the firſt ſtroke of this water makes the lead ſwell outwards but the 100th part of an inch, the lead having no elaſticity, will remain in that poſition, and not ſhrink back; then ſuppoſe the next ſtroke ſwells the lead outwards the 100th part of an inch more, the diameter of the pipe will become ſo much larger and remain ſo. The next ſtroke will ſtill make it wider, and ſo on for many ſtrokes, till at laſt the lead becomes ſo thin that it muſt break. This is inevitable if the force is great enough to begin the enlargement, for after every ſtroke the force of the water ſtriking will be greater than the preceding, in conſequence of the enlargement, and will ſoon burſt the pipe. An iron pipe is beſt to be uſed, for even if it were in itſelf as weak as the lead, it would not be liable to be enlarged, although each ſtroke ſhould make it yield, but by the elaſticity of the metal it would return again to its own dimenſion after every ſtroke. The ſame will happen in pipes of copper or wood, becauſe thoſe ſubſtances are elaſtic.

Wood pipes are made of elm or oak, bored through the middle with a ſucceſſion of augres, increaſing in ſize until the deſired bore is attained. Belidor ſays a man can bore 39 feet of elm pipe, two inches diameter, in a day, but only $6\frac{1}{2}$ feet of oak pipe. The manner of laying and joining pipes is fully explained in our article PIPE.

Care muſt always be taken that wood pipes are bored in the heart of the wood, and that the heart is of ſufficient thickneſs about the bore of the pipe. Elm pipes of nine inches bore, that are from 80 to 140 feet beneath the furface of the water in the reſervoir, muſt have the heart of elm three inches thick after it is bored: therefore, a tree muſt be choſen of no leſs than 18 inches diameter in the ſmalleſt part. For a depth from 60 to 80 feet, the heart muſt be $2\frac{1}{2}$ inches thick, which a tree of 17 inches in diameter will afford; for a depth of from 30 to 60 feet, the heart muſt be two inches thick, and the tree 16 inches in diameter; and for any height under 30 feet, the heart need be but $1\frac{1}{2}$ inch thick, for which a tree of 14 inches will ſuffice.

From theſe proportions it may be determined what thickneſs the heart of elm ſhould be for pipes of leſs bore at the ſame depths, taking it thinner in proportion to the diameter.

Belidor recommends, in laying wooden pipes, to uſe a compoſition of mutton fat beaten in a mortar with powder of brick-duſt, ſo as to make a ſort of wax. When there are cracks in the wood, ſmall wedges wrapped with tow, and covered with this compoſition, are to be driven in to ſtop them.

Earthen Pipes.—M. Belidor ſtates, that the beſt kinds in France are made at Savigny, near Beanvais; they are in lengths of two feet, which enter three inches into one another, and are made of all diameters, from two to ſix inches; when the pottery is ſeven lines thick, they will bear a column of twenty-five feet of water. The joints are made of a compoſition of pitch, aſhes, and brick-duſt with mutton fat: this is applied hot; but for larger pipes, a cement of lime is uſed.

One of the lengths of the pipes for the ſupply of Edinburgh is made of pottery.

Iron Pipes.—The methods of joining and laying iron pipes will be found in our article PIPE; but we ſhall give a

TABLE of the Weight of Iron Pipes caſt at Carron Iron-Works in 1769, being their Standard for dried Sand Caſtings, allowing every 36 Cubic Inches of Caſt Iron to be equal to 10 lbs.

Diameter of the Inſide, or Bore.	Full Diameter of the Flanch.		Length of the Pipe.	Thickneſs of the Pipe.	Weight of the Pipe.		
Inches.	Ft.	In.	Feet.		Cwts.	qrs.	lbs.
2	0	8	6	$\frac{3}{8}$	0	2	10
$2\frac{1}{2}$	0	$8\frac{1}{2}$	6	[illegible]	0	3	4
3	0	9	6	$\frac{1}{2}$	1	0	10
$3\frac{1}{2}$	0	$9\frac{1}{2}$	6	$\frac{1}{2}$	1	0	27
4	0	11	6	$\frac{1}{2}$	1	1	18
5	0	12	6	$\frac{1}{2}$	1	2	18
6	1	2	8	$\frac{5}{8}$	3	1	21
7	1	3	8	$\frac{5}{8}$	3	3	20
8	1	5	9	$\frac{3}{4}$	6	0	10
9	1	6	9	$\frac{3}{4}$	6	3	4
10	1	7	9	$\frac{3}{4}$	7	1	22
11	1	9	9	$\frac{7}{8}$	9	2	17
12	1	10	9	$\frac{7}{8}$	10	1	12
13	1	11	9	$\frac{7}{8}$	11	0	26
14	2	0	9	$\frac{7}{8}$	11	2	7

It was afterwards found that, in a long courſe of practice, it was better to make iron pipes rather thicker; becauſe in moulding there is ſome uncertainty if the metal is equally thick all round.

WATER, *Jets of*, fountains were formerly the ornaments of all garden and pleaſure-grounds; but are now ſo far out of faſhion, that we only find them in the gardens of the greateſt palaces.

The moſt celebrated are thoſe of Verſailles and St. Cloud in France, Fraſcati, near Rome, and Peterhoff in Ruſſia. The ſubject of the latter is the conteſt of Jupiter with the Titans; it contains a column of nine inches diameter, which ſpouts ſixty feet high.

The fountains of Verſailles, which are very numerous and magnificent, are fully deſcribed by Belidor.

They conſiſt of four grand pieces, which contain excellent bronze ſtatues, repreſenting ſome ſubject of the mythology, beſides a great number of jets for the ornament of ſmaller pieces of ſculpture. The baſon of Latona conſiſts of many jets, which throw up water obliquely 30 feet high, into three large baſons, from which it pours down in caſcades. The water-piece of Neptune and Amphitrite conſiſts principally of perpendicular jets, which are very numerous. The baſon of Apollo contains the god in his chariot, drawn by four horſes; the great jets of this piece riſe 57 feet, and the ſmaller jets 47 feet. The baths of Apollo contain moſt excellent ſculpture, and large ſheets of water in caſcade. There are alſo the pyramids of water, mountains of water, alleys of water, theatre of water, &c.

We have no room left for treating this ſubject, which is of ſome intricacy, and ſhall conclude with Mr Mariot's table, which ſhews the altitude of a reſervoir neceſſary to produce a jet of a certain height; and alſo the quantity neceſſary to ſupply jets of a certain bore, meaſured in Paris feet and Paris pints, 42.36 of which are equal to a cubic foot Engliſh.

Altitude of the Jet.	Altitude of the Reſervoir.	Quantity of Water diſcharged in a Minute from an Adjutage ſix Lines in Diameter.	Diameter of the Conduit-Pipe, ſuited to the two preceding Columns.
Paris Feet.	Ft. In.	Paris Pints.	Lines.
5	5 1	32	21
10	10 4	45	26
15	15 9	56	28
20	21 4	65	31
25	27 1	73	33
30	33 0	81	34
35	39 1	88	36
40	45 4	95	37
45	51 9	101	38
50	58 4	108	39
55	65 1	114	40
60	72 0	120	41
65	79 1	125	42
70	86 4	131	43
75	93 9	136	44
80	101 4	142	45
85	109 1	147	46
90	117 0	152	47
95	125 1	158	48
100	133 4	163	49

See our article Jet d'Eau, Vol. XVIII.

Water, in *Gardening*, a well known uſeful article in gardening, as applicable to numerous ſorts of young plants and trees, ſeed-beds, &c., eſpecially in the droughty ſpring and ſummer ſeaſons, both ſuch as grow in the full ground and in pots in the open air, as well as thoſe in green-houſes, ſtoves, hot-beds, &c. : and alſo in ornamental deſigns, in pleaſure-grounds, parks, &c., either when formed into regular pieces, circular, oval, or in oblong or ſerpentine canals, &c.; likewiſe when varied in a ſomewhat natural expanſe, in curves and bendings.

In forming deſigns of this ſort, the nature of the ſupply ſhould be firſt conſidered, whether it be by ſprings in or near the place, by currents or ſtreams paſſing through, or ſo nearly adjacent as to admit of being conducted to the place ; or by being conducted by ſome neighbouring river, brook, or lake, &c. by means of pipes or ſmall cuts, or by being collected iſſuing from higher grounds, and conducted by proper channels. And another circumſtance, equally neceſſary, is to conſider the means by which it may be retained afterwards. In a looſe earthy, ſandy, or gravelly bottom, it will ſoon ſink away, eſpecially in dry weather, unleſs there is a conſtant current or flow of water running in ; but in a naturally ſtrong clayey bottom, of proper thickneſs, both at the ſides and below, it may be retained in ſome tolerable degree. In moſt caſes, ſome art, however, will be neceſſary in this buſineſs. See Basons, &c.

Where it is eaſily attainable in any of the above modes, it ſhould not be omitted, on a ſmaller or larger ſcale, eſpecially in grounds of any conſiderable extent ; but where intended principally as reſervoirs for watering gardens, they may be of much more moderate dimenſions than when deſigned for ornament, and may be formed either in a circular manner, an oblong canal, pond, or cut, &c.; the ſtiffneſs of theſe forms being always broken by varying curves of the margins or borders, conſtantly forming them where the ſupply of water can be moſt conveniently procured.

Ornamental plats, or pieces of water in pleaſure-grounds, are very deſirable, as being great additions to the beauty, variety, and embelliſhment of them, when properly diſpoſed and contraſted with ſome nearly adjoining detached clumps of plantation, and bounded with a proper expanſe of graſs-ground, ſpreading from the verge conſiderably outwards. In general, when any ſpaces of water, on a larger or ſmaller ſcale, are intended, they ſhould be diſpoſed, as conſpicuouſly as poſſible, in ſome principal diviſion ; either ſometimes at or near the termination of a ſpacious open lawn, or occaſionally in ſome other ſimilar open ſpace ; and ſometimes diſpoſed more or leſs internally, in ſome central or other grand opening ; in all of which an expanſe of water has a fine effect. The particular forms may be adapted to the nature of the ſituation, and the extent to that of the ſupply of water that can be had.

In parks and pleaſure-grounds, the moſt proper ſituations for plats, or other forms of water, are ſome rather low convenient places for containing and ſupplying it, which are ſo diſpoſed as to diſplay an agreeable rural view of the water from the reſidences and principal lawns and walks belonging to them, either near at hand, or at ſome conſiderable diſtance from them ; and where there are occaſionally other accidental ſights and views of it, from other parts of the ground, unexpectedly taking place in an abrupt or ſudden manner. In theſe ſituations the forms and appearances of it may likewiſe be greatly varied and diverſified, according to their particular nature and other concurring circumſtances, ſo as to take off any ſort of formal regularity which they may have naturally. They may alſo have oval, oblong, winding, curving, or bending ſerpentine directions given to them, as may be the moſt natural and ſuitable ; and they may be of ſmall or very conſiderable extents, in proportion to the nature of the ſituations, and the ſizes of the grounds, as well as the ſupplies of water which can be commanded. They are ſometimes in large grounds, formed in the manner of natural bending rivers or ſtreamlets, which ſweep round riſing ſwells of land, planted with trees in the form of clumps, or other modes, ſo as to produce a natural and agreeable effect.

Mr. London, in his ingenious work "On forming, improving, and managing Country Reſidences," thinks that water, in whatever point of view it may be taken, whether as neceſſary to the produce of a country, the delight of the traveller, or the intereſt of romantic rural ſcenery, is one of the moſt lovely ornamental materials of nature. Its effects in all theſe ways are highly uſeful, intereſting, and beautiful ; without it all ſoils are barren and unproductive, roads are dull and unintereſting to the taſteful traveller, and rural ſcenes are often tame and diſguſting. For as it occurs in ſpringy banks, purling rills, or winding brooks, it equally engages and delights ; while in the more diſtant view, in larger expanſes, as thoſe of great rivers, glaſſy lakes, or the extent of the ocean, it exalts and fills the mind with aſtoniſhment. And in ſecluded country ſcenery it is not leſs ſucceſsful in affording variety and pleaſure, either by the beauty of its varied appearance, the roar of its fall among rocks and cliffs, the foam and din of it in the ſmall caſcade, or the melancholy of it in the ſtagnant pool, ſhaded by over-hanging boughs.

But though much has been ingeniouſly and uſefully written on this intereſting material of ornamental rural improvement, and the neceſſity and means of a better taſte inculcated in the management of it, little alteration has yet been effected in the modes of practice, as few examples of artificial water rendered pictureſque have been ſet before the public. The former old, naked, tame, ſhaving, formal methods, ſtill continue to prevail too much in the diſtribution and manner of conducting it. There are ftill not a few who are infected with

——————— that ftrange difeafe
Which gives deformity the power to pleafe :

Collections of ornamental water may, it is faid, properly be confidered as of two kinds ; as thofe defigned to be feen in a general view, and in connection with the adjoining fcenery ; and thofe to be feen only when near. The former forts chiefly confift of lakes, rivers, ponds, bafons, and others of fimilar kinds ; the latter of fprings, rills, rivulets, cafcades, and others of the fame nature. There are fcarcely any fituations in which waters of the fpring, rivulet, and others of the fame nature, may not be placed. In nature, rills are ufually found deep funk in dells, as in inftances where they run down the fides of hills, or pafs through foils of the fandy kind. Where they pafs through a fertile valley, or level meadow, they have commonly a very regular courfe ; and when they are met with in hollow places, their courfe is for the moft part ftraight, or approaching to it. The fituations of rivers, lakes, and ponds, are almoft invariably in the loweft parts of the furface of the land. It is, indeed, impoffible that they could be otherwife. Water, whenever it occurs, is conftantly a ftriking feature in grounds, and in this way has always its peculiar fituation : when that fituation is changed, every feature is perverted ; truth, nature, and harmony, are fet at defiance, and the moft glaring difcord fubftituted in their place, ftriking inftances of which prefent themfelves in many different ornamented fituations.

The general fhape of pieces of water muft depend upon the nature of the character which is to be created or given them. Whatever may be the magnitude or dimenfions of lakes or ponds, they fhould be of irregular fhapes, more or lefs wooded, and never entirely naked, being conftantly diftinguifhed by prominences and maffes ; and as often as occafion may ferve, further varied by iflands managed in a fimilarity of manner. And the forms and directions of rivers fhould be given by their fizes, and the nature and kind of country through which they are to pafs. Large rivers, in fertile plains, are, for the moft part, much lefs varied in their courfes than thofe of the fmaller kind ; and both are a great deal lefs fo than thofe which have their directions through hilly uneven furfaces, or through land of a rocky nature. Large rivers can never be imitated where there does not exift a very confiderable ftream ; as without this, the neceffary degree of motion can never be given ; but the directions or courfes of natural rivers may, it is fuppofed, be frequently altered, varied, improved, or divided, with the moft advantageous effects in the way of ornament ; in all which cafes the remarks here given will be applicable. Much might be effected in this way at many of the fine ancient feats of this country, and a high degree of grandeur and magnificence of effect be produced.

In regard to the margins or borders of waters, and the accompaniments of them, it is fuggefted that there are two arguments or reafons, which clearly fhew that the former, in every piece of water, whatever may be its character, fhould be broken and diverfified. The firft of which is, that thereby intricacy, variety, and harmony in form, colour, and difpofition, are produced, in the place of monotony or difcord ; the fecond is, that this mode prevails in nature. Intricacy, variety, and harmony, are produced in the outline, by making the fmall parts irregular, confiderably fo in fome places, and lefs fo in others, according to the kind of water ; in the ground by producing breaks clofe to and alfo at fome diftance from the water ; by fhewing the naked or various-coloured earth and gravel interfperfed among abruptneffes, fmooth flopes, levels, and by every form and difpofition of furface : it is further heightened by the introduction of ftones of different fhapes, and placed in varied or intricate *difpofition ;* and alfo by roots, decaying trunks, or branches of trees. It is further fuggefted, that another fruitful fource of thefe beauties is plants, graffes, low growths, fhrubs, and trees. Plants and graffes may, it is fuppofed, be employed both for cloathing fuch parts of the furface as are fmooth, for varying others, and affifting difpofition. Shrubs and trees may be ufed for the laft purpofe upon a more enlarged fcale. Plants, graffes, and low growths, give intricacy and fhade to fmall breaks, and the interftices among ftones, rocks, &c. Shrubs and trees give intricacy to large receffes, either of fimple margin, or containing thefe leffer enrichments, which, fhaded by trees, will be heightened in effect. All this, it is fuppofed, we fee accomplifhed in nature in fuch a beautiful manner, as far furpaffes every fort of defcription ; it may, it is believed, be admired by perfons of feeling alone, without much judgment or knowledge of the principles by which it pleafes or produces the effect noticed ; but this kind of knowledge and judgment is highly ufeful in directing what to copy from nature, and how to apply it to artificial pieces of water. Without it, perfons, it is contended, may argue either for copying the deformities or fingularities of nature, or for mifapplying them when copied, as has been done by feveral. There is a difference of character in the margin and accompaniments of a lake, river, and brook, though each is varied or harmonious. Each differs alfo according to the nature or ftyle of the country, or foil of the land through which they may have to pafs, as is evident from a great number of different inftances fcattered over the country, in which there are particular differences in the banks, adjacent grounds, and accompaniments, that give an interefting variation of character to each individually.

There are fome other ornamental appendages which are occafionally placed near to or upon water, fuch as erections of the bridge, and other kinds. There is no greater ornament to a piece of water of the nature of a river than a bridge, and few objects fo generally pleafing, becaufe fo univerfally ufeful. This notion has been taken advantage of, it is fuggefted, by improvers, but for the moft part in a very injudicious manner. Their bridges are too commonly formal, and unconnected with the fcenery, either by their unfuitable magnitude, or by the loftinefs of their arches, ftraddling acrofs a fhallow ftagnated river, as is the cafe in many well-known fituations. They want, it is contended, that beautiful fimplicity, connection, and picturefque effect, which may be feen in many highway bridges acrofs ftreams or rivers, and which is produced there by *neceffity* and time. Thus the arches, it is faid, are made low when the banks on each fide are tame and level, becaufe otherwife carts and carriages would have greater difficulty in afcending them. The architecture is fimple, becaufe, in general, the builders were not allowed to incur the expence of ornaments. The plants, ivy-bufhes, and trees which group with them, have fprung up in the courfe of time, but they may be fpeedily imitated by art. The broken parapets, piers, or arches, fupplied by open railing, or a few pales, are the effects of time, or accident, and in fome cafes are worth imitating in the fcenery of a refidence. Thefe circumftances might eafily be copied in ornamental fcenery, and if judicioufly fupplied, it is faid, will invariably fucceed in producing a good effect. Foot-bridges of planks, or rude boles and trunks of trees, fuit well, it is fuppofed, with many fcenes of the rural kind. They have frequently been attempted, it is afferted, but feldom with complete fuccefs, owing to the tafteleffnefs of thofe who contrived them.

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The other ſorts of erections which have been uſually employed for the purpoſe of *ornamenting* water, it is contended, have rarely either picturesque effect, or any uſe; ſuch, for inſtance, as thoſe of aquatic temples, ſtatues, river-gods, and other ſimilar abſurdities, or what may be called falſe decorations. Boat-houſes, however, of ſimple conſtructions, and for the moſt part all uſeful ſorts of erections, may occaſionally be introduced with propriety and good effect. The Perſian-wheel, the forcing-wheel, the corn-mill, and ſome others of ſimilar kinds, are had recourſe to with excellent effects in different places. "The water-wheel and corn-mill at Warwick-caſtle, it is ſaid, is perhaps the grandeſt appendage to that noble building; whether in reſpect to the train of ideas which it awakens in the mind reſpecting its former compared with its preſent uſe, &c., or its effect in connection with the caſcade, for which it forms an excellent apology. And though caſcades of this kind be formal of themſelves, yet the idea of their utility, it is ſuppoſed, compenſates, in a conſiderable degree, for the want of picturesque grandeur; and ſtill the *roar* meets the ear through woods, or diſtance, with the ſame force as in thoſe which are natural."

Mr. London further ſuppoſes, that the picturesque improvement of the pieces of water which already exiſt will be attended to by all thoſe who at preſent have artificial waters, in imitation of rivers, lakes, ponds, or brooks, and who are in the habit of making improvements of this kind upon their grounds. Such proprietors may, he thinks, be aſſured that no part can ſtand in greater need of alterations than ſuch waters; and ſhould they go on with others, except planting, to the neglect of this, they will not certainly merit the approbation of men of taſte, as taſte always prefers excellence to quantity. "If, it is ſaid, any proprietor ſhould heſitate to alter a piece of water which he has long been accuſtomed to ſee without being ſenſible perhaps of any great deformity, in conſequence of habit, if he looks from his windows to a ſerpentine river, winding among ſmooth naked turf, with only here and there a few clumps placed at ſome diſtance from its margin; if the water preſents one uniform glare of light, clear blue, or dull green, and ſeldom varied by any ſhadows or reflections but thoſe of clumps and ſky, let him, before he decides in favour of the tame river, imagine that in place of this a broad irregular lake, forming bays and receſſes, retiring among thick woods, and with its margin in ſome places abrupt, broken, and varied by ſtones, plants, and creepers; in one place ſmooth, ſloping, and covered with graſs; and in another clothed with ſhrubs, trees, and low growths; then let him imagine that he ſees theſe trees, woods, and the different coloured earths and ſtones of the banks, reflected upon the ſtill ſurface of the water, which, in ſome places, was covered with dark ſhadows from the wood, and in others was bright and clear as the heavens: let him conſider how intereſting this would appear, even at a diſtance, and how long he might be employed in tracing with the eye the various receſſes, dark places, and reflections, while ſtill much remained indiſtinct or unſeen, and therefore either employed the imagination in completing it according to its own ideas, or awakened curioſity to walk down and examine it minutely, by tracing, as far as could be done without the interruption of thickets and briars, the various windings and intricate margin of the whole. Let him only contraſt this with the effect of the piece of water already there, which he can *ſee* and *know* as completely by a ſingle glance as if he viewed it an hour; and could examine the two extremities, which are all that could be diſcovered by walking down to it, as completely in a few minutes as if he were to encompaſs it a whole day. If the contraſt does not ſtrike him, he certainly, it is contended, as far as regards his own taſte, is juſtified in preſerving his water as it is; but if otherwiſe, he ought to commence improvement immediately, not only in gratification of his own ſentiments, but alſo in juſtice to every attempt to promote and introduce good taſte in a country where he is a proprietor, and among a people upon whom he is dependent for his rank and affluence. Different ſtyles of improvement may, it is obſerved, be ornamental, and admired while they are in faſhion; but it is only ſuch as this, which are picturesque, or natural, that can ſtand the teſt of time."

The firſt thing to be conſidered in the alteration of artificial pieces of water, is the character which ought to be adopted; and the next, the execution of that character in the beſt manner poſſible, and with the leaſt expence of labour and money. The former has been already fully noticed, and the latter will be particularly conſidered below. In many caſes, however, the alterations required are ſo very ſimple, as to ſtand in need of little art, either in the deſigns or the practical parts, as has happened in altering the waters of different fine country-ſeats.

In ſhort, the management of natural pieces of water, where they come within the province of picturesque improvement, moſtly conſiſts in rendering them more characteriſtic, and by the occaſional introduction of *particular effects*. The leading principles in effecting the firſt of theſe improvements have been made ſufficiently obvious already; and the latter are derived from what takes place in nature; as in the caſes of waterfalls, caſcades, ſprings, and drooping banks or rocks, on the margins of large brooks or rivers, all of which may, it is ſuppoſed, be imitated in particular inſtances. Alſo, in rills and ſmaller ſtreams there are dank-pools, ponds, and little lakes, which often occur in their courſes, that are highly worthy of imitation for their intrinſic beauty, their contraſt with the narrow rills, and their uſe in landſcape. Beſides, it is ſuggeſted that a great advantage of ſuch pools, or little lakes, is, that they may be made to appear natural where no other variety of ſtill water could poſſibly be attempted. And that, in nature, they are found on the ſides of declivities, where they are, for the moſt part, covered by wood, and ſeen only on a near view. In level places or ſituations, or ſuch ſurfaces as are not ſtrikingly inclined, they are or may be opened in ſome parts, for the purpoſe of being ſeen from diſtant places in the grounds, as is admirably done in ſome caſes.

Another ſort of occaſional appearance or effect is *iſlands*, and they are particularly deſerving of imitation, eſpecially in lakes and ponds; nay, even in large rivers or brooks they have often a good effect. In large rivers they are moſtly long and narrow; and in brooks frequently ſo large as to be wholly out of proportion to the ſtream, containing much extent of ſurface; but ſometimes th ey ar extremely ſmall, and only contain a ſingle buſh, a few buſhes, trees, or ſtones and plants; each of which caſes may be ſeen in almoſt every brook, and they deſerve imitation. Iſlands in ponds, it is ſuppoſed, ſhould rather be numerous and near together, than large and diſtant, and be ſituated rather approaching the ſides than the middle parts: the apparent magnitude of a piece of water may, it is ſuggeſted, be greatly heightened from the main point of view, by placing moſt of the largeſt iſlands next the eye, as well as by the mode of planting them. In regard to planting iſlands in general they ſhould be wooded, but not wholly, and never in ſuch a way as to exclude the appearance of ſurface, broken ground, rocks, roots, and ſtones, which are more natural to iſlands than to ſhores, becauſe it muſt always be ſuppoſed that it has been ſome of theſe materials which have either occaſioned the accumulation of the iſland, or prevented it from being waſhed away afterwards.

Waterfalls and caſcades are alſo occaſionally introduced in extenſive pleaſure-grounds, where there is the advantage of a rivulet, by which they may be formed either in one large fall, or in two or three ſmaller ones in ſucceſſion, having large rough ſtones placed below to break the water, and increaſe the ſound of the torrent in its fall and paſſage over them, in ſome degree ſimilar to that peculiar to natural caſcades. And fountains, ſpouting water from images, &c. are ſometimes introduced in the centre of ſmall or moderate baſons, or other reſervoirs of water in gardens or grounds, where a ſupplying head of water is conveniently ſituated ſufficiently high to raiſe and throw the water from the jet or ſpout, in a continued full ſtream, to a conſiderable height, which falling in the baſon, keeps the water of it in motion, prevents ſtagnation, and is thereby rendered more proper for keeping and breeding fiſh of the gold and ſilver kinds, &c. and the ſpouting and falling of the water have a refreſhing effect in the heat of ſummer. In parterres, ſhrubbery grounds, and particular kinds of gardens, water is introduced either in the forms of ſtill ponds, drooping fountains, or jets d'eau; but as theſe are all artificial, no perfect mode can be afforded for imitation. They, however, moſt of them proceed in ſome meaſure on the principle of contraſt, which, in every modification of matter, is capable of producing either incongruity, variety, or harmony; conſequently, of effecting ſcenes which ſhall diſguſt, pleaſe, or highly intereſt the beholder. Jets d'eau are not at preſent in ſuch diſrepute as they were formerly in this country; but they are, for the moſt part, leſs underſtood, and their proper uſe leſs comprehended.

Mr. London, in the above work, remarks, that the epithets waterfalls and caſcades denote different characters in ornamental improvements. Where the water falls over a ridge of rock in one or more *ſheets*, they are properly denominated waterfalls; and where its fall is broken and interrupted by the irregularity of the ridge, and by other fragments of rocks and ſtones, they are properly caſcades. Both kinds, it is ſuggeſted, may be imitated in improved ſcenery, though hitherto this has ſeldom been well accompliſhed, on account either of the reſtricted practical knowledge of perſons of taſte, or the limited or vitiated taſte, or deficiency of judgment, in thoſe who have had the neceſſary practical experience in matters of this kind.

However, waterfalls may either, it is ſuppoſed, be imitated directly, by being copied from nature, or indirectly, by the introduction of weirs for the uſe of water-mills, as already hinted. In imitating nature, the *ſtrength* or *durability* of the whole muſt be equally taken into conſideration with that of the beauty. The firſt depends upon the general form of the whole materials, and the ſecond principally on the foundation; but in a partial way alſo, on the quality of the materials, and the execution. In every caſe which is upon a large ſcale, the foundation ought to be the natural rock, if poſſible; but on a more moderate or ſmall ſcale, it may be a ſecure cauſeway, fixed by oak piles and croſs-planks, the work being performed with great care, and in an exact manner; uſing ſuch mortar, where neceſſary, as is capable of reſiſting water.

It is noticed, that there is one variety of waterfall which may be occaſionally ſeen in nature, and which is highly worthy of imitation, though it is not known to have ever yet been attempted to be introduced. It is that where a ſmall rivulet or rill, at its junction with a river or brook, falls over a rock in one ſmall ſheet. It is ſtated that, "at Matlock Bath, the noiſe of a ſmall waterfall of this kind forms one of the fineſt circumſtances of the ſcenery about that place; — borne upon the breeze, its grateful harmony meets the ear in almoſt every part of the adjacent ſcenery, in murmurs as varied as their paſſages through woods and open glades, along the ſurface of the Dove, under the echoing cliffs of the Tor, or aſcending the heights of Abram. This remarkable effect, it is contended, produced by ſuch a ſmall quantity of water, ought to be the greateſt encouragement to ſuch as poſſeſs brooks or rivulets, as few caſes can occur where it may not be imitated; not indeed with ſuch remarkable ſucceſs, becauſe the ſurrounding ſcenery may not be ſo varied, but ſtill with ſuch an effect as would amply compenſate for the expence, which in every caſe could be but trifling." Others are ſuggeſted, and the beſt manner of forming them clearly explained by drawn figures.

The nature of waterfalls for the purpoſe of driving machinery are, it is obſerved, generally pretty well underſtood; and that as no diſguiſe in the maſonry is requiſite, but art is commonly to appear; the principles of ſtrength and durability noticed above are what chiefly demand attention. But it is remarked that it is to be regretted that ſo few who have rivers take advantage of it, and that ſo many make caſcades equally formal and unnatural, without any real uſe, and with little beauty, either of character in themſelves, or fitneſs and connection with the ſcenery about them.

As to caſcades, what has been ſaid in reſpect to waterfalls will in general apply. In thoſe which are upon a ſmall ſcale, and where there is a plentiful ſupply of water at all ſeaſons of the year, the ſame forms may be built with ſimilar care in reſpect to foundation, ſolidity, and mortar, they being then diſguiſed by rocks of different ſizes in a natural manner, in different ways, according to the different circumſtances of the places. The ſame general principles in relation to form will be applicable to all kinds of *heads*, fiſh-ponds, &c.; only in theſe caſes the materials are commonly clay or gravel; which laſt ſhould always be well *puddled* with clay or ſtiff loam on the ſide next the water. In deſigning waterfalls and caſcades, one principal conſideration is, it is ſaid, to adapt them properly to the ſcenery. In ſome caſes, they are quite inadmiſſible, as in all rivers or brooks without ſtones or rocks in their beds or margins; and in others where they are few, or where the ground on each ſide is level, they can never be made of any great magnitude. An attention to nature is, however, ſufficient to guide us in this, as well as in every thing elſe which relates to the ſubject; a ſubject which, it is ſaid, is ſo highly intereſting and comprehenſive, that it would require a very great ſpace to give a complete elucidation of it in every reſpect. See Water-*Falls*.

It may be noticed, that in the buſineſs of forming ground for water, the earth muſt be excavated to a proper depth, gradually ſloping from the verge to the middle, from three to four or five feet deep; ſometimes, however, in low ſituations, the place is naturally hollowed in ſome degree, ſo as not to require a general excavation, or only in particular parts, and ſome general regulations to the whole, which in extenſive deſigns is a conſiderable advantage. Where the ſides and bottom are of a ſandy, gravelly, or ſtony nature, or abound in looſe ſoil, and there is not a conſtant ſupplying ſtream, they muſt be well ſecured by the application of a thick coat of well-wrought clay. And where this claying is neceſſary in the preparatory excavation, a proper allowance ſhould be made

made for the additional coat of clay, to the extent of twelve or fifteen inches in thicknefs, and of feveral inches of gravel over it, to preferve the clay from being wafted by the motion of the water, and keep it clear, which would otherwife be muddy. But previous to the claying, the loofe and uneven parts in the bottom and fides of the cavity fhould be well rammed, to make the whole firm, even, and fmooth; then beginning in the middle fpace with the clay, and proceeding gradually outward, being careful that no ftones, fticks, or other matter, get mixed with it, to occafion fiffures, or cracks, by which the water may efcape, laying it evenly, a fmall thicknefs at a time, and fpreading it regularly, treading it well with the naked feet; and if dry weather, cafting water on it occafionally, ramming it well from time to time with wooden rammers; then gradually applying more clay, in the fame manner, to the proper thicknefs, being careful that every part is fo well puddled and rammed, as not to leave the fmalleft vacancy. Thus continuing the claying in a regular manner each way, from the bottom to the top of the circumference, fmoothing the furface evenly, and in dry weather covering it, as the work proceeds, with matts or ftraw litter, or with the ftratum of pebbly gravel. When the whole is finifhed, the water fhould be let in.

When this has been done, the top or verge muft be regulated and levelled, forming it evenly from the edge of the water, in a gradual regular expanfion to fome extent outward, without any ftiff flope clofe to the water, diftinct from the furrounding fuperficies; laying the ground with grafs turf, efpecially along the margin, continuing it as far down as the general level of the water. Where the extent is confiderable it may be fown with grafs-feeds.

In conftructing the excavations for a body of water in fuch fituations as are deficient of materials in fome of their parts, as too low in fome of their boundaries, as either at the ends or fides finking below the general furface of the ground, or the height at which the water is intended to ftand; thefe parts muft be ftrongly banked up to the neceffary height in a fubftantial manner, having a fufficient body of proper materials applied, efpecially where the part is to form a head at the end of a canal, or other fimilar piece of water; the whole being inwardly faced with a ftrong body of well puddled clay.

It is well known by every one, the above writer fays, that the expence attending the formation of artificial water by the modes which have hitherto been chiefly practifed is enormous, and in fome inftances fcarcely fupportable; but by adopting improved methods, fuch as thofe which have been fuggefted, it will in almoft every cafe be greatly reduced, and become much cheaper, often to a very remarkable degree. This will be rendered quite evident by confidering the different neceffary operations in their formation, as they relate to each method of proceeding; fuch, for inftance, as the excavation of the bed for the water, the formation of the head, the fpreading of the earth taken out, and the management of the furrounding furface. In regard to the firft, the principal reafon why it becomes fo expenfive is, that a river is commonly imitated inftead of a lake, which, on account of the natural flope of all grounds, requires not merely larger heads, but a far greater number of them. By in a great meafure imitating lakes, one head is, for the moft part, all that is required; and this alfo, many times, of a far fmaller dimenfion than thofe in the cafes of rivers. This alone often makes a very material difference in the coft.

In what relates to the fpreading of the excavated earth, and the regulation of the furrounding furface, as in the methods hitherto purfued in landfcape gardening, whatever may be the natural character or tendency of the furrounding furface, it is to be reduced, by levelling, to a fmooth, even lawn, or pafture, floping in a gradual manner from the margin of the water. This of courfe caufes a prodigious expenditure of money; and what is ftill more difagreeable, it is too frequently quite uncertain, and only capable of being calculated after the finifhing of the whole work. The quantity of cubical yards to be removed in the work of excavating can be eftimated very nearly to a certainty; but the bufinefs of levelling is intricate, troublefome, and often of great extent; hence the great excefs of expence which is frequently incurred beyond the eftimate in this refpect in pieces of made water. If any one plan ever had the advantage over another, it is contended that certainly picturefque or natural pieces of water have the full and complete fuperiority over thofe of other kinds in what regards expence. In them, it is maintained, the natural character of the ground is preferved or improved, and confequently no expence of levelling is incurred; the fuperfluous earth produced in the procefs of excavating being formed into irregular inequalities, or diftributed along the banks in fuch a manner as to augment or increafe their character and picturefquenefs, as is evident in numerous inftances. Under other circumftances, vaft expence may often be run into, without much, if any, beauty being produced; when it could have been effected to a great extent by the modes which are here advifed without laying out much money. Farther information on this very interefting fubject may be gained by confulting Mr. London's excellent work.

Water, *Rain*, *Collecting of*, *for Farm Ufe*, in *Rural Economy*, the providing it in proper fituations for the purpofe. This practice was formerly adopted in different parts of the country: as in moft towns, and in the yards, ponds for the ufe of cattle, are ftill to be met with, which have an artificial appearance. In extenfive pafture heavy or about the houfes of many old farm-lands, pools or land diftricts, pits have evidently been formed by art for the purpofe of catching fuch rain-water as may be brought to them by the ridge-furrows, ditches, or other fuch means, as well as that of land-fprings. The art too has been long practifed on the fouthern chalk-hill parts of the kingdom, and ftill contlnues, in a great meafure, to prevail; and on thofe, in fome northern diftricts, it has been more lately eftablifhed, and fpreads itfelf on the neighbouring heights with vaft benefit. It is certainly neceffary and ufeful in all dry high fituations. It may probably, in fome cafes, alfo be collected into fuch pits, from the roofs of the buildings, for fuch purpofes, with much advantage; though it has been much too common to draw it up, at great labour and expence, from deep wells formed in the bowels of the earth.

Lately much more attention has been beftowed on this matter than was formerly the cafe, in moft places, and in fome with the greateft fuccefs and benefit. It fhould never be neglected where the want of it is confiderable, as live-ftock never do well under fuch circumftances. See Pond, *Made* Streams, and Watering *Live-Stock*.

Water, *Sea*, *Management of Land gained from*, in *Agriculture*, the bringing ground of this fort into cultivation. It has been obferved, that the principal difficulty that can occur in any fituation will be to keep off the water of the rivulets or rivers that may come from the furrounding lands, and to carry away and deliver to the fea the furface-water collected from the land gained: the next important con fideration is that of clearing this land of furface incumbrances. It will often happen, it is faid, that the ground to to be defended is interfected by a river. This is, it is thought, the moft expenfive and difficult cafe that can occur; but it is here only neceffary to carry the defence along each fide of it to the fea; and there, where it interfects the other line of defence, to place a flood-gate, which may prevent the tide from entering, except when it may be neceffary to admit veffels or other things, and which fhall allow the water of the river to pafs into the fea. Small rivulets and fprings may either be turned along the margin of the land gained, and be let out at one end of the defence where it joins the land, or be led the moft convenient way to one or more of the valves or flood-gates, which it is neceffary to make in all defences for excluding the water within. The water collected on the furface of the land gained, may generally be let off by the above flood-gates or valves; but where the defence is extended into the water, this cannot be the cafe, as the level of the fea will moftly be above that of the land. In this cafe, wind-mills for driving pumps muft be placed at proper diftances, according as the particular cafe may be. Perhaps, in general, one fmall wind-mill driving four pumps, may be fufficient for freeing a thoufand acres of ground of water. The expence of fuch a pump-mill would not, it is faid, be above twenty or thirty pounds. By making a fmall defence-bank, from two to four feet high, fome diftance within the larger one, all the water collected between that and the original fhore would be accumulated; and it might be led in a raifed canal in the fame level to a flood-gate in the outer defence. This would, it is thought, leave very little water to be drawn up by the pump; and in this way, though twenty thoufand acres were gained, one wind-mill only would be neceffary. Often, and indeed in moft cafes, in place of a wind-mill, the brooks, rivulets, or fprings collected within, might eafily, it is faid, be made to turn a water-wheel, which would be more permanent and uniform than that turned by the wind. A bafon might alfo be conftructed, fo that the ebb and flow of the tide would turn a draining-wheel; and a great many other methods might, it is fuppofed, be fuccefsfully adopted. Thus, in land gained from the fea, there cannot, it is thought, be any difficulty in preferving it from water, from whatever quarter it may come. When the land to be gained is more or lefs covered with ftones, thefe fhould be put in flat-bottomed boats at low water; and when the tide floats them, they fhould be rowed to the propofed line of bank defence, and be then dropped. This mode of conveyance will generally be found the moft economical for all the folid materials which are at a diftance. Where the ground is fandy or poor on the furface, and argillaceous earth or rich loam below, it may be trench-ploughed to fuch a depth, as to turn up the good and bury the bad foil. If the foil be fhallow, and even rocky, it may ftill, it is faid, be rendered valuable. The moft rocky parts may be covered five or fix inches deep with mouldy matters, and the whole be fown with either meadow grafs-feeds, to be floated with frefh water, or kept as meadow; or with other proper and fuitable grafs-feeds, and kept as falt-marfh. When mud of a good quality and confiderable depth is gained, it may, in fome cafes, it is thought, be defirable to fummer-fallow it for one or more feafons, after it has been fecured from the fea. At other times it may be better to fow it with rape-feed for the firft feafon, and to fummer-fallow it the next, as a preparation for a corn-crop, &c.

It is obferved that no fort of land can be gained from the fea but what is of great value for the purpofe of cultivation, and efpecially as it can for the moft part be flooded by frefh water as well as by that of the fea at all times. By flooding, the moft barren fand or rock, with only an inch or two of foil upon it, will bear excellent pafture. Indeed, much of the fand in thefe fituations that is often reckoned barren and ufelefs, is mixed with broken fhells, and on being examined will be found to contain three or four parts in ten of calcareous matter. Moft of the large rocks, too, within the falt-water mark are, it is faid, in a ftate of rapid decompofition, and fo fragile on the furface, as to be eafily penetrated by the roots of grafs-plants; more particularly after they have been expofed for fome length of time to the action of the atmofphere. The large detached ftones often found within the water-mark are not here meant, as thefe are fuppofed to be either buried in the ground, or boated off as above; but thofe continued rocks which frequently conftitute the bafis of the fea-fhore for great diftances, the furface of which is fo completely oxydated, and occafionally decompofed and reduced fo as to be called *rotten*, that they are capable of affording either an excellent manure for certain foils, or are fit and proper for fupporting the vegetation of faline plants in their actual condition.

The quantity of land of this fort that is eafily capable of being obtained and thus cultivated is very confiderable indeed, perhaps not lefs than fome millions of acres in the whole ifland. See WASTE *Land*, and WATERING *Land*. Alfo SALT-*Marfh*.

WATER, *Gum*. See MUCILAGE.

WATER, *Hungary*. See HUNGARY *Water*.

WATER, *Laurel*. See LAUREL.

WATER, *Lime*, is common water, in which quicklime has been flaked. See LIME-*Water*.

WATERS, *Ophthalmic*, or *Eye*, are fuch as are good in diforders of the eyes. See COLLYRIUM, EYE, and OPHTHALMIA.

WATER, *Tar*. See TAR-*Water*.

WATER, in *Anatomy*, &c. is applied to divers liquors, or humours, in the human body.

Such is the *aqua phlegmatica*, phlegmatic water; which is a ferous fluid contained in the pericardium.

WATER, in *Geography* and *Hydrography*, is a common, or general name, applied to all liquid tranfparent bodies, flowing on the earth.

In this fenfe, water and earth are faid to conftitute our terraqueous globe.

Some authors have rafhly and injurioufly taxed the diftribution of water and earth in our globe as unartful, and not well proportioned; fuppofing that the water takes up too much room.

The quantity of water on this fide our globe, Dr. Cheyne fufpects to be daily decreafing; fome part thereof "being continually turned into animal, vegetable, metalline, or mineral fubftances; which are not eafily diffolved again into their component parts." Philofoph. Princip. of Relig.

Many modern philofophers are of the fame opinion.

An inundation, or overflowing of the waters, makes a *Deluge*; which fee.

WATER, among *Jewellers*, is properly the colour or luftre of diamonds and pearls; thus called, by reafon thefe were anciently fuppofed to be formed, or concreted of water. The term is fometimes alfo ufed, though lefs properly, for the colour or hue of other precious ftones.

WATER is alfo ufed in divers ceremonies, both civil and religious. Such are the *baptifmal water*, *holy water*, &c.

WATER, *Holy*, is a water prepared every Sunday in the Romifh church, with divers prayers, exorcifms, &c. ufed by the people to crofs themfelves with at their entrance, and going out of church; and pretended to have the virtue of wafhing away venial fins, driving away devils, preferving

from

from thunder, diffolving charms, fecuring from, or curing difeafes, &c.

The ufe of holy water appears to be of a pretty ancient ftanding in the church: witnefs St. Jerom, in his life of St. Hilarion, and Gretfer, de Benedict. cap. x. &c.—M. Godeau attributes its original to Alexander, a martyr under the emperor Adrian.

Many of the reformed take the ufe of holy water to have been borrowed from the luftral water of the ancient Romans: though it might as well be taken from the fprinkling in ufe among the Jews. See Numbers, xix. 17.

Urban Godfrey Siber, a German, has a differtation, printed at Leipfic, to fhew, by proofs brought from church hiftory, that one may give holy water to drink to brutes.

Bitter Waters of Jealoufy.—In the Levitical law, we find mention made of a water, which ferved to prove whether or no a woman were an adultrefs. The formula was this: the prieft, offering her the holy water, denounced, "If thou haft gone afide to another, inftead of thy hufband, and if thou be defiled, &c. the Lord make thee a curfe and an oath among thy people, by making thy thigh to rot, and thy belly to fwell; and this water fhall go into thy bowels, to make thy belly to fwell, and thy thigh to rot." And the woman fhall fay, *Amen*. "Thefe curfes the prieft fhall write in a book, and blot them out with the bitter water. When he hath made her drink the bitter water, it fhall come to pafs, that, if fhe be defiled, the water fhall enter into her, and become bitter, and her belly fhall fwell," &c. If fhe be not defiled, fhe fhall be free, and conceive feed." Numbers, chap. v.

WATER, *Interdiction of Fire and*. See INTERDICTION.

WATER *of Flax and Hemp*, &c. that which is ufed for fteeping or raiting them in, in the view of procuring the pure vegetable fibrous matters that they contain. The writer of the "Elements of Agricultural Chemiftry" has obferved, that this water poffeffes confiderable fertilizing powers. It appears, it is faid, to contain a fubftance analogous to albumen, as well as much vegetable extractive matter. It putrefies very readily. And that as a certain degree of fermentation is abfolutely neceffary for obtaining the matters of the flax and hemp in a proper ftate; the water to which they have been expofed fhould on that account be ufed as a manure as foon as the vegetable fibre is removed from it.

WATER, *Black*, a difeafe in neat cattle and fheep, which is not unfrequently of a ferious nature. It has not, however, been yet properly or fully inveftigated.

In neat cattle it is faid to arife from fudden changes in the ftate of the weather from heat to great cold, the taking of cold on being turned into low wet paftures in the early fpring feafon, and the want of proper water in long dry times. Some fuppofe too that it may be caufed by frefh paftures of particular forts, and that certain vegetables picked up by the cattle may produce it. It confifts of a difcharge of a dark black bloody nature from the kidneys, and fometimes probably from other parts of the body. It is moft probably produced by inflammation terminating fuddenly in a ftate of great debility and relaxation of the parts, fo as to admit the dark grumous blood thrown out to pafs away in this manner.

In flight cafes of this nature the cattle do not feem to be a great deal affected by the difeafe, but where the bloody fluid paffed away is confiderable, and lafts for fome length of time, the animals become reduced to a very low ftate or condition, and great weaknefs is the confequence, which if not fpeedily removed by fome proper remedy, the cattle foon fink under the preffure of the complaint.

In the cure, except the difeafe be taken at its commencement, bleeding will feldom be ufeful or neceffary, but the bowels fhould be well cleared out by powerful evacuating remedies of the falt kind, and kept properly open by their repetition, fo that the cattle do not become in the leaft conftipated, which would be hurtful and dangerous. When the difcharge continues, balls compofed of alum, ruft of iron, and armenian bole, made up with Venice turpentine, may often be of fervice, when given in fufficient quantities; but a more powerful and effectual remedy will be found in a ftrong decoction or infufion of bark, with vitriolic acid, and the tincture of opium, given in the proportion of a pint of the firft, two drachms of the fecond, and three drachms of the laft. This may be repeated once or twice in the courfe of the day where neceffary, the bowels being always well kept open.

By fome of thefe means the difeafe may moftly be removed without any great difficulty.

Some think that much benefit often arifes from the ufe of nitre in full dofes in this diforder, as well as from the change of pafture, in fome inftances, as from low to fuch as are rather high in their fituation.

In *fheep* the difeafe is characterized by much the fame appearances, taking place fuddenly, moft commonly among thofe of the hog kind, and fuch as are apparently ftrong, while feeding in rank paftures of the clover or other luxuriant grafs kinds. In thefe cafes, there is fometimes much dark bloody watery fluid met with in the ftomachs of the fheep after death. The difeafe in thefe animals is moftly very rapid in its progrefs, therefore the fheep in fuch paftures fhould be conftantly well looked to, in order to difcover if any of them be indifpofed.

In the prevention of the black water in thefe animals, fome have found great benefit by the ufe of about half a tea-fpoonful of fulphuric or vitriolic acid in mixture with a fmall fpoonful of the compound tincture of cinnamon, when given in a cup of cold water to each fheep in the morning, and cotting or houfing them in the night feafon.

In other cafes, when the difeafe appeared to be prefent, much advantage has been faid to be produced by giving a ftrong infufion of oak-bark with aromatics, well acidulated with the fulphuric acid, and to which has been added a little of the tincture of opium. The bowels are to be kept in an open ftate at the fame time.

The immediate removal of the fheep into clofer fed and drier paftures, will always be attended with great benefit in this difeafe, and the fupplying them with dry food might perhaps in fome cafes be of utility.

WATER, *White*, a name often given to a dangerous difeafe in fheep.

WATER *in the Head*, a denomination frequently applied to a difeafe in the head of fheep. See GID and STURDY.

WATER *Braxy*, among *Animals*, a difeafe in fheep, which has been difputed by fome; but which the writer of the "Shepherd's Guide" is confident exifts, having feen and diffected feveral cafes of it after death; and is affured, too, that it does confiderable damage on fome particular farms, in fome fituations; but that whether it be a fpecies of the common braxy or not, will, it is thought, admit of a doubt, though it is always viewed and confidered by the fhepherd as fuch. It is ftated in addition alfo, that in two external appearances it has a refemblance to it. The firft of which is, that the animal, when living, feems affected much in the fame way, lying frequently down, and loitering behind the reft of the flock, appearing likewife fomewhat fwelled in the body. And that the next is, that, like all others affected with the braxy of any kind, it will not bleed

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to any extent on opening a vein. The cutting of a vein in the tail, fpould, or below the eye, will make other fheep bleed plentifully ; but from thefe fcarcely a drop will iffue ; and even on cutting the principal vein in the throat, only a very fmall quantity, it is faid, proceeds to flow out.

However, in the interior appearances it differs very widely and materially. On opening the fheep, the whole entrails are, it is obferved, fwimming in bloody water, none of which is within the bowels, but only within the rim of the belly. The gall-bladder is very fmall, appearing as having been moftly fpilled previoufly to the death of the animal, and the urinal bladder is contracted and fhrunk up to a fize fcarcely noticeable. The fmall fibres connecting it with the other parts are inflamed, and on bringing it near the nofe fmells fomewhat like the other braxy. The bladder feems entirely without urine, but on blowing it up it is always quite found, and never burfts ; the guts and flefh are a little difcoloured, and have a fmell peculiar to that diforder. The fmaller department of the ftomach or *reid* has fome purple fpots on it ; and, on being felt with the finger, thefe are thicker in the texture than the other parts of it. They feem, too, to have bled a portion inwardly ; this fome fuppofe iffues from the liver.

In an effay inferted in the appendix to the Rev. Mr. Findlater's Account of the Agriculture of the County of Peebles in Scotland, it is faid to be a difeafe that is analogous to the fuppreffion of urine, which is caufed by the want of fufficient activity and exertion. And that it confifts in the bladder being over-diftended with urine, which raifes violent inflammation in that organ, and produces an incapacity to difcharge the urine that is accumulated. The confequence of which is, that the urine regurgitates over the body ; the whole carcafe is tainted by fetid gafes ; the bladder becomes gangrenous, burfts, and the animal dies. That young and vigorous fheep are moft liable to this fort of braxy. And that the immediate caufe of the difeafe is feeding too freely on rich fucculent diuretic food, and refting too long in the morning on the layers, taking place frequently when the fhepherds are more negligent than ufual in removing them.

It is fuppofed that the difeafe may be prevented by avoiding too free an ufe of fucculent diuretic food, and by moving the animals from the layers on which they are early in the morning, making them walk about for fome time in the view of encouraging them to pafs their urine and purl.

In attempting the cure, in cafe the bladder be greatly diftended and affected, which may be known by there being a great fulnefs in the lower part of the belly, the urine may be endeavoured to be drawn off by the introduction of fuitable implements of the catheter kind, or by cautioufly letting it off by incifion or puncture, where that cannot be done. In either of thefe ways, when effected, great relief will be afforded.

And in the view of allaying or preventing inflammation, the ufe of proper purging and evacuating injections fhould be had recourfe to, fuch as Glauber, or other falts of the fame kind ; or even warm milk and water be thrown up.

The firft writer, however, thinks that no remedy for the difeafe has yet been pointed out that can be fully depended upon. See Braxy, and Striking *Ill*, *Blood*, or *Sicknefs*.

Water *Farcy*, a difeafe in horfes of the œdematous or partial dropfical kind, which is often very troublefome in its removal. It has no relation or refemblance, however, to that of the real farcy, being wholly different in its nature, caufes, and effects, though fometimes ignorantly fuppofed to be of the fame kind. It occurs in horfes of all kinds and defcriptions, and at moft periods of their exiftence. It is a foft watery fwelling below the fkin, and is caufed by whatever has a tendency to weaken and deftroy the natural vigour and ftrength of the body, whether in a local or general manner, but more efpecially in the former, fuch as low bad keep, want of fufficient cleaning and dreffing, taking the animals into cold water in a warm ftate, too great expofure to cold rains, and many others. It often, too, happens after fevere colds of the epidemical kind. The fwellings take place in different parts, but particularly in the legs, having a pitted or dimpled appearance when preffed by the finger. In fome cafes, the difeafe has a more general dropfical afpect, the water not being confined to any one part, but fhews itfelf in feveral, over the whole body, by fuch fwellings. Thefe cafes, for the moft part, proceed from foul feeding, or the effects of eating too greadily of rich luxuriant after-grafs. In the former cafe, the limbs and the whole body are fometimes feen enormoufly fwelled, and become very hard, the belly and fheath parts being very greatly diftended.

In the cure of the difeafe, in all the cafes, the great objects are the removal and difcharge of the water, and the prevention of its future formation by every poffible means. The former are to be attempted by the giving of ftrong diuretic purgative remedies, and the latter by the ufe of medicines of the ftrengthening kind, fo as to brace up and reftore the tone of the relaxed folids of the whole body.

In the firft of the above intentions, the combining of calomel and fquills with jalap and aloes, in the proportions of about one drachm each of the two firft, to two drachms each of the two laft, for a large horfe, may be very ufeful, when made into a ball, and given every night, or every other night for four or five times, and repeated as there may be occafion ; throwing in, in the intervals, bark and other tonics, in full quantities, to reftore and keep up the ftrength of the animals.

Rather ftrong infufions of the fox-glove with aromatics may likewife be tried, and oak-bark in powder, with the fame, be given in large dofes at the fame time they are made ufe of.

The horfes fhould frequently, too, have good mafhes in which nitre has been put.

Gibfon, however, advifes the horfes to be purged once or twice in ten days, and to have intermediately a pint night and morning of the ftrong decoction or infufion of black hellebore, prepared by boiling or infufing it in water, and then adding to four parts of it two of white wine, that has ftood upon the fame for fome length of time in a warm ftate ; or a ball compofed of nitre, fquills, and camphor, in the quantities of two drachms of the firft, three drachms of the fecond, and one drachm of the third, made up with honey, and given once a day, either alone, or wafhed down with a hornful or two of the above infufion.

The horfes fhould be kept warm, and have plenty of dry food while they are under thefe courfes of medicine. See Farcin.

Water *Sicknefs*, a difeafe among fheep of the dropfical kind. It is a diforder, or fort of affection, arifing in the weak ftates of their conftitutions, which is incident to all the varieties of foil and climate, it is faid, in its different forms and degrees of violence, from Shetland in the north of Scotland, to the moft fouthern parts of this country, wherever fheep-hufbandry is carried on. It is obferved to occur, in general, among aged fheep, that are fubjected to its attacks in confequence of weaknefs, either of the more general or more local kind. It moft commonly feizes the animals towards the

the end of the harveft-feafon and winter, and on farms which are moftly deftitute of fhelter. It is, in fact, faid to be the genuine offspring of cold and moifture, and perhaps of every thing that debilitates the vigour of the animals.

The appearances that diftinguifh it to be prefent are fwellings in the legs towards night, which difappear in the morning, when the lower jaw often becomes a good deal fwelled. The eyes are dull, the urine, when noticed, is high coloured, the tongue is dry, and as the difeafe advances, the belly often becomes tenfe, and water is felt undulating in it, efpecially on being ftruck on one fide with one hand, while the other is kept fteady on the other fide. The fheep lofe their heart and vivacity, their appetites fail them, they become thin and lean, and at laft fall away and die.

In regard to the prevention of the difeafe, a dry well-fheltered fheep-walk is faid to be good in that intention; and the neighbourhoods of fea-fhores are ufeful in the fame view, as have been found by experience. But if the diftemper fhould fhew itfelf in a fevere manner, in very wet feafons, in winter or fpring, night-fhelter is found of particular benefit in ftopping the increafing ftate of the malady. The animals, too, fhould have good, green, fweet, dry hay chopped and given them, at the fame time with a little oats or bran in fome cafes.

In the cure of thofe which are difeafed, a fhed or room in a houfe, and a full allowance of the fame forts of dry food, are particularly neceffary and ufeful. Some have tried tapping in the advanced ftage of the diforder, but with only a temporary relief. Two drachms of cream of tartar given twice a day, in a little warm thin oatmeal-gruel, have been known to have a remarkably good effect. In the more early ftages of the complaint, fmall quantities of calomel with fquills would probably remove the difeafe, efpecially if accompanied with a few hornfuls of a ftrong decoction of oak-bark two or three times a week. By thefe means, difeafed fheep, when taken early, would perhaps be readily reftored.

In the above-named part of Scotland, the difeafe is faid to be called by the title of fhell-ficknefs, as well as that which is here given it.

WATER-*Calamint*, in *Botany*, the name ufed by fome for a fpecies of mint. See MENTHA.

WATER-*Crowfoot*, in *Agriculture*, the name of a plant of the weed kind, on which cows are faid by fome to be very fond of feeding. And in the fifth volume of the Tranfactions of the Linnæan Society, Dr. Pulteney has obferved that it is not only relifhed by fwine, but that they thrive remarkably upon it, requiring little or other food until put up to fatten. The produce of it cannot, however, be great, fo that the ufe of it muft be limited.

WATER *Crefs*, in *Gardening*, the common name of a fmall creeping plant of the herb kind growing in watery fituations, fuch as the fides of rivulets, rills, brooks, or other fmall trickling ftreams; and which is much employed as a fallad herb, and for eating with bread and butter, or in other modes in its natural ftate, as being highly cooling and agreeably bitter. See CRESS.

WATER-*Dropwort*. See DROP-*Wort*.

WATER-*Germander*. See GERMANDER.

WATER-*Hair-grafs*. See AIRA *Aquatica*.

WATER-*Hemp-Agrimony*. See *Water-Hemp*-AGRIMONY.

WATER-*Leaf*. See LEAF.

WATER-*Lily*. See NYMPHÆA.

WATER *Melon*, the vulgar name of a plant of the melon kind, growing in aquatic fituations, and the fruit of which is of a watery infipid nature. See CUCURBITA *Citrullus*.

WATER-*Parfnep*. See PARSNEP.

WATER-*Poa*. See POA *Aquatica*.

WATER-*Soldier*, a fpecies of *ftratiotes*; which fee.

WATER-*Tath*, in *Sheep Hufbandry*, a term applied to that fort of rank grafs that arifes from an excefs of wetnefs in fheep-walks and paftures, and which has a tendency to produce the rot in thefe animals. It may be caufed by too much wetnefs in the lands, either naturally, or by the ufe of water on them. It is this probably that makes water-meadows fo dangerous for fheep at certain periods. See TATH, and WATER-*Meadow*.

WATER-*Hen*, in *Ornithology*. See FULICA *Chloropus*, *Flavipes*, and RALLUS *Carolinus*.

WATER-*Ouzel*. See STURNUS *Cinalus*.

WATER-*Rail*. See RALLUS *Aquaticus*, and *Bengalenfis*.

WATER-*Wagtail*. See WAGTAIL.

WATER-*Dog*, in *Zoology*, a variety of the CANIS *Familiaris*. See DOG.

WATER-*Elephant*. See HIPPOPOTAMUS.

WATER-*Hog*. See CAPYBARA.

WATER-*Rat*. See MUS.

WATER-*Aidle*, in *Agriculture*, a term applied to the ftagnant water contained in mofs land, in fome places, as in fome parts of the county of Lancafter. It is faid to be highly prejudicial to animals, when they drink water that is mixed or impregnated with it. It is beft removed from fuch land by proper draining, and frequent fuitable tillage cultivation.

The bringing fuch waftes into a ftate of improvement confequently difcharges it in an effectual manner. See MOSS and WASTE *Land*.

WATER-*Bailiff*. See BAILIFF.

WATER-*Barrow*, *Swing*, in *Rural Economy*, an improved contrivance of this fort. See QUENDON *Water-Barrow*.

WATER-*Bearer*, in *Aftronomy*. See AQUARIUS.

WATER-*Bellows*, in *Mechanics*, a machine ufed to blow air into a furnace, by the action of a column of water falling through a vertical tube. The orifice where the water enters the tube is fo contrived, that the water fhall be mixed with air when it enters the pipe; and this air will be carried along with the ftream through the tube, and is collected into a proper receiver, from which it is conveyed to the furnace in a continued blaft. Thefe machines are much ufed on the continent, but have never been introduced in England, becaufe they will not produce by any means fo great a current of air as may be raifed by the fame fall of water, when employed to work bellows, or other machines, by means of a water-wheel.

M. Reaumur has given a minute defcription of the water-bellows employed for the iron furnaces, in the provinces of Dauphiné and Pays de Foix, in France, where fuch machines are called *trompes*. The water is conducted to the furnace by a trough or paffage, having an inclination of one inch in a toife; the body of the trompe is a vertical tube, about 27 French feet in height, and 16 inches diameter on the outfide: it is made of two pieces of fir hollowed out, and bound together by hoops of iron.

The form of the interior of the tube contributes materially to its effect. The mouth or upper orifice, where the conduit-trough pours the water into it, is 13 inches diameter: from this it diminifhes, in the manner of a conical funnel, till at a depth of three feet from the mouth, it is only four inches diameter, which part is called the throat. Here the opening of the tube enlarges all at once to a fize of nine inches, which it continues for all the reft of the height. Immediately beneath the throat, (that is, the upper part of the

the tube where it becomes nine inches diameter,) ten vent holes are bored through the fides of the tube; they are cylindrical, and two inches diameter; their direction is inclined, fo that they point downwards at about an angle of 45 degrees; they are arranged at equal diftances round the tube in two rows, the upper row having fix holes, and the lower row four: it is through thefe holes that the air enters. The tube is fupported in a vertical pofition by a framing, and the lower end is introduced into a ftrong ton or cafk, fix feet deep, and almoft as much in diameter, though it is rather fmaller at top than at bottom. The tube defcends through the head of the cafk 18 inches, fo that it terminates within $4\frac{1}{2}$ feet of the bottom of the cafk; and a kind of table made of a flat round ftone, or a plate of caft-iron, is placed horizontally in the centre of the cafk, at 18 inches beneath the orifice of the tube, being fupported by a crofs of wood, placed upon four legs, from the bottom of the cafk. The cafk is well clofed on all fides, particularly round the tube, where it paffes through the head; but there is an air-pipe conducted away from the top of the cafk, to convey the air to the furnace; and from the bottom of the cafk there is an opening, by which the water can pafs away. The opening is regulated by a wooden fhuttle, which pens up the water to fuch a height within the cafk, that the opening through which the water iffues will be always beneath the furface of the water, fo as to prevent the efcape of the air by the fame paffage.

The action of this machine is not fo eafy to explain as its ftructure, and it has at various times occupied much of the attention of philofophers. Father Kircher was the firft who defcribed the machine in his Mundus Subterraneus; but he did not fatisfactorily explain the reafon of its action. In the Memoires des Scavant étrangers, Barthes, the father, has given a theory which is very defective; and Dietrich was of opinion that the air was produced by the decompofition of the water.

M. Reaumur explains it thus:—The funnel of the tube is always full of water, which iffues rapidly through the throat; but finding immediately a larger place, the ftream difperfes and fcatters into drops, becaufe it is no longer enclofed within a cylindrical furface: it does not, therefore, take any conftant figure, but the ftream is compofed of different fmall ftreams, or rather fucceffions of drops, which are continually changing their pofition with refpect to each other. Now the intervals between thefe feparate ftreams or drops are occupied by the air which is within the cavity of the tube: fuppofe that between two ftreams feparated by air a third comes to defcend, it will pufh the air before it with all its force, and carry the air down to the cafk; and this will be replaced by frefh air, entering at the vent-holes. The irregular arrangement which the ftreams or drops take, either at their iffuing from the throat or in continuing their fall, is fuch that few drops do not carry fome air down before them into the cafk: the water falling upon the table within the cafk dafhes on all fides, and releafes the air which rifes in the cafk, and iffues through the air-pipe to the furnace, whilft the water falls to the bottom of the cafk, and efcapes gently through the fluice.

A fingle trunk of the dimenfions juft defcribed is found fufficient to blow a forge or finery; but for a fmelting furnace, three are joined together, having a common trough of fupply, and the air-pipes from the three cafks are joined together. M. Reaumur fuppofed that a greater height of the fall would produce more air, becaufe it is longer expofed to thofe changes of pofition in the different ftreams of water; but he fuppofed that no adequate advantage would be gained by an increafe of the diameter of the tube, becaufe it would be more likely, in falling in a large body, to defcend in a clofer column.

The machines of the Pays de Foix are fomewhat differently conftructed: in thefe the water is conveyed into a refervoir, from the bottom of which a fquare trunk or tube defcends to the refervoir or air-cheft, which is made very long; and the air-pipe proceeds from an elevated part of it, to prevent the danger of fpray or fmall drops being carried into the furnace. Inftead of a throat and the vent-holes, the tube is made to divide into two branches, at the point where it paffes through the bottom of the upper refervoir: thefe branches rife above the furface of the water in the refervoir, fo that it cannot enter into them, but the water is admitted at an opening between thefe two branches, fo that in effect the tube is divided into three, the centre being an opening for the water to defcend, whilft the two outfide branches admit the air to mix with the water and go down.

The editor of the Art des Forges fuppofes that the vent-holes are ufelefs, but that the violent agitation of the water in paffing the throat, and dafhing upon the table within the cafk, is fufficient to change the water into air. This is the fame hypothefis as that of Dietrich.

Thefe various explanations rendered the fubject ftill more obfcure; and in 1791, the Academy of Touloufe invited philofophers to determine the caufe and the nature of the ftream of air which is produced in thefe machines. M. Venturi, profeffor of philofophy at Modena, gave the real anfwer in an excellent paper on the principle of lateral communication of motion in fluids.

To explain the principle, this philofopher fuppofes a number of equal balls to roll along in a horizontal trough, in contact with each other, with an uniform motion at the rate of four balls in a fecond: fuppofe, on arriving at the end of the trough, they fall fuddenly to a depth of 16 feet. Now, from the laws of gravity, each ball will perform this defcent in a fecond of time; and as four balls fucceed each other in each fecond, it follows that there will always be four balls in the air at the fame time. The relative pofitions of thefe will be as follows: the uppermoft ball will be one foot from the point where they begin to fall, the fecond four feet, the third nine feet, and the fourth fixteen feet. This arifes from the acceleration which always takes place in defcending bodies. A confideration of this circumftance will give a proper idea of the difunion and fucceffive feparation of the particles which the accelerating force of gravity produces in fluids, or in bodies which fall in a ftream.

The rain-water flows out of gutters by a continual current; but during its fall, it feparates into portions in the vertical direction, and ftrikes the pavement with diftinct blows. The water likewife divides, and is fcattered in the horizontal direction. The ftream which iffues out of the gutter may be one inch in diameter, and ftrike the pavement over the fpace of one foot. The air which exifts between the vertical and horizontal feparations of the water which falls is impelled, and carried downwards. Other air fucceeds laterally; and in this manner a current of air or wind is produced round the place ftruck by the water. M. Venturi went to the foot of the cafcades which fall from the Glacière of La Roche Mêlon on the naked rock at La Novalêfe, towards mount Cenis, and found the force of the wind to be fuch as could fcarcely be withftood. If the cafcade falls into a bafon of water, the air is carried to the bottom, whence it rifes with violence, and difperfes the water all round in the form of a mift.

He formed one of thefe artificial blowing engines of a fmall fize; the vertical pipe was two inches in diameter, and four

four feet in height: it was a plain cylindrical tube, without any throat or funnel. But he found, when the water accurately filled the ſection of the orifice, and all the lateral openings of the pipe were cloſed, the pipe no longer emitted any wind.

According to this writer, the circumſtances which favour the moſt abundant production of wind are as follows:—The ſeparation of the deſcending balls is more rapid in the upper than in the lower part of the fall. In order, therefore, to obtain the greateſt effect from the acceleration of gravity, it is neceſſary that the water ſhould begin to fall at the orifice of the vertical tube with the leaſt poſſible velocity, and that the depth of the water in the horizontal trough ſhould be no more than is neceſſary to fill the ſection of the vertical tube. The vertical velocity of this ſection is ſuppoſed to be produced by a height or head of water in the trough, of a depth equal to the diameter of the tube.

We do not know by direct experiment the diſtance to which the lateral communication of motion between water and air can extend itſelf, but we may with confidence aſſume that it can take place in a vertical tube, whoſe ſection is double that of the original ſection with which the water flows from the trough into the pipe. Let us then ſuppoſe the ſection of the pipe to be double the ſection of the water in the trough, and in order that the ſtream of water may extend and divide itſelf through the whole double ſection of the pipe, ſome bars, or a grate, are placed in the orifice of the vertical tube, to diſtribute and ſcatter the water through the whole internal part thereof.

Since the air is required to move in the blowing-pipe with a certain velocity, it muſt be compreſſed in the receiver. This compreſſion will be proportioned to the ſum of the accelerations which ſhall have been deſtroyed in the inferior and cloſe part of the vertical pipe, that is, the part beneath the vent-holes. Taking this cloſed part of the pipe $1\frac{1}{2}$ foot, we ſhall have a preſſure ſufficient to give the requiſite velocity in the air-pipe. The ſides of this portion of the pipe, as well as thoſe of the receiver, muſt be exactly cloſed in every part, to prevent the eſcape of the air.

The lateral openings in the upper part of the pipe may be ſo diſpoſed and multiplied, particularly towards the top, that the air may have free acceſs within the tube.

In ſome machines of this kind, the conſtructors ſeem to have been of opinion, that a great height was required in the water-fall; but Dr. Lewis, who made a great number of experiments upon the ſubject, ſhews that an increaſe in height can never make up for a deficiency in the quantity of water; four or five feet, he thinks, is a ſufficient height for the water to fall: and where there is a greater height, it may be rendered uſeful by joining two or more machines together in ſuch manner, that when the water has once committed its air in the condenſing caſk or veſſel, it ſhall flow out into a new reſervoir, and from thence deſcend through another funnel and cylinder, and fall from it into a condenſing veſſel, where the air is extricated and carried off through the air-pipe.

Another kind of water-bellows was invented by the ingenious Martin Triewald, of Sweden, and is deſcribed in the Philoſophical Tranſactions. The machine conſiſts of two caſks or tuns open at bottom, and ſo loaded, that they will ſink into water in the ſame manner as diving-bells. Theſe being ſo ſuſpended that they can be alternately lowered down into water and drawn up again, will by proper valves and pipes afford a continual blaſt of air.

Fig. 15. *Plate Water-works*, repreſents theſe water-bellows in profile. A A are two caſks, made nearly the ſame ſhape as diving-bells, being in the form of a truncated cone, or wider below than at top, where they are furniſhed with cloſe heads B B, but at the lower ends A A are quite open. In the heads B B are valves V, which open inwardly, and are made like the palates of other bellows, with their hinges and the valves themſelves covered with hatters'-felt. They are cauſed to ſhut by eaſy ſteel ſprings till the air from above opens them, which happens only when the bellows receive their motion upwards. The valves are ſhut by means of the preſſure of the air within, when they ſink down into the water.

On the ſame heads two pliable leather tubes R R are fixed, one at the top at each water-bellows, which tubes are made and prepared in the ſame manner as thoſe uſed in water-engines for extinguiſhing of fire. Theſe leathern tubes or pipes reach from the bellows to the tubes T T, which carry the wind into the furnace, or any other place, according to pleaſure.

Theſe two bellows are ſuſpended from the lever by iron chains K K, which are faſtened to two ſweeps S S, by which means they hang perpendicular from the balance-beam, and at the ſame diſtance from the centre of its motion C on the oppoſite ſides. On the top of this balance-beam are fixed two ſloping gutters F F, into which the ſtream of water runs from the gutter G, and gives motion to the whole work, performing the ſame ſervice as an overſhot or any other water-wheel; but they coſt much leſs, and give as even and regular motion as a pendulum, for as ſoon as ſo much water runs into either of the inclined planes of the gutters F F, that the weight of the water exceeds the friction near the centre of motion C, and the weight of that bellows which is ſunk down into the water, the gutter immediately deſcends with an increaſing velocity till the balance meets with the reſiſtance of the wooden ſprings H H; during this time it has raiſed the oppoſite water-bellows, or that bellows which is fixed under the oppoſite gutter, the gutter which has been filled being come down to the ſpring H, delivers all the water it has received, and at the ſame time the water begins to run into the oppoſite gutter, which receives its load of water almoſt as ſoon as the former is emptied, ſo that one of the gutters begins its effect as ſoon as the other has finiſhed, and this continues alternately as long as the ſtream of water is ſupplied. Theſe ſloping gutters upon the balance-lever, therefore, perform all the effect which a water-wheel does in working the ordinary bellows, and by means of the ſame power of deſcending water, but acting reciprocally on oppoſite ends of the balance-beam.

Theſe water-bellows blow the fire on the ſame principle, which produce the effect of the ordinary bellows, *viz.* that the air which enters the bellows, and which they contain when the top is raiſed, is again compreſſed or forced into a narrower ſpace when the bellows cloſe; and ſince air like all other fluids moves to that place where it meets with the leaſt reſiſtance, it muſt conſequently go through the opening which is left for it, with a velocity proportioned to the force by which the air is compreſſed, and muſt blow ſtronger or weaker in proportion to the velocity with which the top and bottom of the bellows are made to approach each other; the blaſt alſo will laſt a time proportioned to the quantity of air that was drawn into the bellows through the valve or pallet.

The ſame operation takes place in the water-bellows, for the air which they contain muſt neceſſarily be compreſſed by the water, which riſes alternately into the bellows A A, and obliges the air to go through the leathern tubes R R, as being the place where the air meets with the leaſt reſiſtance.

In this machine, the chief part of the weight to be

moved

moved is balanced in equilibrio, for the bellows A A may be confidered as two nearly equal heavy weights in a pair of fcales, which in a great part balance each other. The difference is occafioned by that bellows which finks down into the water, being fo much lighter, as it lofes its weight by the quantity of water it difplaces, from the bulk of air contained beneath the furface of the water. This difference is compenfated by the weight of the water which falls down along the floping gutter, which acquiring the power of a falling body, increafes in the fame proportion as the bellows to be raifed by it increafes in weight; for the bellows which finks down into the water does not at once lofe its weight in the water, but gradually as it defcends deeper; and in the fame manner, the afcending bellows does not at once become heavier than the other, but the weight gradually increafes from the time it is firft raifed till it is quite raifed.

Mr. Hornblower fome years ago propofed an hydraulic bellows of the fame kind as M. Triewald's, except that, to avoid the flexible tubes of leather R R, he employed a lead pipe to go down to the bottom of the ciftern of water in which the bellows defcended, and turn up again beneath the bellows, fo that the orifice of the pipe was above the furface of the water; it therefore communicated at all times from the interior of the bellows to the furnace. Mr. H., in Nicholfon's Journal, mentions a very ftriking difference between thefe water-bellows, in which the moving cheft was eighteen inches fquare and moved perpendicularly nine inches, and a common pair of fmith's leather-bellows of thirty inches long.

The leather-bellows threw confiderably more air to the fire, and its nozzle, compared with the water-bellows, was as 73 to 60 in diameter, but it did not produce fo great an effect in bringing on the heat; and the noife of the water-bellows was fo great as to almoft drown that of the common one. The only difference in other refpects is, that in the hydraulic bellows, the pipe went under ground for about eight feet, and the connecting pipe of the other came down about the fame diftance from the fhop above.

WATER-*Bomb*, a name given by our chemift Godfrey to a machine he invented on the plan of Greyl's difcovery, for the extinguifhing of accidental fires in houfes. He confidered firft, that the unchangeable fize of Greyl's engine was a very great objection, and on this plan contrived a medicated liquor, which was fuch an enemy to fire, that a very fmall quantity would extinguifh as much as a much larger of common water; and this liquor had the farther advantage, that it might be kept ever fo long without corrupting, and by that means the veffels containing it would remain always fit for ufe; whereas in Greyl's method they muft have been rotted by the corrupting and fermenting of the water, after a few years. The author of this invention tried it twice in public with us, and both times with all the fuccefs that could be wifhed; but the ftructure of the veffel was fo much the fame with that of Greyl's, that Godfrey cannot be allowed any farther merit as an inventor, than that of contriving the medicated liquor inftead of common water. The machine is a wooden veffel, made very firm and ftrong, that the liquor, when once put in, cannot leak out any where; in the centre of this is an oblong cylindric veffel, which is filled with gunpowder; a tube is brought from this to the head of the barrel; and this being filled with combuftible matter, and the inner cafe with powder, and both made of plate-iron, that no water may get in, the veffel is then filled with the medicated, or antiphlogiftic liquor. The top of the tube is then covered, and the thing fet by for ufe.

When there is occafion for it, it is only neceffary to uncover the tube, and fetting fire to the matter in it, it is conveyed to the veffel containing the powder, and the whole machine being thrown into the place where the fire is, is torn to pieces by the explofion, and the extinguifhing liquor fcattered every way about, on which the fire is quenched in an inftant.

The contriver of thefe things propofed the making of three kinds of them, the one containing five gallons of the liquor: this was the largeft fize, and contrived for the largeft rooms, and moft urgent neceffities. The fecond kind contained three gallons; and the fmalleft, which was meant for a clofet, or other little room, contained only two gallons. Thofe of the fmaller kind alfo had fometimes a peculiar difference in their ftructure, the powder-veffel being placed not in the centre, but at the bottom: the intent of this was to fit them for chimneys, when on fire, as by this means the liquor, not being wanted to be fcattered on all fides, was carried moftly upwards. Thefe were fixed on the end of a long pole, and by this means thruft to a proper height up the chimney; and the tube that communicated the fire was placed downwards.

The manner of ufing the machines for rooms on fire, is this: the perfon who has the care of them is to throw them as nearly as may be into the middle of the room, and then to retire to a little diftance: as foon as he hears the explofion, he may fafely enter the room, and with a cloth, or any thing of that kind, put out any remaining fparks of fire that there may be in particular places. If the room be fo large, that one of the machines cannot difperfe the liquor to every part of it, two are to be ufed, one being laid at each end: and if feveral rooms are on fire at once, as many of the machines are to be ufed, one being thrown into each room. If a whole houfe is on fire, the lower rooms are firft to be taken care of, and after thefe the upper, as they afcend.

Our Godfrey had fcarce better fuccefs than his predeceffor Greyl; for while he was making his public experiments, one Povey, collecting fome of the fragments of his broken veffels, found out the ingredient ufed in the medicated liquor, and made and fold the things in the fame place where he had proved his right to them. It is probable that the medicated liquor was no other than common water, with a large quantity of fal ammoniac, that falt having this virtue of extinguifhing fire in a very remarkable degree. But it is to be greatly wondered at, that while all the world were convinced by experiments of the ufe of the machine, the author made but little advantage of it, and it is now difufed. Act. Erudit. Ann. 1724, p. 183.

The fociety of arts and manufactures, &c. made trials of balls prepared in Mr. Godfrey's method, by his grandfon, in a proper edifice erected for this purpofe; and they found, that, after the fire had prevailed for a confiderable time, and the flame forced its way through the chimney and windows, it difappeared, and was entirely extinguifhed by the explofion of two of thefe balls. See FIRE, *Extinguifhing of.*

WATER-*Borne*, in the *Sea-Language*, denotes the ftate of a fhip, with regard to the water furrounding her bottom, when there is barely a fufficient depth of it to float her off from the ground; particularly when fhe had for fome time refted thereon.

WATER-*Camblets*. See CAMBLET.

WATER, *Cataract of*. See CATARACT.

WATER-*Clock*. See CLEPSYDRA.

WATER-*Colours*, in *Painting*, are fuch colours as are only diluted

diluted and mixed up with gum-water: thus called, in contradiftinction to *oil-colours*. See WASHING.

The ufe of water-colours, makes what we call LIMNING; as that of oil-colours does PAINTING, properly fo called.

Painters in water-colours have been often afflicted with the difeafe called colica pictonum, occafioned by the poifonous quality of feveral of the pigments which they ufe; and which, by putting the point of their pencils between their lips, whilft they are ftudying their fubject, they infenfibly fwallow. Dr. Fothergill fays, that, when the vomitings are abated, copious difcharges by ftool are procured, and the functions of the bowels in a degree reftored to their ufual ftate by the method purfued in the cure of the colica pictonum; nothing contributes fo effectually to reftore the ufe of the limbs, when impaired by thefe caufes, as the liberal and conftant ufe of the tinctura guaiacina volatilis; which may be given in fuch quantity, as to keep the body gently open; mixed with a little common fugar or honey, and then diluted with any weaker mucilaginous liquor, as thin gruel, or barley-water, or marfhmallows-tea. Med. Obf. vol. v. p. 394.

WATER-*Cifterns*, for *Rural Purpofes*, fuch as are formed for different domeftic ufes. In high, dry, upland fituations, cifterns of this kind are of great utility and importance in many parts of the country. In the account of the agriculture of the North Riding of Yorkfhire, it is ftated that in the high eaftern parts of it, water-cifterns or refervoirs are made by the inhabitants within the ground, which are highly ufeful: thefe, it is faid, are fed by the rain-water which falls upon the roofs of the buildings, and is conducted from thence by fpouts. That in thefe cifterns a very ample fupply of foft water is always ready at hand; and that by their being under ground, and kept clofe, the water is fweet and fuitable for every domeftic or other ufe.

A water-ciftern of this fort is ftated to be formed in this manner. A cube of the required fize being dug in the ground, and the fides made even and perpendicular, the bottom is covered with fo much clay, as that, when well beaten, will be four inches thick; a foundation of ftone is then laid round the fides; upon the clay, a brick floor is laid in terras, the furface of which fhould not be lower than the top of the foundation; the fides are then built a fingle brick thick, and the bricks laid in terras, a foot fpace being left betwixt the wall and the earth, which is gradually filled with clay in a foft ftate; and this well beaten as it ftiffens; the whole is arched over, leaving a hatchway for a man to go in and clear it out, and an opening or paffage into a drain, for the furplus water to run or be taken off, when the ciftern is full.

The water is raifed for ufe by means of a pump. In thefe cafes, as keeping all external air out of the ciftern contributes, it is faid, much to the fweetnefs of the water; the pipe by which the ciftern is fed fhould be continued to within a few inches of the bottom, and the furplus water be conveyed off by a pipe rifing from near the bottom to the extreme height the water is defigned always to be at, when that takes place, and there communicate with the drain: by thefe precautions, it is faid, there will be no more of the furface of the water expofed to the external air, than what is within thofe pipes and that of the pump.

This method of forming water-cifterns may be found ufeful, cheap, and convenient, in many places, where fuch water is neceffary to be preferved pure and fweet.

Cifterns of this fort have fometimes the title of water-cellars, and are of great convenience and ufe for farm-yards. See WATER, *River*, *Collecting of*, and WATERING *Live-Stock*.

WATER-*Courfes*, in *Agriculture*, are fuch larges ditches or paffages for taking off the water as are formed, and remain conftantly for the purpofe in different places, and properly belong to the public.

They fhould be kept conftantly well opened and cleared out, not having too much fall given them, fo as to deftroy the evennefs of their bottoms. See SEWER.

WATER, *Cut*. See CUT-*Water*.

WATER, *Dead*, in *Sea-Language*. See DEAD-*Water* and SHIP-*Building*.

WATER-*Engine*, in *Mechanics*, denotes either an engine to raife water, or any engine that moves by the force of water.

WATER-*Falls*, in *Ornamental Gardening*, are thofe falls of water which are formed and introduced in pleafure or other grounds for the purpofe of producing ornamental and picturefque effects, or which naturally exift in fuch fituations. They are of different kinds and forms, being fometimes of the nature of cafcades, and at other times contrived for the intention of driving fome particular fort of interefting machinery, fo as to afford an agreeable and ftriking picture in the rural fcenery of the particular place where they are bad recourfe to. They are ufually conftructed, where they do not exift naturally, either by means of large rocky ftones thrown rudely together into a fort of ridge form of head, over which the water paffes, formed in the way of weirs, or built in mafonry in a careful and exact manner, according as the different nature of the circumftances and fituations may require. See WATER.

Mr. London, in his ufeful work on "Country Refidences," has well defcribed and delineated feveral different modes of forming water-falls. They fhould, he thinks, be natural, ftrong, and lafting, from the general form of the whole of the materials, the fecurity and folidity of their foundations, and the quality of the work and materials ufed in building them.

WATER, *Foul*, in *Sea-Language*. See FOUL.

WATER-*Fowl*. See FOWL.

WATER-*Furrow*, in *Agriculture*, a deep open furrow drawn by the common or a large double mould-boarded plough made for the purpofe, in a proper direction of the field in arable lands, or thofe in the ftate of tillage, for the ufe of conveying and taking off the fuperabundant hurtful water, and preventing the ftagnation of it from injuring the crops. This is efpecially neceffary and proper in the winter feafon, and often in others. It is therefore effential that, as foon as poffible after fowing moft forts of grain, but particularly wheat, when there is any difpofition in the foil or land to the retention of moifture in too large a proportion, there fhould be as many water-furrows opened in this way as may be fufficient for carrying off and completely removing the excefs of water, and thereby preferving the ground in a properly dry and found condition for the healthy growth of the crops. It is obferved by the writer of a late Calendar of Hufbandry, that the making of proper water-furrows is a circumftance of much importance in the culture of wheat, but that it is oftentimes ftrangely neglected. It is a work, however, that fhould be well and effectually performed on all lands, except thofe that are perfectly dry all the winter through. The water-furrows fhould be formed by the plough, as foon as the field bas been finifhed ploughing, fowing, and harrowing, and then a fpit of earth fhould be dug from out of the bottoms of them, and laid on one fide oppofite the rife of the land or ridge, and the loofe mould in the bottom parts be well fhovelled and cleaned out, fo as to make a perfectly free paffage for drawing off the wetnefs; the openings of all the common ridge-furrows being

being likewife well cleanfed at the fame time, fo that the water may have an eafy fall out of every one of them into the large water-furrows. The number of thefe large furrows muft conftantly depend on the variations of the furface, and fome other circumftances of the lands: the only general rule is to make them fo many in number, as that no water may be fuffered to ftand on any part of the land in the wetteft weather. In the bottoms or low parts of fields, or in other places of them where there is a double flope of the land, it is neceffary to form and cut double water-furrows at the diftance of about a yard or four feet from each other, in order to take the water from each defcent fingly.

The fame writer, too, farther advifes, that in all lands fown with clover or other graffes among the corn, thefe forts of furrows fhould be dug a fpit deep, and the mould raifed in that way be carefully thrown out. Many farmers, it is faid, are not attentive enough to this point. They only fcour the furrows in fuch cafes. They fhould, however, it is thought, confider how long the grafs crops are on the ground, which may be two or three winters; confequently it muft be very material to fuch crops to lie dry all that length of time, which fcouring alone will not effect, at leaft not in a fufficiently perfect manner. Particular attention fhould alfo be paid to the fpreading of the earth that is dug out of the furrows in thefe cafes, as if the men be not cautioned, they will lay it too thick and injure the crops; it fhould be chopped and rendered fmall, and then fpread with great care, in order that the feeds may rife freely through it.

In the cafe of arable land, thefe furrows fhould be often examined during the winter feafon, to fee that they are perfectly open and free; the clods, lumps, and other fuch matters that may have fallen into them, being cleared out by means of the fpade.

This is a practice which is either much overlooked, or very imperfectly executed, in a great many diftricts of the kingdom. The fides of the furrows in thefe cafes fhould always be made to ftand firm, and to have a good flope each way, which prevents their falling in and mouldering down fo much. The name of water-furrow drain is fometimes given to this fort of furrow. See WATER-*Furrowing*.

WATER-*Furrow Fall Plough*. See the next article.

WATER-*Furrowing*, a term ufed to fignify the operation of opening water-furrows. It is a fort of work moftly executed by the affiftance of a large plough for the purpofe and the fpade, but fometimes by the plough alone. And in fome parts of the county of Effex, particularly in the neighbourhood of Colchefter, they have a method of doing it by means of a machine that is termed a fall-plough: in the lines where this fort of furrowing is to be performed acrofs the ftitches or ridges, this fort of tool is ufed there once in fix, feven, or eight years, for the purpofe of lowering, or, as they call it, *falling* the furface. They firft gather four or fix furrows by the plough; then follows this implement acrofs thefe furrows, in their loofe frefh ploughed ftate, taking up the parts of the mould, and dropping them on the crowns or fides of the ftitches or ridges, and when finifhed, the water-furrows are ploughed and fcoured in the common manner: the invention is faid to have merit, as the water certainly takes a freer courfe than in the ufual method. In a dry feafon, a large extent of ground can be done in a fhort time, at little expence, in this way.

Some think this work done in the neateft and moft effectual manner by means of a fhovel; and that an old worn fhovel is the beft for the purpofe. See WATER-*Furrow*.

WATER-*Gage*, the name of a fimple contrivance for meafuring and afcertaining the depth or quantity of any water in its application to any purpofe, or otherwife. See GAGE.

WATER-*Gang*, a term applied to a channel or paffage cut through any fpot to drain and free a place of water by carrying off a ftream from it.

WATER-*Gavel*, in our *Old Writers*, a rent paid for fifhing in, or other benefits received from, fome river.

WATER-*Gilding*. See GILDING.

WATER-*Lanman*, a fmall glafs inftrument, which is a tube of about three-quarters of an inch in diameter, with a ball about $1\frac{1}{2}$ inch at one end, the other end being hermetically clofed; the ball contains water, and the empty fpace is rendered nearly a vacuum by boiling the fluid previoufly to fealing it. In this inftrument the heat of the hand applied to the wetted tube, is fufficient to produce bubbles of vapour, which enter the ball, but fpeedily collapfe. The feries of thefe condenfations is as quick as 15 or 16 in a fecond. But in the fteam-engine the condenfation is prodigioufly more rapid. When a fmall double fteam-engine, on the conftruction of Boulton and Watt, having all the parts and gear of the large engines, but its cylinder being only $2\frac{1}{2}$ inches diameter, and the length of ftroke $6\frac{3}{4}$ inches, was fet to work; it gave 600 ftrokes *per* minute, or about twice as many as the beats of a common watch. By an eafy calculation it may be fhewn, that the fteam condenfed was then much more than 300 cubic inches *per* fecond; and if the condenfation, inftead of being effected in maffes of about a pint at a time, could have been performed by fucceffive collapfes of each cubic inch in an open fpace, the pulfes would have produced the tone of the loweft E flat in the treble cliff. But the number of cubic inches condenfed in a large fteam-engine, *e. g.* a three-feet cylinder with an eight-feet ftroke, will be eight or nine times as much at the ufual rate of working. See Nicholfon's Journal, vol. iv. 8vo.

WATER-*Level*, the level which is formed by the furface of ftill water, managed in fome way or other in a convenient manner for its application in different cafes; and which is perhaps the trueft of any for moft ufes. The term is alfo applied to and fignifies the level ufed in watering land, and performing different other operations in the bufinefs of agriculture. See LEVEL, SPIRIT-*Level*, and WATERING *Land*.

WATER-*Levels* are alfo lengths of canal in fome places, that are not connected by locks with other navigations; but at the ends of which the goods are unloaded into team-waggons. See CANAL.

WATER-*Line and Reel*, the ftrong large line and reel of the garden kind, which is ufed in forming fome part of the works in watering of land.

WATER-*Lines*, (fee SHIP-*Building*), are the lines of floatation fuppofed to be defcribed by the furface of the water on the bottom of a fhip. Of thefe the moft particular are thofe denominated the *light water-line* and the *load water-line*; the former, namely, the light water-line, being that line which fhews the depreffion of the fhip's body in the water when light or unladen, or when firft launched, called the *launching draught of water*; and the latter, which exhibits the fame when laden with all her guns and ballaft, or cargo.

WATER-*Logged*, in *Sea Language*, denotes the ftate of a fhip when, by receiving a great quantity of water into her hold, by leaking, &c. fhe has become heavy and inactive upon the fea, fo as to yield without refiftance to the effort of every wave rufhing over her deck. In this dangerous fituation of a fhip, the crew have no refource, except to free her

her by the pumps, or to abandon her by the boats as foon as poffible.

WATER, *To Make.* See MAKE.

WATER-*Machine.* See MACHINE.

WATER-*Mead* or *Meadow*, in *Agriculture*, a term applied to that fort of meadow or other inclofed low ground, which is capable of being improved and kept in a conftant ftate of fertility and productivenefs, by means of water from fome adjoining river, brook, or ftream, being thrown and conducted over it in the winter or other proper feafon. This manner and beneficial practice of forming meadows has prevailed locally for fuch a very great length of time in different parts of the country, efpecially in Wiltfhire, Gloucefterfhire, and Devonfhire, that it is extraordinary that it has not been generally adopted and introduced into other diftricts, where it is equally capable of being had recourfe to without great difficulty, and where it may be equally advantageous and proper. This neglect has been afcribed by a late intelligent writer to a deficiency of information among farmers in general, in regard to the nature and management of the bufinefs, and particularly in what relates to the nature of levels, and the means of adjufting them in different cafes. Thefe circumftances, it is fuppofed, have confined it to the weftern diftricts and parts of the kingdom. Other caufes may, however, have operated in this way, as the facilities afforded by the fituations of the lands in general, the numerous rivulets and ftreams always ready at hand for the purpofe, and many others of the fame nature.

It is neceffary that water-meadows fhould have fuch a form, either by nature or art, as that this fluid may be capable of flowing over their furfaces in a rapid manner, in order to produce and promote the early and quick growth of the grafs in a healthy ftate. It is effentially neceffary, too, to their perfect fuccefs and completenefs, that there be at all feafons a full command of the water, as well as of the means of diftributing it to every part of them, and of difcharging it in a complete manner, whenever it may become requifite. See WATERING *Land.*

As to the advantages to be derived from meadows of this kind, they are very confiderable, not only in the vaftly increafed quantities of hay which they afford, but alfo in the point of early fpring food for ewes and lambs, as well as in many other refpects and particulars.

It may be obferved, that from the grafs of water-meadows being fo very forward in the months of March and April, it is in general fed down or paftured in the fpring with fheep; and to thofe farmers who keep them for breeding or fattening, becomes almoft invaluable, from the great fcarcity of green food at fuch a period; but that after being flooded in the latter end of the laft of thefe months, they are moftly fhut up for hay in the fummer.

And the after-grafs is eaten off in autumn by neat cattle, it being confidered as very pernicious and dangerous for fheep to pafture on water-meadows at that feafon. A remarkable inftance of its fatal effects is ftated by the writer of the Corrected Account of the Agriculture of the County of Suffex. Eighty ewes from Weyhill fair were turned into fome field adjoining a watered meadow: a fcore of them broke into the meadow for a night, and were taken out in the morning, and kept till lambing; when they produced twenty-two lambs, all of which lived, but every one of the ewes died rotten before May-day. The remaining fixty made themfelves fat, nor could a rotten fheep be difcovered amongft them. It is an extraordinary fact, it is faid, though not eafily accounted for, that the grafs of watered meadows fhould be fo nourifhing to fheep in the fpring, and yet have fo deftructive an effect on them in the autumn. The fact feems, however, to be well and indifputably eftablifhed. It may probably depend upon the grafs being in a more foft and loofe watery ftate of production in the autumn than what it is in the vigorous growth of the fpring. See TATH and WATER-*Tath.*

By the author of the "Treatife on Watering Meadows," it is advifed that no fheep, except thofe that are juft fat, fhould ever be fuffered, even for an *hour*, in watered meadows, as they will infallibly rot them at any other feafon than the fpring, but efpecially if made from low, boggy, or fwampy ground; but that it is not fo, when made from dry heathy land. Others, however, think it dangerous on all, and therefore always to be avoided.

It cannot be doubted but that on farms of this nature, where it is convenient to have three or four meadows that can be watered, they will be found particularly advantageous; as, while neat ftock are eating the firft, it is faid, the fecond will be growing, the third becoming dry, and the fourth under water: by which an extenfive fyftem of feeding and producing of dry fodder may be carried on.

It is noticed by Mr. Smith, in a late effay on thefe kinds of meadows, that even a fmall piece of this fort of meadow, which will produce an early crop of fpring feed at the very time of the greateft preffure of fcarcity, and when the turnips ought to be off the ground, muft be much more valuable to a poor arable farm than can eafily be imagined by any one who has not witneffed the great utility derived from them, in many parts of Wiltfhire. What, but for the water-meadows, could enable the Wiltfhire farmers, it is afked, to bring to market a much greater number of fheep, and that at an earlier feafon than can be produced from any other county in the kingdom? The water-meadows have unqueftionably a great fhare in doing this.

They afford there, it is faid, an early fupply of grafs for the forward or early breed of lambs, on which they begin to feed them about the middle of March, having previoufly withdrawn the water from them, and laid them perfectly dry. It is obferved, that on a good crop of grafs of this kind, it has been faid, that five hundred couples may be fed on an acre for one day. The practice is to hurdle out, daily, fuch a portion of the ground as is neceffary, leaving a few open fpaces in the hurdles, through which the lambs may feed forward on the frefh grafs. The hours they are fuffered to feed on this grafs, in fuch cafes, are from about ten o'clock in the morning until five in the afternoon, when they are generally folded on the contiguous barley fallows, or lands in preparation for that crop. This is a practice or fort of management, too, which is fuppofed to have a great advantage, in confequence of its manuring a part of the farm without the dunghill. The manure, however, in fuch cafes, is drawn from, and at the lofs of fuch meadows.

The writer of the Corrected Report of the Agriculture of the County of Middlefex mentions a remarkable inftance of the beneficial and fertilizing effects of water in thefe meadows, as occurring in the early part of the autumn of 1796, when fuch grafs lands as had not had the advantages of water, as in thefe cafes, were nearly burnt up. A clofe of about twenty acres, which had been watered in this way, had, it is faid, a moft luxuriant after-grafs of from fix inches to a foot in depth; and a neighbouring inclofure of near forty acres afforded fupport for three months to forty-feven horfes and bullocks, all which throve very well. And another cafe of the fame nature is recorded, in which forty acres employed in this way were found equal to the fupport of five hundred Wiltfhire ewes, from the middle of the month of March to the firft of May, or about fix weeks;

and

and that the improvement of the ſtock in that time was one ſhilling a week, or three pounds fifteen ſhillings the acre. In ſome parts of the ſame county, five pounds worth of hay might alſo, it is ſaid, be taken off the firſt week in May. Theſe facts and ſtatements ſtrongly prove and diſplay the utility of theſe meadows, wherever they can be properly provided.

In ſpeaking of the management of water-meadows, the author of the eſſay already noticed remarks, that in thoſe great diſtricts of water-meads, which in Wiltſhire are watered by the common conſent of many different proprietors and occupiers of land, the operation of floating muſt begin and end at certain fixed periods, which it is neceſſary for every one to know, and regularly adhere to, not only in order to the production of a crop of graſs, but for the procreation of thoſe animals that eat the graſs: conſequently, as every farmer knows at what time he ſhall have graſs for his ſheep, he ſo manages his breeding flock, that his lambs may be ſtrong enough at the uſual time of feeding to go with the ewes to take their food in the meadows, and return to the fold for lodging.

It is noticed, that the time to commence the feeding on the meadows upon thoſe large ſtreams in this county is generally about the twenty-fifth of March: therefore, if the winter be very mild and favourable for the growth of graſs, it ſometimes gets to ſuch a height as many farmers, unaccuſtomed to the herbage, might think to be much too coarſe and luxuriant for ſheep, and even too high to be fed off with cattle. So great was the luxuriance of the graſs in the water-meads of Wiltſhire, it is ſaid, ſome years ſince, occaſioned by the mild growing weather immediately after the commencement of floating, that ſome farmers laid their meadows dry, and fed them off in November, and the following month; and then, by floating again, obtained a crop of feed in the ſpring before the uſual period. Many who did not adopt this method lamented that their graſs was too high, even in the month of February; and it was then not uncommon to ſee it in the water-meads nine inches high, but laid on the ground, and white at the bottom, before the lambs were ſtrong enough to go into the meadows. Some apprehended, it is ſaid, that the long four graſs would be waſted; yet it was aſtoniſhing with what avidity the ſheep devoured it, and even preferred the parts that were the longeſt, and rendered white at bottom, in conſequence of the extreme thickneſs: this they would, it is obſerved, gnaw down to the very roots. It was remarked by Mr. Davis, it is ſaid, that the graſs then on one Rickwood's mead was ſuch a crop as, at the uſual time of cutting it, would have been eſtimated at 18 cwt. *per* acre. Many declared that they never ſaw the crop of the water-meads ſo very abundant and early; but on viſiting the ſame meadow, at the particular requeſt of the above-named friend of the writer, on the tenth of March, when it had been in feeding more than three weeks, and aſking the floater if they ever began to feed it ſooner, he replied that he had had the management of the meadows more than thirty years, and never knew it ſo early but once, when they began feeding it on the eleventh of the firſt month in the year. The writer walked over the greateſt part of this extraordinary piece of ground with ſome conſiderable difficulty, it is obſerved, from the thickneſs and height of the graſs; and he could diſcover but one place, to the great credit of the floater, which was worſe than another, and that not two rods ſquare. The man ſoon ſaw it noticed, it is ſaid, and before the writer could mention the circumſtance, told him he knew what he was looking at, and had contrived to do away even ſuch a trifling defect: ſo this may be truly ſaid to be, the writer thinks, a ſpotleſs meadow. This ſhews the nice attention and great care beſtowed in forming water-meadows in this diſtrict; and in ſome other counties the care beſtowed upon the water-meadows is probably not much, if any leſs. This would ſeem to be particularly the caſe in the county of Glouceſter, where very great attention is given to the floating of them, to the manner of feeding them down by live-ſtock, and the ſhutting them up for the production of hay, as well as in every other part of their management.

They are there, too, equally valuable and important in the quantity and utility of the produce which they afford, as well as the qualities of it, yielding much profit to individuals, and advantage to the whole diſtrict.

The utility and benefit of water-meadows are indeed now beginning to be every where well underſtood, wherever they are capable of being formed in a convenient and ſuitable manner.

Water-meadows are in general calculated to afford an early ſpring feed for ſheep, or other ſorts of live-ſtock, which may be continued in feeding by them until towards the beginning of the month of May, when, if deſigned for the producing of hay, that muſt then ceaſe; as, if perſiſted in even for a ſingle week in that month, the hay would, as ſuppoſed by ſome, be wholly ruined in quality, being rendered ſoft, woolly, and unſubſtantial, as in the caſe of aftermath crops: but being then ſhut up, and floated for ſome days, a crop of hay is next produced, which is in readineſs for the ſcythe in about ſix weeks; and this crop being removed, and the meadows again floated as before, a third or aftermath crop is afforded, for being paſtured by neat cattle and horſes, but never, or in few caſes, by ſheep, or for being uſed as cut green food in houſe-feeding, which, in ſome caſes, is probably the moſt beneficial application of it; as where one or two more ſuch crops are cauſed and taken in the ſame way, at the ſame ſeaſon.

The great ſuperiority of the produce from water-meadows is thus rendered very evident, and the uſes of it not of leſs value or importance.

Water-meadows ſhould conſtantly be well eaten down before they are floated, but eſpecially in the autumn.

It is of great advantage, in many different reſpects, to have ſeparate water-meadows, which can be alternately in the courſe of feeding off, floating, and being laid dry, as has been already ſeen; as, by this means, their benefits can never be loſt for any length of time. And it is particularly beneficial in providing an uninterrupted ſucceſſion of aftermath paſturage, or of that ſort of graſs for being cut and uſed green in the ſtalls.

Any thing which is done to the ſurfaces of water-meadows, in the way of rolling or giving them preſſure, ſhould always be done while they are in a quite dry ſtate, about the beginning of the month of March, and never when they are much in a moiſt condition.

The hay produce of meadows of this ſort is moſtly proper for all kinds of neat cattle and ſheep, but not ſo ſuitable for horſes, eſpecially thoſe of the working or team kind.

WATER-*Meaſure*. Salt, ſea-coal, &c. while aboard veſſels in the pool, or river, are meaſured with the corn buſhel heaped up; or elſe five ſtriked pecks are allowed to the buſhel. This is called water-meaſure; and this exceeds Wincheſter-meaſure by about three gallons in the buſhel.

WATER-*Microſcope*. See MICROSCOPE.

WATER-*Mill*, in *Rural Economy*, that ſort of mill which is turned by the power or force of water applied in ſome way or other. As mills of this kind often form and oppoſe great obſtructions to different improvements of the farmer,

 and

and especially in the practice of watering land, they should consequently be diminished in number as much as possible in such cases, and those of the tide and wind kinds be substituted in their places, as might be done with great facility in many instances. See MILL.

WATER, *Mother*, in *Chemistry*. See CRYSTAL.

WATER *Ordeal*, or *Trial*, was of two kinds; by hot, and by cold water. See ORDEAL.

WATER-*Organ*. See ORGAN.

WATER, *Petrifying*. See PETRIFYING.

WATER-*Poise*. See HYDROMETER, and ARÆOMETER.

Dr. Hooke has contrived a water-poise, which may be of good service in examining the purity, &c. of water. It consists of a round glass ball, like a bolt-head, about three inches in diameter, with a narrow stem or neck, one twenty-fourth of an inch in diameter; which being poised with red lead, so as to make it but little heavier than pure sweet water, and thus fitted to one end of a fine balance, with a counterpoise at the other; upon the least addition of even $\frac{1}{1000}$th part of salt to a quantity of water, half an inch of the neck will emerge above the water, more than it did before. Phil. Transf. N° 197.

WATER-*Proof Cloth and Leather*. It would be very desirable to render the principal articles of clothing impenetrable to water, provided it could be done without injuring the pliability of the cloth.

The most common resource is to line the garment with oiled silk, such as is used for hat-covers and umbrellas; that is, silk which has been dressed with a varnish of drying linseed oil, so as to prevent the admission of water. This effectually guards the wearer of such a garment from becoming wet; but it is not perfect, for the outside cloth can imbibe moisture, which will evaporate by the wind, and cause great part of that coldness which renders wet clothes so prejudicial.

What would be desirable is, that we should give to cloth the same property which we find in the fur of several animals; the otter, beaver, and water-rat. This is a repellence of water, which when thrown upon the animal rolls off in pearl drops, without wetting the fur in the least; but we observe this only in the living animal, and when in a state of health, for these animals are known to be sick when they are found to be wetted after having dived in the water. This perfection has not yet been attained, but we shall proceed to state what has been attempted, with a view of water-proof varnishing for cloth.

Mr. Albert Angel, in 1781, had a patent for preparing an elastic varnish for this and various other purposes. His receipt is, linseed oil, or nut oil, one gallon; bee's-wax (yellow or bleached), one pound; glue or size, six pounds; verdigris, a quarter of a pound; litharge, a quarter of a pound; spring or rain water, two quarts; to be put into an iron kettle, and melted down till it forms the composition.

Caoutchouc, or elastic gum, called Indian rubber, is a substance which has engaged the attention of philosophers, ever since it has been known. Its singular elasticity, its flexibility and impenetrability to water, have caused it to be considered as very valuable for this purpose.

It is not possible to effect the liquefaction of caoutchouc, by means of heat; it will melt as well as other resins, but when cooled, it remains liquid and adhesive. Alcohol or spirit of wine, the usual solvents of resinous substances, do not act upon it, nor is it dissolved in water, as gums are; it was then tried to dissolve it in drying oils, and it was found that by the aid of heat, the caoutchouc may be dissolved, and form an excellent varnish, supple, impervious to air or water, and resisting a long time the action of acids. With such varnish Messrs. Charles and Roberts covered their air-balloons.

Several essential oils, as those of turpentine and lavender, act upon the caoutchouc, even when cold, and these are of no great price. The disagreeable smell of the oil of turpentine becomes, perhaps in process of time, less disagreeable than that of the lavender.

The oil of turpentine always leaves a kind of stickiness.

The following process is described in a patent granted to Mr. Henry Johnson of London in 1797, for rendering cloth and other articles water-proof.

The article to be operated upon, must first be cleansed from all grease or dirt by washing it with an alkaline solution, and then stretched in a frame. The water-proof compound, as it is termed, is formed by dissolving caoutchouc or Indian rubber in spirit of turpentine, (the smell of which is taken off by adding oil of wormwood, and spirit of wine in equal quantities;) this forms a sort of varnish, which is capable of being spread, or washed over the surface of the leather or cloth, always applying it on the wrong side of the article, or that side which is not to be seen. The varnish is laid on by means of a large piece of Indian rubber, instead of a brush or sponge. To conceal the varnish and make a good internal surface to the cloth or leather, it must be sifted over with some substance, such as silk, wool, or coney, cut very fine, in the same manner as flock paper is made; and being left to dry, in a few days the flock, by its adhesion to the varnish, forms a very good lining, at the same time that it conceals the varnish. These articles were called by the patentee hydrolaines, and were loudly recommended by advertisements, but never came much into use.

M. Pelletier's Method of making Varnish of Caoutchouc, or elastic Gum, by dissolving it in sulphuric Ether.—Boil the elastic gum for the space of an hour in common water, by this it becomes soft enough, to be cut into small threads; being thus divided, put it again into boiling water, and keep the vessel on the fire for about another hour; this second boiling penetrates the elastic gum very sensibly, and deprives it of that hardness which it possesses in the first state.

When the gum is thus divided and softened, put it immediately into a matrass, or any other closed vessel, containing rectified sulphuric ether. In the course of a few hours the ether penetrates the elastic gum (which swells very considerably), and at the end of a few days the solution is complete, without the assistance of heat, provided a sufficient quantity of ether is made use of.

According to this process, the solutions are of a white colour and transparent; the heterogeneous and sooty particles, which the elastic gum generally contains, fall to the bottom of the vessel in which the solution is made, and have a sooty appearance, so that by merely decanting the solution it may be obtained very clear.

Mr. Parrish and Mr. Ackermann have likewise had patents for the same object; the latter succeeded much better than the elastic varnishes.

Water-proof Leather.—In the memoirs of the Academy of Sciences at Turin, 1789, is a paper by the chevalier de St. Real, on the manner of rendering leather impermeable to water, without diminishing its strength or its suppleness, and without sensibly augmenting its price. M. St. Real shews that skins may be tanned in such a way as to give this desirable quality to the leather, and in other respects with benefit to the tanner, by reducing all the processes of the art to the following.

For strong ox or cow leather, which is used for making the outer soles of shoes and boots.

1st, Soak the green hides, separate from each other, in running

running water, a ſufficient time to extract all the ſoluble animal matter or lymph; it will be eaſy to determine when that is done, by putting a piece of the hide into water, and heating the water gradually; if no ſcum is formed upon the ſurface, it is a proof that no lymph remains.

2dly, Place the hides (after they have been waſhed and cleaned) in a cauldron, ſimilar in conſtruction to thoſe in which common ſalt is made; fill the cauldron with water, which is to be heated to 167 degrees of Fahrenheit, and no more: after the hides have been one hour expoſed to this degree of heat, take them out.

3dly, Stretch them upon the horſe, and proceed to take off the hair in the uſual manner.

4thly, Put them again into the cauldron (which ſhould be ſo contrived that it may receive as much water from a cock on one ſide as is let out from a cock on the other ſide), and ſo keep up in this cauldron a conſtant current of water, of the heat of 60 degrees.

5thly, Let the hides remain in this cauldron till the water no longer contains any animal jelly; which may be eaſily known by evaporating a ſmall quantity of it.

6thly, Take the hides out of the water and place them upon the horſe, that the cellular and muſcular membrane may be taken off.

7thly, Waſh the hides again in running water, then put them again into the cauldron, or one ſimilar to it, which is to be filled with filtered tan-liquor. This liquor is to have the ſame degree of heat that the water had in the former operation; the ſkins to remain in it till they are completely tanned, taking care to put freſh tan-liquor in the place of that which ſhall appear to have loſt its energy by the combination of its aſtringent principle with the hides; this may be readily known by dropping in a few drops of a ſolution of green vitriol.

The author ſtates, that leather made according to this ſyſtem would be more free than any other from the animal jelly, which is not combined with the tan, and conſequently would be leſs ſuſceptible of moiſture. The fibrous part of the ſkin being more ſtrongly acted upon by the tan-liquor when heated, would become more firm and more difficult to be penetrated by water; it would be increaſed in ſtrength and compactneſs, without loſing any part of its ſuppleneſs.

That excellent Swediſh leather ſo ſuperior to all other, of which boots, breeches, and great-coats are made, is capable of reſiſting the moſt violent rains. This leather is prepared in Jutland with hot water.

In the common way the tanner contents himſelf, before he delivers the leather to the ſhoe-maker, with beating thoſe parts which are ſoft, or which have a very irregular ſurface, upon a ſmooth log of wood with a mallet. The more careful tanners beat all their hides; and this practice is general in England.

Beſides the ſtrong ſole-leather already mentioned, leather of a different kind is uſed in a great variety of arts and manufactures. It is made of ſkins of cows and oxen, but more generally of calves'-ſkins; it ſerves to make the ſoles of pumps, or women's ſhoes; for belts, harneſſes, covering trunks, &c. or the inner ſoles of men's ſhoes, and the upper-leathers; in ſhort, any kind of work in which the thickeſt and ſtrongeſt leather is not required. All this ſort of leather is curried, becauſe leather as it comes out of the pits is by no means fit for the various uſes for which it is intended: it is rough, of an unequal thickneſs, and unmanageable. The object of the currier's art is to ſupple it, and to give it an uniform compactneſs and denſity; this object he fulfils by the following operations:

1ſt, He treads the ſkins, that is, after having ſoaked them till they are ſoftened, he kneads them with his feet, to make the water penetrate every part equally.

2dly, He works them with the pummel; this is done by applying to the ſkins a ſquare tool made of hard wood, about a foot long and five inches broad; it is furrowed longitudinally, and convex at the bottom and flat at top; it is fixed to the workman's hand by a leather ſtrap ſo that it cannot ſlip. This tool by being worked forcibly along both ſides of the ſkin, firſt upon the ſide of the epidermis, and then on that of the fleſh, forms the grain of the leather, and gives it ſuppleneſs.

3dly, He then works the ſkin with an iron inſtrument with a blunt edge; with this he ſcrapes very ſtrongly thoſe parts which are too thick, thoſe in which there is left any fleſh, or any tan, and thoſe in which there are hollows; ſtriving as it were to preſs the ſuperfluities of the thick parts into thoſe which are too thin, and thus to give to every part of the ſkin an equal thickneſs and an uniform denſity.

4thly, He pares the ſkin with a paring-knife; this paring-knife is circular: the workman cuts away thoſe thick and projecting parts which the operation juſt deſcribed was not able to remove; ſo that this laſt operation may be conſidered as completing the object of the preceding one.

After the four operations above-mentioned, the leather is ſupple and ſmooth, and of an equal thickneſs and denſity in all its parts: it is now in a ſtate capable of being employed by the workmen who make uſe of it. But the very operations which give it theſe valuable properties appear to injure its compactneſs. The leather by being beat, ſtretched, and ſcraped, muſt neceſſarily become more ſpongy, and conſequently more permeable to water. To remedy this inconvenience, the currier impregnates it with fat or oil.

To dreſs leather with fat, it muſt firſt be made perfectly dry. The pores of the leather are then dilated, by paſſing it over a clear ſtrong fire, and it is rubbed over with a kind of woollen mop dipped in melted fat, pretty hot. The fat thus applied to each ſide of the leather penetrates into its ſubſtance, lodges within its pores, and adhering there fills them up ſo as to preclude the entrance of any moiſture; ſhould the leather be wet when the fat is applied, it will remain upon the ſurface, and not penetrate into the ſubſtance.

The manner of dreſſing leather with oil is the reverſe of this, and is founded upon the property which water poſſeſſes of ſwelling thoſe ſupple and elaſtic capillary tubes into which it inſinuates itſelf; alſo that of its not being miſcible with oil, and upon that of its evaporating much more ſpeedily than oil.

The currier therefore ſoaks thoſe ſkins in water which he means to dreſs with oil, and while they are yet wet, he ſpreads over them with a wool mop any kind of fiſh oil. As the water evaporates, the oil takes its place; and conſequently the more the ſkins were ſwelled with water, the more thoroughly they become impregnated with oil.

M. St. Real found the cow-leather dreſſed with fat imbibes more water than the calf-ſkin dreſſed with oil; but he attributes this difference to the manner in which the currier applies the fat. He rubs the leather with a kind of mop, dipped into melted fat moderately warm, it ſeems impoſſible that, by this manner of applying it, the fat can penetrate into the interior parts of the leather; the air contained in its pores oppoſes an invincible obſtacle to the penetration of it. On the contrary, there is no air in the pores of the wet leather upon which the oil is applied, and the permanent fluidity

fluidity of the oil itſelf alſo facilitates its paſſage into the leather.

To make the leather imbibe the fat, he propoſes three or four days immerſion in running water, to drive out the air; then to ſoak the leather in melted fat, of the temperature of 167 degrees of Fahrenheit, till all the water in the leather is evaporated by the heat; the fat would then penetrate into the interior pores of the leather, and render it impermeable to water.

If leather is compreſſed, it evidently diminiſhes the thickneſs, and increaſes its compactneſs; and if it is beaten with an iron hammer upon a very ſmooth anvil, it produces a permanent contraction of its pores. Leather is in that reſpect very much like iron, and all other metals which harden by beating; and, conſequently, our author ſuggeſts that it would be of great advantage to compreſs the leather before it is uſed, by paſſing it between a pair of rollers, ſuch as are uſed to flatten metal: this would ſtiffen the leather.

It appears from experiment that the ſtrong ſole-leather, by being properly impregnated with fat, and compreſſed in the rollers, abſorbs only one-thirteenth part of water, imbibed by the ſame leather which has not undergone thoſe operations. The quantity of water which the firſt abſorbs, and which amounts to about one-thirtieth part of its weight, is ſo ſmall, that it does not render it capable of wetting any ſubſtance it may come in contact with, nor does the leather appear wet when taken out of the water; it may therefore be conſidered as almoſt impermeable to it.

The cow-leather, when impregnated with fat, and compreſſed, abſorbs about one-ninth part of the water abſorbed by leather of the ſame nature which has not undergone thoſe operations. The quantity of water abſorbed by the firſt amounts only to the thirty-fourth part of its own weight.

The calf-ſkin, when impregnated with fat and compreſſed, abſorbs only one-third part the quantity of water that the ſame quantity of leather abſorbs when it has not undergone thoſe operations; and that quantity is not ſo much as one-fortieth part of the weight of the leather.

In this manner, without making any alteration in the uſual method of tanning, except with reſpect to the thin ſole-leather, it is poſſible to render leather very nearly impermeable to water, by the known operations of currying, provided to them are added compreſſion by rollers, and ſoaking in fat, as before deſcribed. The additional greaſing and preſſing will not ſenſibly increaſe the price of the leather, for it retains only about the ſixteenth part of its weight of fat.

The leather which had paſſed through the rollers was not diminiſhed in its ſtrength; for it ſupported, without breaking, weights as heavy as were ſupported by leather of the ſame kind which had not undergone that operation.

In 1794 Mr. Bellamy of London obtained a patent for a method of rendering leather water-proof, which he thus deſcribes.

Take nut oil, one gallon; poppy-oil, one gallon; and linſeed-oil, two gallons; or they may be in other proportions: put them into an iron veſſel, and ſet it over a gentle fire. To every gallon of the mixed oils, put half a pound of umber, or white copperas, ſugar of lead, colcothar, or any other proper drier, but obſerving to uſe a larger proportion than the above, when the oil is to be prepared for new leather, or a leſſer proportion when it is to be prepared for old.

Let the oils remain on the fire, and give it as great a degree of heat as it can bear without burning, or cauſing it to riſe, for ſix or ſeven hours; and if it will not dry ſufficiently continue the ſame degree of heat till it does: then take it off the fire, and when it is a little cooled, it is ready to be applied to make water proof leather.

This is done by a bruſh being dipped into the prepared matter, and rubbed or bruſhed into the leather.

When the article is well filled with the prepared oils, lay it on an even board, and ſcrape off what is ſuperfluous with a thin iron tool; then put it to dry in a warm room, and when ſufficiently dry it will be fit for uſe.

For ſole-leather of thick ſubſtance, let it be gently warmed, and with a bruſh or pad, made of wool or hair, rub or bruſh the prepared matter on the leather, till it is thoroughly ſaturated; then let it dry in a warm place, and it is ready for uſe.

The proportion of the mixtures of oils, muſt be varied according to the nature of the oil, and alſo according to the nature of the leather, for the ſame kind of oil will not always have the ſame qualities.

Oils expreſſed at different times will frequently have a greater or leſs propenſity to finiſh; and muſt, on that account, have more or leſs of the poppy or nut oils. If the drying oil finiſhes reluctantly, there muſt be added a leſſer quantity, or none at all, of the nut or poppy oils, and a ſmall quantity of an eſſential oil added, till it will finiſh with eaſe and beauty. The ſame kind of leather will alſo require a different mode of treatment; for if the leather be new it will abound more with the natural greaſe of the animal which produced it, and it will require the oil to be ſo managed as to abſorb or neutralize the greaſy quality, that it may finiſh without loading the leather, and making it unpleaſant to the wearer. When this is the caſe, one-fourth part of eſſential oil of turpentine muſt be mixed with the above oils when prepared; and *vice verſâ* if the leather is old.

Another of Mr. Bellamy's receipts is as follows: to one gallon of the above prepared oils add one pound of gum reſin, half a pound of pitch, a quarter of a pound of tar, and a quarter of a pound of turpentine. Let them be well incorporated with the oils, by firſt heating the whole maſs gently, and then increaſe the fire till the whole is thoroughly mixed; or he propoſes to add to the oils, gums ſandarac, maſtic, anime, copal, amber, together or ſeparate, or aſphaltum, or one-ſixth part of bee's-wax. In ſhort, any bituminous, reſinous, or adheſive matter, which will reſiſt acids, alkalies, and water, and will unite with drying oils, provided when mixed in proper proportions they do not render the leather hard, or make it crack, or otherwiſe diſagreeable.

In the Annales de Chemie, Mr. Hildebrand of St. Peterſburgh propoſes the three following methods of rendering ſole-leather impermeable by water.

The firſt preparation is made by boiling $1\frac{1}{2}$ lb. of minium with 20 lbs. of oil of linſeed, or hemp-ſeed; continue the boiling till the metallic oxyd be entirely diſſolved, and the mixture aſſumes a carbonaceous dark brown colour: apply this compoſition to the inſide of the hides till they can abſorb no more of it; then dry them, in ſummer by the heat of the ſun, in winter before a fire. When the compoſition becomes too thick, it may be liquified by the addition of oil of turpentine.

The ſecond preparation is ſimply either of the ſame oils, in part diſhydrogenated by fire; it will ſerve equally well for upper leathers.

The third preparation is a mixture of two ounces of black pitch with a pound of tar, melted together by a gentle heat;

the leather is then anointed with the mixture, and dried. Soles thus prepared ought to be used with the smooth side inwards.

Another receipt for an elastic water-proof varnish is, gum asphaltum, two pounds; amber, half a pound; gum benzoin, six ounces; linseed-oil, two pounds; spirits of turpentine, eight pounds; and lamp-black, half a pound; united together in an earthen vessel over a gentle fire.

The leather is to be nailed on a board, and the varnish applied upon it; it is then to be passed into an oven several times, the varnishing being each time repeated, till the leather is completely covered.

Mr. William Baynham took a patent in 1816 for a water-proof varnish, which very much resembles those of his predecessors. It is prepared as follows: six gallons of linseed oil, one pound and a half of rosin, and four pounds and a half of red litharge, or any other substance usually known under the denomination of dryers, are to be boiled together till they acquire sufficient consistence to adhere to the fingers, and draw out into strings when cooled upon a piece of glass or otherwise. It is then to be removed from the fire, and when sufficiently cooled, thinned to about the consistence of sweet oil, by adding spirits of turpentine to it, which generally requires about six gallons. It is left to settle for a day or two, and then carefully poured off from the grounds; and about one pound and a half of ivory or lamp-black, and one pound and a half of Prussian blue ground in linseed oil, added to and intimately mixed with it. It is then ready for use.

To apply this varnish, stir it up, and lay it on with a brush until it lies on the surface of the leather with an even gloss; then hang up the article which has been operated upon until the next day: repeat the application as before, taking care to leave the surface as thin and even as possible. This must be repeated each successive day, until it has the desired appearance.

WATER, *Raiting*, in *Rural Economy*. See RAIT.

WATER-*Rocket*. See ROCKET.

WATER-*Sail*, in a *Ship*, denotes a small sail, spread occasionally under the lower studding-sail, or driver-boom, in a fair wind, and smooth sea.

WATER-*Scape*, of the Saxon *waterschap*, denotes an aqueduct, drain, or passage for water.

WATER-*Shield*. See HYDRASPIS.

WATER-*Shoot*, a young sprig, which springs out of the root or stock of a tree.

WATER-*Shot*, in *Sea Language*. See MOORING.

WATER-*Spout*. See *Water*-SPOUT.

WATER-*Table*, in *Architecture*, is a sort of ledge, left in stone or brick walls, about eighteen or twenty inches from the ground; from which place the thickness of the wall begins to abate. See WALL.

WATER-*Thermometer*, a thermometer made with water by Mr. Dalton, for the purpose of ascertaining the precise degree of cold at which water ceases to be farther condensed; and likewise how much it expands in cooling below that degree to the temperature of freezing, or 32°. With this view he took a thermometer tube, such as would have given a scale of ten inches with mercury from 32° to 212°, and filled it with pure water. He then graduated it by an accurate mercurial thermometer, putting them together in a bason filled with water of various degrees of heat, and stirring it occasionally: as it is well known that water does not expand in proportion to its heat, it does not therefore afford a thermometric scale of equal parts, like quicksilver.

From repeated trials agreeing in the result, he found that the water-thermometer is at the lowest point of the scale it is capable of, that is, water is of the greatest density at $42\frac{1}{2}$° of the mercurial thermometer. From 41° to 44° inclusively, the variation is so small as to be just perceptible on the scale; but above or below those degrees, the expansion has an increasing ratio, and at 32° it amounts to $\frac{1}{8}$th of an inch, or about $\frac{1}{180}$th part of the whole expansion, from $42\frac{1}{2}$° to 212°, or boiling heat. During the investigation of this subject, his attention was arrested by the circumstance, that the expansion of water was the same for any number of degrees from the point of greatest condensation, no matter whether above or below it: thus he found that 32°, which are $10\frac{1}{2}$° below the point of greatest density, agreed exactly with 53°, which are $10\frac{1}{2}$° above the said point; and so did all the intermediate degrees on both sides. Consequently, when the water-thermometer stood at 53°, it was impossible to say, without a knowledge of other circumstances, whether its temperature was really 53° or 32°. Our ingenious author, recollecting some experiments of Dr. Blagden in the Philosophical Transactions, from which it appears that water was cooled down to 21° or 22° without freezing, was curious to see how far this law of expansion would continue below the freezing point, previously to the congelation of the water, and therefore ventured to put his water-thermometer into a mixture of snow and salt, about 25° below the freezing point, expecting the bulb to be burst when the sudden congelation took place. After taking it out of a mixture of snow and water, where it stood at 32°, (that is, 53° *per* scale,) he immersed it into the cold mixture, when it rose, at first slowly, but increasing in velocity, it passed 60°, 70°, and was going up towards 80°, when he took it out to see if there was any ice in the bulb; but it remained perfectly transparent: he immersed it again, and raised it 75° *per* scale, when in an instant it darted up to 128°, and that moment taking it out, the bulb appeared white and opaque, the water within being frozen: fortunately it was not burst; and the liquid which was raised thus to the top of the scale was not thrown out, though the tube was unsealed. Upon applying the hand, the ice was melted, and the liquid resumed its station. This experiment was repeated and varied, at the expence of several thermometer bulbs, and it appeared that water may be cooled down in such circumstances, not only to 21°, but 5° or 6°, without freezing; and that the law of expansion above-mentioned obtains in every part of the scale from $42\frac{1}{2}$° to 10°, or below, so that the density of water at 10° is equal to the density at 75°.

WATER-*Tight*, in *Sea-Language*, the state of a ship when not leaky.

WATER-*Tracing Crescent*, in *Rural Economy*, the tool formed in the manner of the gardener's edging-iron, but made much larger, and in the crescent form, very thin and well-steeled, and sharp in the edge, having a stem about three feet in length, with a cross handle for bearing upon in working with it, in cutting out the sides of the different conductors of the water in watering land. See WATERING *Land*.

WATER-*Ways*, in *Ship-Building*, the side-strake of a deck wrought next the timbers, and much thicker than the deck, but reduced to the thickness of the deck in front: it makes a channel for the water to run through the scuppers, and prevent leaking at the side.

WATER-*Wheel*, an engine for raising water in great quantity out of a deep well. See PERSIAN-*Wheel*, and WATER, *Raising of*, supra.

WATER-*Workers*, in *Agriculture*, a term applied to the makers and formers of meadow-drains and trenches, or wet ditches,

ditches, as in the practices of watering and draining of land, or otherwise.

Water-*Worm, Reproduction of*, in *Natural History*. See Reproduction, and *Water*-Worm. See also Vermes.

Water *Key*, in *Geography*, a small island in the bay of Honduras, near the coast of Mexico. N. lat. 17° 30′. W. long. 88° 40′.

Water *Key*, a small island in the Spanish Main, near the Mosquito shore. N. lat. 12° 15′. W. long. 82° 55′.

Water *Key, South*, a small island in the bay of Honduras. N. lat. 16° 35′. W. long. 88° 45′.

Water *Point*, a cape on the east coast of Java. S. lat. 7° 55′. E. long. 114° 33′.

Water *Sound*, a strait of the North sea, between South Ronaldsha and Barra, two of the Orkney islands.

WATERBOROUGH, a town in the district of Maine, and county of York, containing 1395 inhabitants; 15 miles N.W. of Wells.

WATERBURY, a town of the state of Connecticut, containing 2874 inhabitants; 20 miles S.W. of Hartford.

WATEREE, a river which rises in the Allegany Mountains, then runs southerly into South Carolina, and changing its name to Wateree; after a course of about 120 miles, it joins the Cangaree, and then takes the name of Santee.

WATERFORD, a maritime county of Ireland, in the province of Munster, having the county of Cork on the west, the counties of Tipperary and Kilkenny on the north, the county of Wexford on the east, and St. George's Channel on the south. It extends from east to west 40 Irish, or 51 English miles; and from north to south 23 Irish, or 29 English miles. Its breadth, however, varies much, and is in one part not more than six miles. The area is stated to be 262,800 acres, or 410 square miles Irish, which are equal to 425,692 acres, or 665 square miles English. Dr. Beaufort states the number of houses to be 18,796; and the number of inhabitants at least 110,000. The number of parishes is 74, in which there were 21 churches, divided between the sees of Waterford and Lismore. Waterford returns four members to the imperial parliament, two for the county, one for the city of Waterford, and one for the borough of Dungarvan. The county of Waterford is in general hilly, and the northern part is particularly rough and mountainous; in the south and east the soil is rich and productive. In the west of the county, on the north of the Blackwater, there is a ridge called the *Knockmeledown* mountains, many parts of which are very high, though Mr. Twiss is mistaken in calling them the highest in Ireland. The Commeragh mountains cover a great extent of country between Dungarvan and Clonmell. These hills, except in a few desolate and craggy spots, afford pasture to small cows, which produce a great quantity of butter. In the eastern part agriculture has been much improved, and the farms are not surpassed in any part of Ireland.

The river Blackwater flows through the west of this county into the bay of Youghal, and is navigable to Cappoquin. The banks of this river are peculiarly beautiful, especially near Lismore. The river Bride, which joins the Blackwater, passes near the town of Tallow, and is so far navigable for large boats. The gentle and majestic Suir forms the northern boundary, dividing it from the counties of Tipperary and Kilkenny, and running east till joined by the Barrow; when, turning south, they form an estuary, 9 miles long, and 2 broad, which is the harbour of Waterford. At Dunmore, near the extremity of this, on the Waterford side, a very fine pier is building, for the protection of the packets, and of such vessels as may put into this harbour.

Dr. Charles Smith published "The ancient and present State of the County and City of Waterford," in the year 1745, which was reprinted in 1772. In this work, he states the Menapii to have been inhabitants of this county and Wexford in the time of Ptolemy, which Menapii he supposes to have been a colony from the Belgic Menapii, mentioned by Cæsar. The Desii are stated to have been a powerful clan at the time of the English invasion. These came from the county of Meath, and gave name to the baronies of Desies within and Desies without Drum, and their descendants are now called Deasy. Though the power of the Desii was abolished by the English, yet, for many years after, the O'Feolains, kings of the Desii, are occasionally mentioned in the Irish annals. Henry II. in 1177 made a grant of the city of Waterford, with all the circumjacent province, to Robert Le Poer, his marshal, from whom are descended not only the family of Le Puer, the head of which was created, in 1535, earl of Tyrone, but also the several respectable families of Power, settled at Clashmore, Gurteen, &c. By marriage, the estates and honours of the Le Poers came to the family of Beresford, the head of which is now marquis of Waterford, and has a noble seat at Curraghmore, in this county. In the civil war, Waterford had its share of disturbance, and Cromwell himself was engaged unsuccessfully in the siege of its capital. Dr. Smith's Topography is still interesting to the reader, from the various information he collected respecting the different families settled, though many of them are now extinct or removed. His natural history is very defective, yet it is the best hitherto published. He drew attention to the fisheries, and to the Nymph bank, yet even now, though employment is so much wanted, the fisheries remain without encouragement. In his enumeration of eminent men born in this county, we find the names of Congreve the poet, and of Robert Boyle, who was born in the castle of Lismore. The duke of Devonshire, as descendant of the eldest branch of the Boyle family, possesses the towns of Dungarvan, Lismore, and Tallow, with a great tract of land, which gives him a preponderating influence in the county. Beaufort's Memoir of Ireland, &c.

Waterford, a city and sea-port town on the south side of the river Suir, in Ireland, capital of the county of the same name. This river is embanked by a noble quay, extending the whole length of the town, to which vessels of great burden can come up, though the largest ships generally lie a few miles lower down. Like most of the other sea-ports of Ireland, it was originally built by the Ostmen or Danes; and is said to have been founded A.D. 853, nearly at the same time as Dublin and Limerick. Waterford seems to have been the chief settlement of this people, for we find the kings of the Danes of Waterford often mentioned in the old annals. Strongbow, soon after his landing in Ireland, took Waterford by assault in 1171, and in 1172 he gave it up to king Henry II., who landed at Waterford, and received there the submission, not only of his English subjects, but also of many Irish chiefs. King John also landed at this city, and made it his residence for some months. The steady adherence of Waterford to the English caused it to be engaged in almost constant warfare with its neighbours; and in return it received many marks of royal favour. Richard II. landed twice at Waterford. When Simnel was crowned king by the earl of Kildare, the lord deputy, the citizens of Waterford refused to admit him, adhering steadily to Henry VII., in consequence of which he addressed a letter to them, thanking them for their adherence, and giving them power to seize the rebels and their effects, and to employ the latter for their own advantage. They behaved with the same loyalty against Perkin

Warbeck, who had many adherents in Ireland, in confequence of which the king gave them this motto, which is ftill ufed, "Intacta manet Waterfordia." In the reign of James I., Waterford appears to have become turbulent in confequence of its attachment to the Roman Catholic religion, and in confequence was deprived of many privileges, but thefe were reftored by Charles I. In the civil war, Waterford was on the fide of the Catholics, and a meeting of the popifh clergy was held there by the pope's nuncio in 1646. It was befieged by Cromwell without fuccefs; but was afterwards taken by Ireton. It has been already mentioned that Waterford was built by the Danes; it was at firft called *Portlargie*, from *lairge*, a thigh; the courfe of the river Suir, near this place, refembling that part of the human body. The Englifh gave it its prefent name, as it is faid, from a ford in St. John's river, which empties itfelf into the Suir. The city chiefly faces the north and eaft, which, though feemingly a fituation not fo defirable, being expofed to the chilling blafts of thefe winds, yet the healthinefs of it makes amends for the bleaknefs of the expofure. A further advantage is its noble fituation, near the confluence of three large and navigable rivers, the Suir, the Nore, and the Barrow, by which inland commodities may be fupplied at a very inconfiderable expence of carriage, from the very centre of the ifland, and from feven different counties wafhed by thefe rivers, and other counties adjacent to them. Over the river Suir, a fine wooden bridge has been erected within a few years, to facilitate the communication with other places. A very flourifhing commerce with England and other countries is the happy confequence of fuch a fituation. Its exports of beef, butter, hides, tallow, pork, and corn, are confiderable. The number of large hogs weekly flaughtered during the feafon exceeds 3000 on an average. The quantity of butter annually exported exceeds 80,000 cafks.

This city is alfo largely concerned in the Newfoundland trade. The population is fuppofed to exceed 40,000, and it ranks as the fourth town of Ireland in extent, and the fifth in commercial importance. Packet-boats are eftablifhed between this port and Milford Haven, for the convenient intercourfe of the fouth of Ireland with England. This city fends one member to the united parliament, elected by the freemen and freeholders. This election is free, and, to the honour of the electors, fir John Newport, one of the moft fteady friends of Ireland, has been repeatedly returned. The cathedral of Waterford, adorned with an elegant fteeple, is a fine ftructure. There is alfo a very fuperb Catholic chapel, with feveral other places of worfhip. The other public edifices are conftructed with much elegance, and effentially contribute to ornament the city. It is, however, of more confequence to obferve, that its numerous charitable inftitutions are well conducted, and liberally fupported. Its houfe of induftry may ferve as a model for others. Its fever hofpital was the firft in Ireland, and nearly the firft in the united kingdom, and has been carried on with uniform fuccefs. Without any wifh to take from the merit of other worthy individuals, much of this praife is due to the exertions of the *Society of Friends*, who are numerous in Waterford. This city is $74\frac{1}{2}$ Irifh miles S.S.W. from Dublin. Smith's Waterford. Carlifle's Dictionary. Wakefield, &c.

WATERFORD and LISMORE, *Bifhopric of.* The firft of thefe fees, which is confined to the eaftern part of the county of Waterford, and is very fmall, was founded by the Oftmen in the 11th century; but that of Lifmore, which includes the greateft part of Waterford county, and a confiderable portion of Tipperary, was founded in the feventh century. The union took place in 1536. The extent of the union is, in Irifh miles, 39 by 29, and in Englifh 49 by 37. The number of Irifh acres 354,800, which are divided into 106 parifhes. Forty-four of thefe are impropriate, and the reft form only 44 benefices, of which, when Dr. Beaufort publifhed his account, only 30 had churches, and only 8 glebe-houfes. Many churches and glebe-houfes have been built throughout Ireland within a few years. Beaufort.

WATERFORD, a populous and compact incorporated poft-village, in the S.E. corner of Half Moon, Saratoga county, on the W. bank of the Hudfon; 10 miles N. of Albany. It is the moft populous town in the county, and has the greateft fhare of trade. It is handfomely laid out, in 5 E. and W. ftreets, interfecting at right angles. It has 190 houfes and ftores, 2 houfes of worfhip, and fome other buildings, together with three fchools on the Lancafter plan. It is well fituated for a manufacturing town; and in 1812 a wharf, 320 yards long, was conftructed, and a canal along it to the channel of the Hudfon.

WATERFORD, a town of the ftate of Vermont, in the county of Caledonia, on the W. bank of the Connecticut, formerly called Littleton, containing 1289 inhabitants; 40 miles N. of Norwich.

WATERFORD, a poft-town in the diftrict of Maine, and county of Oxford, containing 188 inhabitants; 95 miles N. of York.

WATERFORD, a poft-town of Virginia; 20 miles N.W. of Wafhington.

WATERFORD, a town of Connecticut, in the county of New London; containing 2185 inhabitants.

WATERFORD, or *Le Beuf*, a poft-town of the ftate of Pennfylvania, in the county of Erie, containing 162 inhabitants; 370 miles N.W. of Wafhington.

WATERFORD, a townfhip of New Jerfey, in Gloucefter county, containing 2105 inhabitants; 40 miles S. of Trenton.—Alfo, a town of Ohio, in the county of Wafhington, containing 701 inhabitants.

WATERGUCHEE, or WATERQUECHIE, a river of Vermont, which runs into the Connecticut, N. lat. 43° 34'. W. long. 72° 18'.

WATERING, in *Gardening*, the practice or means of rendering feeds, plants, fhrubs, and trees, as well as garden-grounds, properly and fuitably moift for the purpofe of their better, more ready, and more healthy germination, growth, and taking root, when fown, planted out, or fet, and afterwards for continuing them in the neceffary ftates of vegetation, growth, and increafe, efpecially when the weather is dry, hot, and parching. It is alfo occafionally ufeful in preventing fome forts of fruit-trees from being deftroyed by the attacks of different forts of infects, as well as for the clearing them of other kinds. It is occafionally equally effential for the feeds and plants in the full ground, as for thofe in pots in it, and thofe in green-houfes, glafs-cafes, hot-beds, hot-houfes, ftoves, and other fimilar fituations; fuch, for inftance, in the former kinds, as the feeds in drills, beds, and other open places, different young plants in the fame fituations, numerous others of the cutting, flip, offfet, and other fimilar kinds, which have been newly pricked out, planted, or tranfplanted, not only at the time of firft putting them out, but now and then afterwards, when dry hot weather is prefent; alfo in many kinds of newly-planted young trees and fhrubs in the fpring and early autumnal plantings; and to all the plants which are in pots in the open air, whether they may be of the more or lefs hardy kinds, during the droughty feafons of fpring, fummer, and early autumn; and in the latter defcription, to all the fine tender kinds

kinds of potted plants and trees under any ſort of covering or protection of the houſe or other kind.

There are many ſorts of plants which cannot exiſt without watering in either a ſmall or plentiful manner. Some ſtand in need of it only in a ſlight degree, and at particular ſeaſons of the year, while others demand it in very full proportions at all times. Some are very nice in the quantities which are required at any one time; but others are leſs particular in this reſpect. Some too are under the neceſſity of having it thrown over their leaves as well as to their roots; others only have occaſion for it to the root part. And there are ſome other methods of adminiſtering and applying it, which are peculiar to certain kinds of plants, trees, and other vegetable products, as ſhewn under their particular individual modes of culture.

In all caſes, the moſt proper water for this uſe is that which is contained in any ſort of pond, reſervoir, or other ſimilar kind of excavation, for the purpoſe of containing it in a ſtate of conſtant expoſure to the atmoſphere, in gardens or other places, as it is not only more convenient and ready for being employed, but, at the ſame time, a great deal more ſalutary, and better adapted to promote the growth and increaſe of the different ſorts of plants and vegetables, than that of the raw, ſharp, cold, hard kind, which is drawn from wells or raiſed by pumps for immediate uſe, as being more ſoft in its nature, and more ſuitable in its temperature.

The moſt ſuitable time of applying it is in the evening, after the diſappearance of the ſun, and when the exceſſive heat of the day is gone off, and in a great meaſure abated, as its effects are then more beneficial and laſting; and beſides the work can be performed with more eaſe and convenience, as well as in a more agreeable manner.

When once the buſineſs of watering has been commenced, it ſhould always be regularly proceeded with, or the plants or vegetables may ſuffer much, and be greatly injured by the omiſſion or neglect. It is conſtantly better never to attempt it, than to juſt begin and then leave it off again, as is much too frequently the caſe, in the practice of horticulture, with ſome gardeners, who have not fully conſidered the matter.

The work of watering ſeeds, plants, ſhrubs, and trees, is uſually performed, either by means of common watering pots and cans, large ſyringes contrived for the purpoſe, forcing engines for throwing it up over the plants, or by ſome other contrivance of a ſimilar nature. The water being moſtly brought to the places where it is wanted, either in tubs hung in a ſort of barrow-frame, or by their being placed on the barrows themſelves.

The water is commonly applied in a fine divided ſtate, over the plants, where it is not required in any large quantities, and for clearing away and deſtroying ſmuts: but where it is demanded in large proportions, it is often poured in full ſtreams to their roots or other parts.

But in uſing it upon a large ſcale for garden-grounds, Mr. London has ſuggeſted that it may be accompliſhed by a practice ſomewhat ſimilar to that of overflowing tillage-land, or by means of ſubflooding; this laſt may, he thinks, be effected by having a ſtratum or layer of gravel underneath the whole garden, which by having a trench ſurround-it, or, if upon a ſlope, at the upper ſide of it only, may have the ground wholly ſaturated with the water let into it, which will ſoon be abſorbed and taken up by the incumbent ſurface containing the vegetables that are under cultivation. And, in the former of theſe methods, by having pipes, open-cuts, or rather ſmall wooden troughs, which may ſerve to convey and conduct the water upon the ſurface of every quarter of the ground; it may there diſtribute itſelf in the intervals between the beds or drills, as well as over the general ſurface of the broad-caſt crops. It is further ſuggeſted that the former method could be put in practice at any period of the ſpring or ſummer; the latter, for the moſt part, in moiſt weather, or in the night ſeaſon. See Watering *of Land*.

In the watering of both ſeeds, plants, and garden grounds, much care ſhould, however, be taken, in every inſtance, that injury inſtead of good be not done, by employing too large quantities, or continuing them for too great a length of time.

On the whole, it will be evident, from what has been ſaid above, that the practice of watering in garden culture may be beneficial in different ways, as in exciting and promoting a better and more ſpeedy vegetation in newly-ſown ſeeds and tranſplanted vegetables; in forwarding the growth and increaſe in a proper manner of different crops, plants, and trees; and in the deſtruction or removal of inſects, ſuch as the *aphis*, red ſpider, and ſome of the *coccus* tribe.

Watering-*Barrow*, in *Gardening*, ſuch as is employed in conveying water to gardens or other places. They have uſually a tub fixed upright in the frame by means of pivots, hooks, and gudgeons, or ſome other way, one-half of which is below and the other above it, the water being, in a great meaſure, prevented from ſpilling while it is carrying. See Quendon *Water-Barrow*.

Watering *Forcing-Engine*, an engine contrived for the purpoſe of forcing water in a ſort of ſhower over ſome kinds of fruit-trees, garden vegetables, and plants, and which commonly effects the buſineſs in an eaſy, convenient, and effectual even manner, being well adapted to particular modes and purpoſes of watering.

Watering *of Land*, in *Agriculture*, the practice of overflowing it artificially in the graſs ſtate, with the water which is diverted from an adjoining or neighbouring river or ſtream, which has a higher level than the ground to be covered, or where there is a proper fall. In this way, by the new-formed water-courſes being kept nearly on the level, the ſpaces of land between the new and the old channels may be watered, the water being brought upon the ground by the former, and diſcharged or taken away by the latter; and thus a conſtant ſucceſſion of the water be retained and removed without ſuch an accumulation of it as would be injurious, or ſuch a deficiency as would leave any part imperfectly ſupplied. In different diſtricts different names are applied to this practice, ſuch as thoſe of floating, flooding, drowning, ſoaking, and ſome others.

It is, without doubt, a practice of great antiquity, which it is probable the extraordinary fertility afforded by the annual overflowings of the river Nile, in Egypt, may have firſt ſuggeſted as the means of improving the lands of other countries. In this country, indeed, it would ſeem to have been had recourſe to, for the purpoſe, at a very early period, as in the county of Hereford, it appears to have been practiſed more than two hundred years ago, as is evident from a work on the ſubject written by Rowland Vaughan, and publiſhed in the year 1610, entitled "Moſt improved and long-experienced Water-Works; containing the manner of ſummer and winter drowning of meadow and paſture, by the advantage of the leaſt river, brook, fount, or water-mill adjacent; thereby to make thoſe grounds, eſpecially if they be dry, more fertile ten for one." And the practice is probably ſtill more ancient in the county of Wilts than in the above or any other diſtrict, in conſequence of its poſſeſſing naturally watered graſs lands, which perhaps firſt led to to the notion of forming them in an artificial manner. The general want of good pafture-grounds in the high lands of this county might, it has been fuppofed, be a great inducement to improve fuch watery valley-tracks, which muft ever have difplayed the moft pleafing and interefting appearances of early and luxuriant vegetation and growth.

However, in whatever way the practice originated in this country, it is unqueftionably a method that is deferving of the attention of the land proprietor and the farmer in a very high degree.

It has been ftated by different writers on the practice of watering land, that the moft proper qualities of the grounds for being watered, are all thofe which are of a fandy or gravelly friable open nature, as on fuch the improvement is not only immediate, but the effects produced more certain and powerful than on other kinds of them. There are alfo fome ftrong adhefive four wet lands, which are alfo capable of being improved by watering.

There are ftill fome other forts of lands, as thofe which contain different kinds of coarfe vegetable productions upon their furfaces, fuch as heath, ling, rufhes, boggy and other aquatic plants, which may likewife be much improved by watering. It fhould, however, be conftantly kept in mind, in attempting this fort of improvement, that the more ftiff and tenacious the foil or land is, the greater the command of water fhould be, in order to effect the purpofe.

The lands which admit of this fort of improvement with the moft fuccefs and benefit are, for the moft part, all fuch as lie in low fituations on the banks and borders of brooks, rivers, and ftreams, or in floping directions on the fides of hills, to which water can be conducted in an eafy and ready manner.

The writer of a late ufeful tract on the fubject, however, feems inclined to fuppofe that there are only a few foils or forts of land to which watering may not be advantageoufly applied; the experience which he has had, it is faid, has determined, that the wetteft land may be greatly improved by it, and likewife that it is equally beneficial to that which is dry. But that as many perfons, unacquainted with the nature of watering land, may be more inclined to the latter fuppofition than the former, the reafon of wet land being as capable of improvement by watering as that which is completely dry before it is ufed, is explained. It is that, in the conftruction of all watered meadows or lands, particular care muft be taken to render them perfectly dry when the bufinefs of floating or covering them with water fhall terminate; and that the feafon for floating or watering is in the winter and not in the fummer, which thofe who are unacquainted with the procefs have too commonly fuppofed. All bogs of the peat kind are certainly, it is faid, of vegetable origin, and thofe vegetables are all aquatic in their nature. It therefore follows that the fame water which has produced the vegetables of the bog would, under due management upon the furface, produce fuch graffes or other vegetables as are ufually grown by the farmer; and the writer has hitherto had reafon to think, that this may be confidered as a general rule for determining the fituation for any experiments or trials with water. The writer having fucceeded in the attempt to make good watered lands, upon foils which have been thought unfit for the purpofe, and floated or watered them with water that was equally condemned, in point of quality, he is now, it is faid, fufficiently emboldened to recommend the trial of watering land by means of machinery, and that the moft flattering hopes of fuccefs are entertained from it. It is noticed that the graffes produced by the firft year's floating or watering of a peat-bog, or any wet land, will be much more like what will become the permanent herbage of a water-meadow, than the firft or fecond year's crop from a newly-floated or watered piece of dry land. The herbage of the former being, it is faid, previoufly ftored with aqueous plants, is in fome degree fuited to this new ftate, whereas the herbage of dry land is generally of quite a different nature, and often produces an exceeding great crop of grafs the firft year, which does not appear the next; for the fame water which caufed thefe graffes to grow fo very luxuriantly the firft year, will totally deftroy them in the courfe of the enfuing winter, and produce an herbage much more congenial to that degree or ftate of moifture. The utility of watering in all thefe cafes has been fully eftablifhed in feveral different diftricts, fo that proper examples of the forms and crops may always be readily had for the trials of others in the fame way. This has been done, it is faid, in the counties of Bedford, Norfolk, and Kent, in the firft and laft of which upon foils that are very different from thofe of moft water-meadows in the county of Wilts; and that the floating or watering of them has been effected with water which was always before confidered to be wholly unfit for that purpofe, even by thofe fuppofed to be the beft acquainted with the practice: it is now, however, fully proved and fhewn to be the cafe, not only by the accurate inveftigations of the moft able chemifts, but by the extraordinary growth of graffes in particular boggy fituations, that waters of the ferruginous kind are not at all hurtful to vegetation; but, on the contrary, very friendly to it, when they are properly applied. Such facts being eftablifhed beyond all poffibility of doubt, afford, it is faid, a much greater fcope for the improvements by water, than was ever expected or thought of by the moft fanguine advocates of watering, and enables the writer, from his great experience and obfervation, in different parts of the kingdom, to fay that there are few diftricts to which they are not applicable.

It is, however, fuppofed by fome, that the quality of the water, like that of marl or other manures, is a matter of the firft importance, and fhould be particularly afcertained. And it has been remarked by the author of the "Treatife on Landed Property," that it is univerfally known that water which flows out of a dung-yard poffeffes a fertilizing quality. It is generally admitted, too, that the wafhings of fheep-walks, frefhly-manured arable lands, ftreets of towns, roads, and other fuch places, after a long drought, have the quality of fertilization. And it is equally evident, it is thought, that the waters iffuing in different parts of the kingdom from chalk, lime-ftone, marl, or other calcareous ftratum, though they are perfectly limpid, poffefs the power of fertility; and thofe of fome diftricts, as of Wiltfhire, Dorfetfhire, and fome others, to an aftonifhing degree. And a fimilar, though lefs powerful, effect is produced by the limpid waters, which iffue from the flate-rocks of Devonfhire and Cornwall. On the other hand, waters that ooze out of peat-bogs, and iffue from particular mines, are well known to be injurious to the growth of agricultural vegetables.

It is added, that chemiftry points out tefts and proceffes whereby waters, as well as marls and other grofs manures, may be tried and analyfed. But the virtue of water, when confidered as a manure, does not refide in a fingle principle, like that of lime-ftone. Water is capable of fufpending, not only calcareous earth, but various other matters,—of animal, vegetable, and foffil origin: fome of them friendly, others inimical, to vegetation. It would, therefore, it is thought, be imprudent in a practical man in this bufinefs to commit himfelf to theoretic guidance alone, while the theory of manures, and efpecially of watering land, remains fo much in-

 volved

volved in obfcurity; and while trials in the field, on the very land which is defired to be improved, may be made with facility and prompt decifion.

The effects of watering are remarkable in many inftances: in Wiltfhire, it is not uncommon to fee, it is faid, lands, where water has been diverted for the purpofe of improvement, divided by a hedge or a ditch only, the grafs on one fide of which is of the moft luxuriant nature and abundant growth, but on the other fo diminutive that the ftrongeft blades have never reached the height of three inches. The fame is the cafe in other fituations, which fufficiently marks the importance of the practice.

It will be neceffary, before we ftate the different methods of performing the bufinefs of watering in different circumftances, to give fome account of the implements which are requifite for the purpofe, as well as fome explanation of the terms employed in carrying on the work in the different modes. The firft and principal inftrument in the execution of the work is a proper level, of which the fpirit one is perhaps the beft. It is neceffary for taking the level of the land at a diftance, compared with the part of the river or other ftream, from whence it is intended to take the water, to know whether it can or cannot be made to float the part defigned to be watered. It is particularly ufeful in works of this fort on a large fcale, though the labourers too frequently neglect the ufe of it, bringing the water after them to work by in-cutting the feveral parts that are to convey the water. It fhould, however, be moftly ufed as being more certain and correct. See LEVEL, and WATER-*Level.*

A proper line and reel and cutting-iron are likewife abfolutely neceffary, as well as a breaft-plough, which fhould be of the beft kind, as being of great ufe in cutting turfs for the fides of the channels and other parts. See WATER-*Line and Reel*, WATER *Crefcent*, and BREAST-*Plough*.

The fpades ufed in this fort of work fhould have the ftems or handles confiderably more crooked than thofe in common ufe, the bit being of iron, about a foot in width, in the middle, terminating in a point, a thick ridge running down the middle part, from the top to near the point; the edges on both fides being drawn very thin, and kept quite fharp by frequent grinding and whetting: when they are become thin and narrow by wearing, they are ufed for the fmaller trenches and drains. By means of the handles being made fo crooked, the workman, ftanding in the working pofition in the bottom of the drain or trench, is enabled to make it perfectly fmooth and even without any difficulty.

Both fhort and narrow fcythes are alfo neceffary, in order to mow and cut away any weeds or fuperfluous grafs that may be prefent, during the running of the water in the trenches or other cuts; as well as forks, and long four or five-tined crooks or drags for pulling out the roots of the fedges, rufhes, reeds, and other fuch matters, that may be in the large mains or other channels. Thefe crooks fhould be made light, and have long fhafts to reach wherever the water is fo deep that the labourers cannot work in it, fo as to remove fuch obftructions.

Wheel and hand-barrows, too, become neceffary and ufeful, the former for removing the clods and earths to the flat or hollow places, for this ufe they may be made open, without fides or hinder parts; the latter are ufed where the ground is too foft to admit the former, and where the clods or other matters require to be removed during the time the land is in water. But when large quantities of earth are wanted to be removed, efpecially when to be conveyed to fome diftance, three-wheeled carts are proper.

And in all cafes a ftout large water-proof pair of boots is abfolutely requifite, having the tops made fo as to draw up half the length of the thigh; they fhould be large enough to admit a quantity of hay or other fuch materials to be ftuffed down all round the legs, and be kept well tallowed, in order to refift the running water for any length of time.

The terms ufed in the practice of watering are very numerous. A weir is a work thrown over or acrofs a brook, river, rivulet, ftream, main, or other fuch parts, the ufe of which is to divert the water; and when the hatches are all properly adjufted and in their places, to ftop the whole current, in order that the water may rife high enough to overflow the banks, and fpread over the adjoining land; or, by ftopping the water in its natural courfe, turn it through mains or channels, cut to convey it another way, to fome diftant lands that are to be watered. See WEIR.

A fluice differs from the above fimply in having but one thorough or opening, as when there are more than one it becomes a weir. It is applicable in fmall ftreams in the fame way that the weir is in large ones. See SLUICE.

The covered fluice or trunk is conftructed and had recourfe to in all fuch cafes, as where two ftreams of water are to crofs each other at the point of difcharge, and to ferve as a bridge. The drain-fluice or trunk is that which is placed in the loweft part of a main, as near to the head as it can be formed, and put low enough to drain the main and other parts. It is put with the mouth at the bottom of the main, being let down into the bank; and from the other end of which a drain is cut to communicate with fome trench-drain that is the neareft. It is ufed for carrying off the leakage through the hatches when fhut down, to convey the water to other grounds, and for fome other purpofes. See SLUICE.

Hatches are flood-gates, and ufed for the fame purpofes: they are confequently differently formed in different cafes; but fuch as have about a foot to take off, and let the water pafs over fo much of them, are thought ufeful by fome in different cafes of watering. Others fuppofe them the beft when made whole and of good timber. See HATCH.

A carriage is a fort of fmall wooden or brick paffage, built in an open manner, for the purpofe of carrying or conveying one ftream over another, and is ufeful in many cafes, though very expenfive in the practice of watering.

Head-main in watering land implies that part of the principal cut or channel which takes the water firft out of a river or ftream, and conveys it to fuch lands as are laid out for the purpofe, by means of fmaller mains and trenches. It is neceffarily formed of various breadths and depths, according to the quantity of land to be watered; and to the length, or the fall of the ground it is cut through. Small mains are the next order of cuts for the diftribution of water on lands, as connecting between the head-main and trenches. Thefe fmaller mains are moftly taken out of the head-main; and the only difference between them is, the one being much lefs than the other; they are commonly cut at, or nearly at, right angles with the other, though in fome cafes at many degrees lefs. The ufe of both thefe forts of mains is to feed the various trenches and gutters that branch out in all parts of the land with water, and to convey it for floating the ground in an equal manner. By fome thefe fmaller mains are termed carriages, but improperly, as it is confounding them with the open trunk fo named, as already feen.

The trench, in watering, is a fhallow narrow cut or ditch made to take the water out of the mains for floating the land. It fhould always be drawn in a ftraight line from angle to angle, with as few turnings as poffible. It is never

never made deep, but the width of it muſt be in proportion to the length it has to run, and the breadth of the pane of ground between that and the trench-drain. It ſhould conſtantly be cut gradually narrower and narrower, in the wedge-form, to the lower end, in order to force over the water more equally.

The trench-drain is conſtantly cut parallel to the trench, and as deep as the tail-drain water will permit when neceſſary. It ſhould always, where poſſible, be cut ſo as to come down to a firm ſtratum of ſand, gravel, or clay. If the laſt, a ſpade's depth into it will be of great benefit. The uſe of it is to take away the water immediately after it has run over the panes of the land from the trench. It is not neceſſary to be brought up to the head of the land by five, ſix, or more yards, as the nature of the ſoil may be. The form of it is the reverſe of the trench, being narrower at the head, or upper part, and gradually wider and wider, until it comes to the lower end, and empties itſelf into the tail-drain, which is a receptacle for all the water that comes out of the other drains, that are ſituated ſo as not to empty themſelves into the river; and, conſequently, it ſhould run nearly at right angles with the trenches; but it is, in general, preferable to draw it in the loweſt part of the ground, and to uſe it for conveying the water out of the ground where there is the greateſt deſcent: this is commonly found in one of the fence-ditches; for which reaſon a fence-ditch is moſtly made uſe of for the purpoſe, as anſwering the double uſe of a fence and drain at the ſame time.

The pane of ground is that part of the land which lies between the trench and the trench-drain, and is the part on which the graſs grows, which is cut for hay: it is watered by the trenches, and laid dry by the trench-drains; conſequently there is one on each ſide of every trench. The term pane is alſo applied to the part which is uſed, for taking off the produce.

The bend implies a ſtoppage made in different parts of ſuch trenches as have a quick deſcent, in order to obſtruct the water. It is effected by leaving a narrow ſlip of greenſward ground acroſs the trench where the bend is deſigned to be, and cutting occaſionally a ſmall part out of the middle of it in the wedge form. It is uſeful for checking the water, and forcing it over the trench on to the panes; which, if it were not for ſuch bends, would run rapidly on in the trench, and not flow over the land as it paſſes along. The great art of watering land conſiſts in giving to every part of each pane of ground an equal quantity of water, which is greatly promoted in this way.

The gutter is a ſmall groove cut out from the tails of theſe trenches, where the panes of ground run longer at one ſide or corner than the other. The uſe of it is to carry the water to the extreme point of the panes. Thoſe panes which are interſected by the trench and tail drains, meeting in an obtuſe angle, want the aſſiſtance of theſe gutters to convey the water to the longeſt ſide. And another uſe of them is, when the land has not been ſo perfectly levelled but that ſome parts of the panes of ground lie higher than they ſhould, a gutter is then drawn from the trench over that high ground, which would otherwiſe not be overflowed. Without this precaution, unleſs the flats were filled up, which ſhould always be the caſe when materials are to be had, the water will not riſe upon it; and after the watering-ſeaſon is paſt, thoſe places would appear of a ruſty-brown, while a rich verdure would overſpread the others; and at hay-time the graſs in thoſe places would ſcarcely be high enough for the ſcythe to touch it; while that around them, which has been properly watered, will, from its luxuriance, be laid down. This neglect is, therefore, to be reprobated in moſt caſes, as the great art of watering land is that of throwing the water regularly over all parts, thoſe where it cannot riſe of itſelf as well as others, and in carrying it off from thoſe in which it would otherwiſe ſtagnate and be hurtful.

The catch-drain is an occaſional ditch, ſometimes cut for the purpoſe of carrying the ſame water into a ſecond main or other part, for watering lower lands or panes of ground with the water that has been before uſed. It is made uſe of too in ſome other caſes, as catching the water that is thrown forward.

Pond is uſed to ſignify any part where the water ſtands on the ground in watering, or in the tail-drain, trench-drains, or others, ſo as to injure the lands near them; and is occaſioned by flats and irregularities in the ſurface of the grounds, as well as by other cauſes.

The turn of water means the ſpace of land that can be watered at one time in any caſe; and is accompliſhed by ſhutting down the hatches in all thoſe weirs where the water is deſigned to be kept out, and opening thoſe that are to let the water through them. The quantity or extent of land to be watered by one turn, muſt of courſe vary with the ſize of the river, brook, main, and other ſuch parts, and by the plenty or ſcarcity of the water.

The bed of a river, main, trench, or other ſuch part, is the bottom of any of them.

The head of any watered land is that part into which the river, main, or other ſuch part, firſt enters. And the tail of it is that part where the water laſt paſſes off by the tail-drain into the courſe that is to take it away.

The upper ſide of a main or trench is that which, when they are made at nearly right angles with the river or other ſuch part, fronts the place where the river, &c. entered. And, of courſe, the lower ſide is the reverſe.

The upper pane of the land is that which lies upon the upper ſide of the main or trench when made at right angles with the river, &c. running north and ſouth. Where, however, theſe run parallel with the river, &c. the panes on either ſide are not diſtinguiſhed from each other.

Some other terms, which are uſed by the more modern writers on watering land, will be explained as we proceed in pointing out the nature of the buſineſs.

After noticing the manner in which water is artificially brought on and taken away from the land in watering, as already ſeen, the writer of the tract before alluded to remarks, that the art of watering land may properly be called floating, not ſoaking or drowning. Soaking the ſoil, ſimilar to the effects produced from a ſhower of rain, is not ſufficient for the general purpoſes of watering; nor will damming up the water, or keeping it ſtagnant upon the ſurface, like that in a pond, or on the fens, produce the deſired effect. The latter, it is thought, may properly be termed drowning, becauſe it drowns or covers all the graſſes, thereby rendering the plants beneath it certainly aquatic, or the herbage diſpoſed to take on ſuch a change; whereas the herbage of a watered meadow or land ſhould, from the form and circumſtances of the ground, enjoy the full benefits of air and water. Practice has proved, it is ſaid, that there is no better method of effecting this, than by keeping the water paſſing over the ſurface of the land with a briſk current, but not ſo briſk as to waſh away the ſoil, and yet in ſufficient quantity to cover and nouriſh the roots, but not too much to hide the ſhoots of the graſſes: hence appears the nicety of adjuſting the quantity of water; and hence it appears, too, that one main-drain, to bring the water on the upper ſide of the land, and another on the lower

lower ſide to take it away, will not be adequate to all the purpoſes of ſuch an accurate regulation. If the ſpace between the upper channel, or *main-feeder*, and the lower one, or *main-drain*, ſhould therefore be wider than what is proper for the due adjuſtment of the water, that is, ſo that every part of the ſpace may have enough of water paſſing over it, and no part too much, then that ſpace muſt be divided into ſmaller ſpaces by intermediate drains, which may catch and re-diſtribute the water. Theſe, and the ground capable of being watered in this way, have this term applied to them, as they *catch* or collect the water and re-diſtribute it, being in well-formed lands never made more than eight or ten yards apart. As the water is brought by the main-feeder upon the higher ſide of a piece of ground, which ſlopes towards the main-drain, and down which ſloping ſurface the water will very readily run, to perſons unacquainted with watering, it does not at firſt ſight appear neceſſary to make ſuch a number of intermediate catch-drains; but it is proved by experience, that however regular the ſlope of ground may appear to the eye, the water will find a number of irregularities, force itſelf into gutters or channels, and defeat the purpoſes of watering, in the hollow places by exceſs, and in the high ones by the want of water. Hence the water that was ſcattered over the ſurface of the firſt ſpace, being all collected in the catch-drain, may, by the ſkill of the floater, be let out upon thoſe parts of the bed of ground below, which ſeem to need the greateſt aſſiſtance.

As it is eſſentially neceſſary to poſſeſs full and complete command of the water in all caſes of improvements of this nature, the works for the purpoſe ſhould always be well-formed at firſt. Temporary means of making dams and hatches to divert the water out of its uſual channel may, it is ſaid, by the writer of the tract on watering land, ſuffice to try an experiment, or for a tenant who has but a ſhort term in the grounds to be watered; but every land-owner, or other proprietor, who enters upon or undertakes ſuch works in this temporary manner, ſadly miſtakes his own intereſt; indeed, it is frequently more difficult to repair than to renew upon large ſtreams, where the foundations are not ſeldom deſtroyed or very greatly injured by the force of the water. The ſame principle holds good upon ſmall ſtreams, and even in the feeders and drains of watered land. Wherever the channels are ſo contracted as to make a fall, or much increaſe the rapidity of the ſtream, it is conſtantly diſpoſed to wear away the ſides of its channel, or undermine a dam. The repair of theſe defects will ſtand in need of land to be dug away and waſted each time, they are replaced with the loſs of labour. The conſequent ill-management of the water renders it more adviſeable, and perhaps cheaper, to make all ſuch works of maſonry. When works are well done at firſt the owner ever finds a pleaſure and ſatisfaction in viewing them; and even the labourers feel much more intereſt in their good management, which is a circumſtance not to be overlooked.

In the undertaking of buſineſs of this kind, it is neceſſary, before entering upon its execution, to fully conſider whether the ſtream of water to be made uſe of will admit of a temporary weir or dam to be formed acroſs it, ſo as to keep the water up to a proper level for covering the land without flooding or injuring other adjoining grounds; or if the water be in its natural ſtate ſufficiently high without a weir or dam, or to be made ſo by taking it from the ſtream higher up, more towards its ſource, and by the conductor keeping it up nearly to its level until it comes upon the meadow or other gound. And ſtill further, whether the water can be drawn off from the meadow or ground in as rapid a manner as it is brought on. Having, in addition to all theſe, too, an attention to all ſuch other difficulties and obſtructions as may preſent themſelves, from the lands being in leaſe through which it may be neceſſary to cut or form the mains or grand carriers, from the water being neceſſary for turning mills, from the rivers or brooks not being wholly at the command of the floater, and from ſmall necks of land intervening, ſo as to prevent the work from being performed to the greateſt advantage, the operator may be in a ſituation to commence his works.

The water being thus under full command and regulation in every part of the land to be watered, by a proper direction, uſe, and form of the works, it is ſuppoſed neceſſary, in order to have an equal diſtribution, and prevent the waſte of it, that no part of the meadow or land, either in the bed or catch-work mode, ſhould be ſo formed as to be floated or watered directly from the main-feeder; but that all the main-feeders ſhould be kept high enough to diſcharge the water into the ſmall feeders with conſiderable velocity, and through a narrow opening. The motion of water is ſaid to be truly mechanical; and that it requires a great deal of ingenuity, and a perfect knowledge of lines and levels, to make it paſs over the ground in a proper manner. Each meadow or portion of land requires a different deſign, unleſs the land-owner or tenant makes up his mind to the heavy expence of paring off banks, and filling up ſuch hollows as may be neceſſary to reduce it to ſome regular method, the conſtruction to be varied according to the nature of the ground. This conſtitutes the difference between the watered meadows or lands of Berkſhire and thoſe of Devonſhire. Thoſe of the latter county being upon ſmall ſtreams carried round the ſides of the hills, and are chiefly in catch-work; thoſe of the former are near large rivers and boggy ground, being thrown up into ridges to create a briſk motion in the water; and alſo for the eſſential purpoſe of drawing off the ſuperficial moiſture which might be injurious to the graſſes when ſhut up for feeding or mowing. Where there is much floating to be done with a little water, or rather where the great fall of a ſmall ſtream will admit of its being carried over a great quantity of ground, and uſed ſeveral times, it is deſirable to employ it in ſuch a way, though meadows or land ſo watered are not to be conſidered as perfect models. If it ſhould anſwer the purpoſe of a coat of manure upon ſuch an extent of ground, it is all that can be expected, and will amply repay the expence. In all caſes, loſing fall is waſting water. All the drains of watered meadows or lands require no greater declivity than is neceſſary to carry the water from the ſurface; therefore, the water ſhould be collected and uſed again at every three feet of the fall, if it be not catch-work. It is ſometimes difficult to do this in bed-work lands; but where the upper part of the land is catch-work, or in level beds, and the lower part not too much elevated, it may be done. By collecting and uſing the water again in the ſame piece of ground before it falls into the brook or other courſe, a ſet of hatches is ſaved, and it is not neceſſary to be very particular about getting the upper part into high ridges, ſince that part of land which is near the hatches generally becomes the beſt, and the lower end of the field being often the wetteſt or moſt boggy in its natural ſtate, requires to be thrown up the higheſt. If the land be of a dry abſorbent nature before floating or watering, it is not neceſſary that it ſhould be thrown up into high beds. There are many good meadow lands in the county of Wilts that have little work in them, and ſome that have neither feeder nor drain: but theſe are extraordinary ſituations that do not occur in almoſt any

other

other county, or they muſt, it is thought, have ſuggeſted the ideas already ſtated as to the origin of floating or watering. There is ſome reaſon, it is thought, from the natural warmth of peat-ground, which keeps it from freezing, that ſuch land will produce an earlier crop of ſpring-feed than any other. At all events, it will firſt ſhew the advantages of watering, and gravel or ſand may the next to it.

It has been ſuggeſted that if graſs-land of the heavier kind could be ploughed in ſuch a manner as to ſet the two furrow-ſlides or ſods in a leaning poſition againſt each other with the graſs ſides outwards, the roots of the graſſes would be perfectly dry all winter; the ſhoots would have the full benefit of the ſun, and great advantage from mutual ſhelter. Upon wet land, this ploughing ſhould be done the way the water runs. If the ground ploughed in this form before winter could be watered toward the ſpring, ſo as to give it a good ſoaking, it might be preſſed down again to a level ſurface with a heavy roller. If theſe narrow ridges, too, were croſſed with level trenches at every forty, fifty, or one hundred yards diſtance, according to the fall of the ground; and theſe trenches made to communicate with other main trenches, which ſhould run up and down the ſlope, and ſupply or diſcharge the contents of thoſe which are horizontal, ſuch ground might be laid dry or wet at pleaſure. And it is believed, that land ſo ſhaped might be floated or watered all winter with ſtagnant water to its great benefit, and probably in the ſpring too, if the water be changed at frequent and proper periods; for the water would remain only in the furrows, where there would be little or no vegetation, and the newly looſened ſoil of the ridges could not fail to abſorb moiſture, ſuch as would promote the growth of the graſs without any danger of putrefaction. The levels muſt be taken before a piece of ground be ploughed in this ſhape, and the earth taken out in cutting the croſs-drains, be uſed in ſtopping the furrows on the lower ſide of them. Perhaps upon wet lands it would be neceſſary to re-plough them every autumn, or the ſtrong lands might become too ſolid to receive the ſame benefit from the practice; and it will be neceſſary to level the ridges every ſpring, if the ground be mowed, but if ſummer-fed, it may as well remain in this form as any other. This eaſy method of getting land up into ridges, which are very narrow, gives to the ſurface all that inclination which is neceſſary for drawing off water, and is certainly ſo far likely to anſwer the purpoſe of watering. The water is thus under the ſame command as in any of the beſt-formed meadows or lands, and a much leſs quantity will be ſufficient than under any other plan of watering. It is ſuppoſed that it might, probably, anſwer the purpoſe to float young wheat, or any other ſort of grain, in ſome caſes, by a ſimilar method. It is thought that flat peaty ground, ſuch as the level fens in Norfolk, which are ſubject to be covered a few inches deep every winter with ſtagnant water, would be much benefited by ploughing in this way before the floods commence. Some parts of it would thereby be raiſed above the water, and vegetate quicker in the ſpring, and the ſedgy matter growing up in the furrows, would in a few years raiſe them to the ſame level. The croſs-drains, where on a declivity, would ſerve to catch and re-diſtribute the water, and the fall from one to the other muſt be very little. If this method be found not to do for watering, it is thought that four furrow-ridges of turf, with a ſmall feeder upon each, would anſwer all the purpoſes of a more expenſive ſyſtem. There is always good graſs by the ſide of the feeder, whether the water ruſhes over it or not, and a meadow or land of this nature would be nothing but feeders. It requires ſo little elevation of ridge and fall in the feeders, that the water might ſoon be uſed again; therefore a very ſmall quantity would ſuffice; and if there was a ſcarcity in the winter, the whole diſcharge might be ſtopped, and gradually lowered in the ſpring. This method would anſwer all the purpoſes of complete ſaturation, which ſeems to be one of the moſt eſſential parts of watering, and might be applied more or leſs, according to the time of the year. When the water is put on, it is ſuppoſed no graſſes would ſuſtain any injury by excluſion from the air for a day or two at the firſt application. If theſe ridges could be elevated but four or ſix inches above the furrows, it would give the ſurface nearly the ſame ſlope as the wider ridges of common meadows or lands; perhaps it would be better to begin ploughing the furrows wide at the ridge, and very narrow at the furrow, which would leave but narrow ſpaces for drains. If a piece of turf-ground were ploughed in ſuch ridges by the common way of turning over the furrow, if it were ſet pretty much on edge, it is thought the graſs between would ſoon cover the whole ſurface.

Ridges, too, might perhaps be made by beginning the two firſt furrows more apart than the uſual width, thus leaving the width of one furrow between the two firſt to conſtitute the channel of the feeder. Theſe ridges ſhould be ploughed up and down, with only three or four inches fall between the croſs feeders; and the water may be brought into uſe again at every other ſet of beds. If the ground require to be looſened every year, or every other, or two years or more, it will not be attended with much expence, and there will be no very great inconvenience in mowing ground in this ſhape, if the ſides of the ridges be about a ſwath wide. It is thought that meadows or lands of this ſort might be made for twenty-five or thirty ſhillings the acre, floated or watered with leſs water than catch-work, and have many advantages over it; namely, the water would lie more above the ſurface, would be more at command, and therefore changed more readily, and it may be pent up better to get a good ſoaking when ſcarce. This may be done more effectually in turns, and will run drier when the water may be taken off. It does not require much ſkill in the making or management. All the water will be let through nicks inſtead of running over a nice level edge, which in the firſt place is ſeldom made well, and in the next is difficult to keep in repair. This ſort of work would, it is thought, have all the advantages of drains and feeders, whereas the ſame channels are obliged to ſerve for both in the common catch-work; it would require but very few or no ſtops, and conſequently want but little attendance. It might be practiſed where there are ſix or eight inches of fall between the croſs-feeder and croſs-catch, as the water of each ridge, which ſhould be ſhort, may be led out by a ſod with leſs trouble in the regulation than catch-work. See Weir.

The whole of the channels and drains for carrying the water on or off the land, in the conſtant courſe and regular quantity which practice proves to be neceſſary, have two very diſtinct uſes. The firſt ſort or feeders bring a continued ſupply of water to make the ſlopes wet; and the latter by carrying it away, prevent the land from getting too wet in the time of floating or watering, and ſerve to render it dry when that operation is over, and to remove any ſuperfluous moiſture which may leak from the ſoil or fall from the clouds. The large ones which convey the water to the land, and along the main ridge to ſupply the others, are ſometimes ſaid to be the *main feeders;* and the branches that run along each ridge and diſtribute the water down the ſides, the *floating feeders*. The firſt operation of floating or watering begins, or ought to begin, at the edges of theſe feeders; the main feeders being nothing more but channels or courſes

along

along which the water muft pafs, from the places where it can be found to the places where it is to have its effect. The place of its ufe lies between the floating feeder and the foot of the flope or drains, which are made in every furrow, for the purpofe of catching the water; and which are faid to be catch drains, and the large ones, which collect the water from thefe, main drains.

It is fuppofed that all floating or watering, in large rivers, may be done without conftructing hatches, which are often attended with heavy expences and many inconveniences. If the proprietor has the land far enough up the river, nothing more is neceffary, than to go thither and cut a channel out of it, which fhall be deeper than the bottom of the ftream. The water, which will be taken out in this new channel, may be dammed up by the hatches in it, at any place moft convenient for getting it out upon the furface. To turn it into its old courfe down the river, nothing more is neceffary than a hatch at the upper end of the feeder. Feeders conftructed in this way will be extremely ferviceable in time of floods, for by drawing both the hatches an entire new channel will be opened, which is generally much ftraighter than the old one. To contrive the fhorteft poffible way to get the water upon the ground, it is evident that an obtufe angle is the beft calculated for that purpofe; it fhortens the length of the feeders, facilitates the motion of the water, increafes the velocity, and confequently preferves that natural warmth or motion which keeps it from freezing in the winter or ftagnating in the fummer. It alfo prevents the accumulation of fcum, or whatever floats upon the furface, and enables the floater to diftribute the water much more equally on every part of the work than if it went in a more circuitous courfe. The wind has lefs power to retard the motion of the furface, and the fediment which fhould go out upon the beds is lefs liable to lodge in the bottom of the feeders, and confequently the feeders will be cleared out with much lefs trouble and expence, efpecially if there be proper plugs or fmall hatches to draw up for the purpofe of fending a ftream through them. It may appear to fome that thefe hatches are too expenfive, or unneceffary, but practice proves that it is beft to have them well done at firft, which is doing them for a length of time. Inclined planes, too, are abfolutely neceffary for the purpofe of watering. To form thefe between ftraight and parallel lines, it is requifite to dig away land where it is too high, and move it to thefe places where it is too low, to make fuch an uniformity of furface. The new-made ground will, of courfe, fettle in hollows proportioned to the depth of the loofe matter which has been lately put together, but fuch fettlement will not take place until the new ground has been completely foaked with wet and dried again; confequently, thefe defects cannot be removed before the fecond or third year of watering; it will therefore require more fkill to manage watered land for a few of the firft years, than may be the cafe at any time afterwards.

In conclufion it is noticed, that however fimple the conftruction of a watered meadow or land may appear upon a fuperficial view, thofe who enter particularly into the concern will find it much more difficult than is commonly fuppofed. It is no eafy tafk to give an irregular furface that regular yet various form which may be fit for the overflowing of the water. It is quite neceffary for the defigner to have juft notions of lines, levels, and angles; the knowledge of fuperficial forms will not be fufficient. Accurate ideas of folid geometry, fomehow acquired, are abfolutely neceffary to put fuch a furface into the proper form for the reception of water, without the trouble and expence of doing much of the work twice over.

Divifion of Watering.—The practice of watering land may be divided or diftinguifhed into two principal heads or modes; as thofe of performing it in flat work or flat-flooding, and in floping or catch work. Each of thefe divifions has, however, many varieties in the methods of executing the bufinefs, as will be feen below.

In the former, or that of watering lands in flat-flooding, there muft be a full fupply of water, which ferves only one turn, and is then carried off the field. There fhould be a very moderate but uniform declivity in the furface of the land, and the requifite expence be incurred by the undertaker. But though in fuch works a very fmall gradual declination will moftly be fufficient, there will be confiderable variety in this particular, according to the actual form of the land. The moft defirable and perfect declivity for this purpofe has been found to be in the ridges, from the upper to the lower extremities of the field, one inch in every nine yards. With this gentle fall, the water paffes over by the mere contraction of the feeder, without any ftop; but fuch exact declivities are feldom had. It is alfo found that the declivity of the fides of the ridges, from the crown to the furrow, fhould be about two inches for every yard; fo that, fuppofing the ridge to be ten yards broad throughout, and every fide to be in the form of an inclined plain, declining in this proportion, the crown may be ten inches raifed above the furrow, meafuring by the furface at each part. In thefe proportions, however, there is great actual variety. It is by no means uncommon to find the ridges fourteen yards wide; and when the water is very fcanty, they are fometimes twenty yards in width. Where there is a full ftream of water, the narrow ridges are found to produce the greateft crops in proportion; but the expence of forming them is likewife greater. Where the field or land has an uniform furface, and the declivity fuits, one principal feeder may ferve the whole. It is to be cut fo as to be the wideft at the upper end, contracting all the way as it defcends. Notches are to be cut in the bank on the fide next the land; and a notch oppofite to and communicating with each of the leffer feeders, in order to fupply them all in fucceffion with water. Thefe fmaller feeders, too, are to be formed fo as to be the largeft at the heads, contracting gradually as they defcend, until near the lower end of the ridge, when the fmall feeder entirely difappears. The correfponding fmall drains are made fomewhat lefs than the feeders, though not much lefs, and the proportions of the drains are reverfed, being formed the largeft at the lower ends, and diminifhing into fcarcely any thing at the upper ends.

But though the furface of the field or land fhould be uniform, yet if the defcent in the line of the principal feeder be too rapid to admit of its giving fupply to the leffer feeders, in a regular manner, without great ftops or hatches, the method below may in that cafe be had recourfe to. The main ditch may act as a conductor only, not as a feeder; and parallel to it the main feeder may be formed in feveral different parts, each of which is eafily levelled up, fo as to fupply five or fix ridges, and is itfelf fupplied from the conductor, by fimply adjufting a ftop or hatch for every fubdivided feeder. If the furface fhould confift of feparate and gently rifing fwells, there muft be a main feeder branching away from the conductor to fupply every afcent, on the top of which this feeder is formed; while a correfponding drain is cut at the bottom, and the refpective ridges are marked out and formed between the feeder and the drain.

If it fhould be neceffary, fome catch-work may be intermixed, fo as to water the irregular portions of furface, which poffefs a degree of declivity anfwering to that mode

of

of watering; and too much of it to be conveniently and properly watered in flat flooding.

The ridges being formed, and all the feeders and drains cut out, and their materials placed and difpofed in fuch a way as to render the furface as regular and correct as can at firft be done; the feeds of proper graffes fhould in fome cafes be fown, but in others it will be unneceffary. When the land is ready in the fpring, the feeds may be fown with a thin crop of fome early grain kind, but it may be as well to fow the feeds alone towards the beginning of the autumn if the land be then ready.

In the latter mode of watering, or that of catch-work, the principle confifts in floating as much of the furface, as can be done, in the way moft fuited to the form of the grounds; taking care to prevent the water from finking or ftagnating; and collecting it again to be a fecond time, or more frequently thrown over new furfaces of the land. In order to put it in the power of the floater to receive the water, and to throw it again over fome other portions of the ground, there muft be a declivity fufficient for fuch purpofes. A fmaller quantity of water may be enough for watering, according to this method, than is neceffary in flat flooding; and as the water is accommodated to the form of the ground, and no ridges required, the expence of watering in this way is generally very moderate, in comparifon with that of watering flat meadows or lands. It is well adapted, too, to thofe gentle declivities which produce very little in the ftate of nature, but may become highly valuable at little expence, when properly watered. On thefe and fome other accounts, it would feem that all the preference to flat meadows or lands, that has been commonly claimed for them, is not due. At leaft, it admits of no queftion, that watering in catch-work, when properly executed, is a very beneficial and advantageous method.

The principal objection to this mode of watering is, perhaps, in the feeming unequal diftribution of whatever nutriment the water may contain, which has certainly fome weight in it; as the firft furface over which the water paffes, muft of neceffity have the advantage. It fhould not, however, be entirely forgot, that in moft cafes of land in fuch declivities the confiderate farmer beftows moft manure where the foil or land is the moft thin and poor; and the water of catch-work meadows or lands does the fame; the higher fituated grounds receiving it and its benefits the firft, and afterwards thofe which are lower, and, for the moft part, richer, and deeper in point of earthy ftaple.

In this mode of watering, the feeders and drains are cut in a direction paffing acrofs the flope of the furface of the land; and having no greater fall, as the water flows in them, than to caufe it to move gently and freely, without either ftagnating, or acquiring fuch a rapidity, as might endanger the works. In order to accomplifh the work in this eafy way, the water may be introduced at an upper corner, where it paffes gently, and by a very fmall declivity in the feeder acrofs the flope, and overflows the furface below its tract. A drain, at a proper diftance below, receives the water, and tranfmits it into another feeder, cut on the fame plan as the former, where it again overflows, and is again taken up in a drain to be fent over new furfaces.

In this manner, a moderate quantity of water may float a fet of different fpots lying in a diagonal direction, until it arrive at length at the bottom of the watered grounds, and reach a drain which carries it off completely. An entirely new fet of different fpots may then be watered in the fame manner, the drains in the firft procefs, or cafe, acting as feeders in the fecond, and the contrary in other cafes. But catch-work watering, fo far as regards the method of performing it, admits of almoft an endlefs variety. A conductor with ftops may be formed, pointing directly down a declivity, if the rapidity of the current be not fufpected as dangerous for forcing up the channel in which it flows. From this conductor, feeders may be formed at right angles, to the right and to the left, or in either direction; and the ftops in the conductor fend the water into thefe feeders; which, being formed only a very little off the level, foon fill and overflow the grounds below them. The furplus water is collected in drains parallel to thefe feeders, which reftore it to the conductor, whence it can again be diffufed to right and left, in order to float a lower fituated furface, from feeders conftructed in the manner already feen.

There are many other ways of watering in different cafes of this nature; but where the lands are neceffary to be laid down into permanent meadows, the works fhould evidently be fubftantially executed at once, and with proper care and defign, whether the method be catch-work or flat meadows or grounds.

Regular plans of this mode of watering may be feen in the laft editions of Wright's tract on the "Art of floating Land," and of Young's "Farmer's Calendar."

The writer of the work on "Landed Property" has given practical directions for four different methods of applying it artificially on the furfaces of grafs lands, which may be ufeful in guiding the practice of the inexperienced.

1ft. Flooding or covering low flat Lands with ftagnant or flowly-moving Water.—This is a mode which, it is thought, was formerly, perhaps, the only one in ufe, in this country, for enriching the bafes of valleys by the means of water. In the midland diftricts, tradition, it is faid, fpeaks of it with familiarity. And the remains of works that have been ufed in practifing it, are ftill evident. Even in the weftern diftricts of the fouthern range of chalk hills, which have long profited more by watering, than all the other diftricts of the ifland, this, it is more than probable, has been heretofore the only method in ufe. It is indeed an interefting fact, it is faid, that the far-famed long-grafs mead of Orchefton, in the county of Wilts, is ftill watered in this manner. But it is conceived that there are now, however, few fituations in which this method can be practifed with the beft effect. The one for which it is the moft applicable is, it is fuppofed, a *drained* morafs, or other flat moory ground, through which a ftream naturally paffes, or to which a fufficient fupply of enriched waters can be led. A body of water, refting on a light fpongy furface, tends to comprefs and confolidate it; while the fediment of foul waters, let fall in paffing from an agitated to a ftagnant ftate, further promotes this tendency. The rich moory meadows and pafture grounds, which are feen in various parts of the kingdom, were doubtlefsly, it is thought, brought to their prefent profitable ftate, by being flooded with ftagnant or flowly moving waters.

Another, and perhaps the only other, fort or clafs of lands, to which this method can now be properly applied, is *dry* valley grounds, which are compofed of a fufficient depth of foil for the pafture of herbage, with a fubfoil of flints, pebbles, or rough gravel, to draw off quickly the fuperabundant moifture that may be left in the foil, after its furface has been freed from water; and, thereby, to give vegetation the immediate freedom of action. But lands of this fort, having a fufficient command of water to flood them, are much lefs common, in this country, than thofe of the former clafs or kind. The valley of Orchefton is, however, in itfelf, it is thought, a fufficient ftimulant for fearching narrowly for lands of fo valuable a formation, and which can command fertilizing water to flood them; as they may generally

nerally be watered at lefs expence by this, than by any other method.

The method of flooding flat or difhing lands artificially with ftanding water, is fimply, it is faid, that of raifing a dam acrofs the lower end of the fite of improvement, of a fufficient height to overflow the land, and proper ftrength to fuftain the weight of the water; with a channel at each end, to carry away the overflow; and with a valve in the middle or loweft part to draw at pleafure.

Where the fubfoil is not fufficiently abforbent and open to free the upper foil of fuperfluous moifture, prefently after the body of water has been drawn off, a main drain fhould be run up into the area of the fite, and lateral ones be branched off from that, to wherever the water is found to hang; whether on the furface or in the fubfoil. But where the fubfoil throughout is retentive, though but in a fmall degree, the land may be confidered as improper for this mode of watering, as will be feen below.

2d. Watering flat Lands with running Water, when raifed into Ridges.—This is a method of practice which is conceived to be modern when compared with that of flooding, drowning, or covering the entire furface with ftanding water, as being a fpirited mode which is ftill, as a general practice, confined to one part of the kingdom. Among the chalk-hills of Wiltfhire and Dorfetfhire, but efpecially the former, there are large tracts of water-formed valley lands, which have long been watered with fcientific accuracy and correctnefs. Thefe lands, it is probable, were firft brought to a firm ftate of fward, by flooding them, during a great length of time, with ftanding water; and have been fince moulded into their prefent form; been raifed into ridges, or other inequalities, in fuitable manners, and properly watered.

It is proper and neceffary, however, before fo expenfive a practice be recommended, to explain the principles on which it proceeds, and on which it may be profitably purfued and had recourfe to; where fuitable ground, and a fufficient fupply of water, which is proper, can be employed. It is noticed that plants, as well as animals, have their natural elementary matters. That water plants, aquatics which root beneath the water, live but in this fluid, where they are fecluded, in a certain degree, from air and heat. On the contrary, the agricultural vegetables of this country, among which are to be reckoned the more nutritious meadow plants, require a free communication of atmofpheric air and heat, to every part of them: they cannot live with their roots immerfed in water, nor flourifh while water is lodged immediately beneath them. And between thefe two oppofite tribes of plants, is found an intermediate one, which is fomewhat amphibious, or partakes fomething of the nature of both,—the plants of which delight in water, yet can live, though not flourifh, on dry land,—provided it be of a cool nature or quality.

It is ftated that where the foil of low flat meadow lands of this nature, refts on a retentive bafe, the paluftrean fort of plants feldom fail to intermix with the meadow herbage. In a feafon which is favourable to dry land plants, the fuperaquatics are kept in a dwarfifh underling ftate. On the contrary, in a wet feafon they flourifh; while the better herbage becomes weak and unproductive. If, through neglect, the foil or land be fuffered to remain faturated for fome length of time with water, the meadow plants dwindle, or die, and the ranker wet-land weeds take poffeffion. Hence, in the practice of watering, the propriety of quickly relieving the foil or land from fuperfluous moifture or wetnefs, in order that the better herbage may gain the afcendancy; efpecially in the fpring, when a few days of warm weather at the critical juncture may give the one or the other a fuperiority during the early fummer months. Even in meadows where the fuperaquatics do not abound, the fame principle of practice holds good; for it is well known to common obfervation, that flat retentive meadows, which do not readily fhoot off furface-waters, are materially injured by a cold wet fpring: by which the finer more nutritious herbage is cut off, or wholly checked; fo that the hay-crop proves thin, is of fmall bulk, and of an inferior quality. But further, though it be evident that water, even ftanding water, may remain for a fhort time upon dry land-plants with impunity, efpecially in a cold feafon; yet wherever it is fuffered to lie long on the furface, particularly during warm weather, there, dry land-plants, in general, are deftroyed, are probably fuffocated for want of that fupply of air which *ftanding* water is incapable of affording them. Hence, it is fuppofed, appears to arife an advantage of watering with *running* water; and hence, too, the propriety of watering by *intervals*; in order to enable the plants to recover their ftrength, and to exert their natural powers of imbibing the nourifhment the water may have provided for them, and thereby increafing their ftrength. Befides, the warmth which moving bodies, even agitated liquids, naturally generate, may be fuggefted as another advantage of watering with running water.

Thefe confiderations may, it is fuppofed, fufficiently explain the reafon for laying up cool flat lands into ridges for the purpofe of watering. Experience has well afcertained, it is faid, that where calcareous water, at leaft, is fpread over a fufficiently floping furface of grafs-land, the fuperaquatic plants difappear, while the more nutritious graffes luxuriate. On the contrary, where the fame fort of water is fuffered to loiter on a flat foil, lying upon a retentive bafe, the groffer wet-land plants prevail. And further, that the fame or fimilar water in its nature, thrown over the fame or a fimilar fort of foil, with the fame turn of furface, but with a dry abforbent bafe, produces luxuriant crops of valuable herbage. And, from long continued obfervations on facts of this nature, has doubtlefsly arifen, it is thought, the prefent *practice* of Wiltfhire and its neighbourhood.

The work of raifing flat lands into water-mead ridges in thefe cafes, is directed to be performed in this manner. In a fuitable fituation, where the ftream of water can be properly received to begin and mark out a plot of the green fward, or land, of the proper length and breadth for the purpofe. Then if to be done by the fpade, to roll back the turf after it has been cut, and form the earth of the foil into the proper fhaped convex ridge, being careful in forming it, to keep the beft of the mould conftantly toward the furface, and leaving the opening on the ridge eight or nine inches or more deep, and nearly level; the end towards the ftream being made fomewhat higher and rather wider than the other, that the water may flow evenly over every part of the ridge. The turf is then to be returned, being careful to replace it evenly and firmly along the fides of the trench in the middle; and cut a drain on each fide of the ridge thus formed, with proper outlets to carry away the wafte water. Laftly, raife a channel between the ground and the fource of the water, to conduct it into the watering-trench; and continue to adjuft the ground until the well flow evenly over every part of it. The moft proper forms, and the degrees of convexity which are the moft fuitable in different cafes, will be feen below.

This work may be performed either with the fpade or with the plough. The former is the more expenfive method, but it is the more accurate, and fooner brings the improvement to profit. By the fpade, the natural earth and foil are again diftributed on the furface. By the plough much of them is buried

buried under the ridges, while the furrows are left deftitute. Where there is a great depth of fertile foil, the plough may be ufed with better effect than where the foil is fhallow.

The next confideration is the elevation and convexity of thefe meadow ridges. On the principle offered, it is faid, the fteeper the fides are formed, the more beneficial will be the effect of the work. But it is not lefs certain that the expence of it will be proportionally great. Something may depend on the nature of the materials of which the ridges are to be formed, and the method of forming them. If, in moving the materials, a regular ftratum of flints or gravel can be buried, at a proper depth, as an open fubfoil, a fmall degree of elevation will be fufficient. In ordinary cafes, one foot of rife to fixteen feet and a half, or a ftatute-pole of bafe, will fuffice ; provided the drains between the beds be funk to a fufficient depth. One foot of rife to five feet and a half of flope, or eleven of bafe, may be confidered as the maximum of elevation in thefe cafes. On thefe premifes, it is concluded, that a ridge fet out one ftatute-perch in width at the bafe, requires an elevation of from nine to eighteen inches at the ridge ; one of two perches in width, an elevation of from eighteen inches to three feet, according to the nature of the materials by which it is formed. In refpect to the *turn* of furface, or form of the flope, there are fufficient reafons why it fhould be convex, not a regular inclined plane, nor of a concave or hollow caft. A regular fheet of water fpread over a floping furface has a natural tendency to break into ftreamlets, and to collect into partial currents. In the procefs of watering, this effect is produced in part, by the unevennefs of the furface it is fpread over, and the obftructions it meets with in its defcent, as well as by the natural propenfity of falling waters to collect into a body ; and the fteeper the defcent, the greater freedom of action this propenfity acquires. Hence, the propriety of giving the water a gentle defcent on the upper part of the flope, in order to preferve the entirety of the fheet as far down the fide of it as may be ; and this is effected by the convex form, which alfo gives firmnefs to the fides of the trench. Befides, a convex furface, while it leffens the defcent at the ridge, increafes it at the foot of the flope, and thereby haftens the drying in that part ; to which the fuperfluous moifture of the entire flope tends, and where noxious plants are moft liable to gain a footing ; the earth or foil being there kept the longeft in a ftate of faturation.

The width of thefe convex beds is a matter of much confideration. In what has been faid of their elevation, it plainly appears that the expence of forming them is in proportion to their width. An acre of ground may be raifed into beds of a rod wide, with the mentioned flope, at half the expence that another acre can be formed into thofe of two rods in width, and the fame flope : the latter requiring to be raifed at the ridge twice the height of the former ; befides the work in this cafe being within a fmaller compafs. And from what has been faid of the form of the flope, it is equally clear, that water may be more evenly fpread over a narrow than over a wide or deep flope ; and that a narrow bed will dry more quickly than a wide one of the fame foil and fubftrata. Neverthelefs, there is an advantage of wide ridges, which, in fome fituations, may more than over-balance all their inconveniences. A given quantity of water will float twice the quantity of ground, though perhaps not with twice the profit, when raifed into beds of two poles wide, that it will in thofe of one perch in width, befides the current expences of management being lefs. If, however, the quantity of water be great in proportion to the extent of ground, or if it can be collected again, and fpread over other lands belonging to the fame owner, which lie below thofe that have been watered, narrow ridges may claim a fuperiority. Hence, the proper width of watered meadow ridges depends much on foil and fituation, and on the quantity of water proportionate to the quantity of ground. In the neighbourhood of Salifbury, the prevailing width, it is faid, is ten yards, nearly two perches. In the vicinity of Amefbury, there are fome of three times that breadth or width, but they are nearly flat. From one to three poles may fairly, it is thought, be fet down as the ordinary limits of width.

In refpect to the arrangement of thefe meadow beds, and the general economy of watered meadows or lands of this nature, almoft every thing may be faid to depend on the particular circumftances of the given fite. But fuppofing a copious ftream of good water to pafs through a flat of water formed land, in a dilatation of the bafe of a valley ; and fuppofing the fituation of it to be nearly level from fide to fide of the fame, or to have a gentle defcent, the banks of the ftream towards the outer margins ; a cafe which often occurs where flat lands have long been liable to the overflow of foul waters. In this cafe, the beds require, it is faid, to be run acrofs the valley in a direct or oblique manner, as the defcent may point out ; and the water to be conducted to them by an artificial channel, winding on each fide of the natural ftream, with a main-drain near each outer margin, leaving room for a carriage-way between it and the foot of the bank of the valley ; and where the grounds to be watered are wide, other road-ways may be left between the conducting trenches and the bed of the brook or rivulet. Thefe dry flips of land are ufeful, not only in conveying away the crop, but in furnifhing comfortable lodging-grounds for pafturing ftock when the area of the land is moift. It follows, of courfe, that thefe road-flips fhould be watered with caution, late in the fpring and during the fummer months. The moft eligible method of *raifing* the water high enough to fill the trenches, is that of placing folding-gates, like thofe in ufe for navigable canals, acrofs the ftream, at the upper end of the ground to be improved. In fummer, or when the water is not wanted for ufe, the gates may be thrown open, and faftened back, to give free paffage to floods. But during the time of watering they are kept fhut, to throw a conftant fupply of water into the main trenches. If the defcent downward of the valley be confiderable, the main trenches or conducting channels require to have ftops, or rather checks, placed acrofs them, at diftances proportioned to the defcent, in order to fill with due effect the working trenches, the mouths of which open into the conducting channels ; and, to gain more perfect command of the water, the mouth of each acting trench fhould be furnifhed with a regular valve, to admit juft water enough to fupply the given ridge while under watering, and to clofe the entrance effectually when it is laid. A lifting-board in the form of a fhovel, with a fhort handle, and fliding in upright grooves made in the faces of two flender pofts, joined together within the ground, becomes a fimple and defirable regulator for the purpofe. And where a meadow ridge happens to be long and much declining, a circumftance which fhould, as much as poffible, be avoided : checks are likewife requifite to be placed in the working-trenches, to affift in diftributing the water evenly over its furface. Thefe checks are formed in different ways. Two thick tough fods placed in the trench, fo as to leave an opening between them narrow enough to force a fufficient quantity of water over the fides of the trench above them, and wide enough to let the remainder pafs down freely into the lower part of the trench, form a ready and not ineligible check for this purpofe ; as the opening may be eafily widened or narrowed

rowed at pleafure. If the defcent ftraight acrofs the valley be not fufficient, where the defcent down it is confiderable, it is advifed to direct the beds obliquely acrofs it, and by this eafy mean gain the required fall. But where the bafe of the valley is wide, fo that the length of the beds, if run out from the natural ftream to the outer bank, will be too great, as from fifty to a hundred yards, wind a conducting trench along the foot of the bank, as well as by the fide of the brook or rivulet, and fink a deep drain in the midway between them. As to what regards the dimenfions of working trenches, they fhould vary according to the breadths and lengths of the beds to be watered. The wider and deeper they are formed, the more freely a large body of water will pafs along them. Hence it is evident, that the upper end of a long trench fhould have the larger dimenfions, in order that a fufficient fupply of water may pafs freely to the further end, where the dimenfions are required to be lefs; as the uniform contraction ferves as a continual check to the water, and thus tends to force it in its paffage over the fides of the trench. From fix to fifteen inches wide, and from four to ten inches deep, may ferve to give a general idea, it is faid, of their dimenfions.

3*d*. *Watering by fpreading running Water over naturally uneven Surfaces.*—In the more weftern counties of this country, but particularly in Devonfhire, this practice has been eftablifhed time immemorial. Even tradition there fpeaks not of its origin. The fpring-waters that iffue from the flate-rocks, which are there the prevalent fubftructure, are of a fertilizing nature; and the fteep valleys that there abound are moftly covered with a rich deep foil, fit for hay-ground. Such circumftances may well ferve, it is faid, to account for the prevalence and antiquity of the practice in that part of the kingdom. Something of this practice, on a fmall fcale, too, has been long in ufe in different parts of the country for fpreading the overflowings of dung-yards and pits, and the wafh of home-ftalls over grafslands lying below them. Of late years, alfo, it has been employed in different diftricts, in diftributing the waters of more copious ftreams; and numerous inftances ftill remain in which the practice may be extended with great and valuable effects.

If the quantity of water be fmall, whether it flow from a farm-ftead, or a fpring of fuperior quality, it fhould, it is faid, be collected in a proper place, whenever it is not employed on the ground; more efpecially in the fpring months, while the hay-crop is growing, in order to be able to liberate it, fhould its growth be arrefted by a dry feafon, and to meliorate the foil as foon as the crop is off the ground for the benefit of the after-growth. The ground or fituation of improvement is moftly given in the fource of the water, or the point at which it can be commanded. Where this is a matter of choice, it is generally advifable to run the channel of fupply along the brink or brow of a flope, as above: thus giving the flatter lands above it to the plough, to which in upland fituations they are beft fuited, and the fteeper to the fcythe, as watered hay-grounds, for which they are the moft eligible; extending the ground downward to the foot of the flope, and to the flatter lands beneath it, provided their fubfoil be abforbent and open, and the given quantity of water be fufficient for the whole extent. The canal or artificial water-courfe from the natural ftream or other fource of the water, to the ground of improvement, requires a certain fall, to give a due degree of current to the water it may convey. If the motion of water in a fupplying channel be fluggifh, part of it is liable to fink, and be loft by the way. Slowly moving water does not tend to make the bottom of the channel firm and water-tight, like a living ftream: nor will a channel of the fame fize convey an equal quantity of water in the fame time; nor will it clear itfelf fo well from obftructions, as with a quicker current. On the contrary, dead water gives the fufpended matter, which fhould be conveyed as nourifhment to the plants, an opportunity of being depofited by the way in the form of mud, for want of agitation, and thereby fouling the channel. On the other hand, if the current be made too rapid, it is liable to wear the channel, and to caufe unneceffary repairs. Befides, where all the height that can be properly got is required, every foot of fuperfluous fall contracts, unneceffarily, the field of improvement. On the grounds of practical experience, it is fuppofed, that one *per cent.* as one inch, foot, or yard of fall, in every hundred inches, feet, or yards of diftance, is, in ordinary cafes, the proper fall: this giving an active but inoffenfive current. Under the above circumftances, and where the length of channel required is great, one-half *per cent.* may be made to fuffice. Two-thirds of the ordinary fall gives a degree of life to the ftream, and may, in many cafes, be eligible and proper.

In fetting out water-courfes of this nature and fort, the ufe of the level is neceffary; and the beft forms of fuch courfes, whatever the fize may be, are thofe of inverted arches, as clearing themfelves better when low in water, and giving firmer banks on the lower fides than is the cafe with fquare flat-bottomed fteep-fided trenches. The modes of performing the work, and of laying them out properly, muft be directed by the particular turn of the furface of the grounds.

In the low lands which lie at the feet of the floping grounds, the natural furfaces of which are fufficiently uneven to admit of running water being fpread over them, without the affiftance of art; and the fubftrata of which are fufficiently abforbent and open, to permit them to dry quickly, after the water is taken off: the method of watering, where they lie pretty regularly fhelving, is to lead the water along the higher fide of the land, and to draw it off by a main-drain on the lower fide; ftraight working trenches and correfponding drains being cut, downward of the area, fo as to fpread the water over the whole, without fuffering it to lodge on any part of the furface. This is that which may be diftinguifhed by the Devonfhire practice, or manner of watering.

Where, however, the furface is more irregular, lying in natural fwells and ridges, with dips and hollows between them, the water is to be led along the tops of fuch higher parts, without regard to the ftraightnefs or regularity of the trenches; and the drains to wind up the hollows and loweft ground with the fame irregularity. There are two ways of afcertaining the true lines of the trenches and drains in cafes of this nature. The one is by flooding the entire area, where it can be done, and driving down levelling-pegs over every part of it, fo as to leave their heads uniformly level with the furface of the water; which being let off, the fhorteft pegs fhew the proper lines for the trenches, the longeft thofe of the drains. This method was ufed by Bakewell, in Leicefterfhire. The other, which has occurred in the writer's experience, is attended, it is faid, with lefs trouble and inconvenience. The higher parts are readily afcertained, and the lines of the trenches accurately traced by a proper levelling implement; artificial mounds being raifed between the detached knolls when wanted. After the frefh-made ground has properly fettled, and the trenches have been duly formed, the water is turned on; and by this ready mean, the proper lines of the drains are accurately given. This is an eafy way of watering valley lands; and where

where the irregularities of furface are fufficiently great, and the fubfoil abforbent, it is very eligible; efpecially, if in making the trenches and drains, the turf and foil fo raifed be applied in adjufting the natural defects of the furface.

In the watering of more fteeply floping grounds, as the fides of hills, and the lower banks of valleys, in what may be termed the Devonfhire practice, as having been long there and thereabouts chiefly eftablifhed; as there, the fides of the valleys lie in or nearly in their natural ftates; many of them appear as if they had never been fubjected to the plough; and thofe which have been in tillage, have been laid down again to grafs with nearly their natural furfaces. The practice of laying up foils into high arable ridges, has never, perhaps, gained a footing in that part of the kingdom. In thefe cafes, the conducting channel being led along the brink, and acrofs the upper part of the flope, as advifed, the working trenches are to be fupplied from it by means of checks and valves, as already feen. The diftances between the working trenches are to be regulated by the fteepnefs and evennefs of the furface. Wherever the fheet of water is feen to break, and to divide into numerous ftreamlets, there a trench is required to catch and refpread it; the working trenches, in this manner of watering, acting in the two-fold capacity of trenches and drains: frefh fupplies of water being let down from above, to the lower trenches, as occafion may require.

Where the depth or downward length of the flope is great, or where an additional fupply of water offers itfelf, and where refervoirs are formed at different heights, an additional main-channel is required, to lead a frefh fupply acrofs the midway of the flope. This main-trench likewife receives the wafte water from above; and, like the working-trenches, acts at once as a fupplying-channel, and as a receptacle of the wafte water: hence, a given quantity of water will float a much larger extent of ground in this manner of watering, than in watering ridges, raifed on level ground; though, it may be prefumed, not with equal benefit.

In forming the trenches of whichever fort, the turf and loofe earth that are raifed out of them, and which are not wanted to make their lower fides firm and level, are to be ufed in filling up the channels and dimples that naturally happen in the face of the flope; in order that the water may fpread more evenly over it, and thereby to leffen the requifite number of trenches. To the fame end, if hillocks or fmall protuberances occur, as they generally do on natural furfaces, they are to be lowered by turning back the turf, ufing their contents as above, and returning the fods to fmoothed furfaces. But, where the knoll is large, water may be led by a narrow branching trench to its top, and be thus fpread evenly over its fides. The proper defcent or decline of the working trenches depends, in fome meafure, on the prefs of water that enters them. One quarter *per cent.* may ferve as a guide in fetting them out: firft making them of inferior dimenfions, and then turning on the water: afterwards enlarging them, and in doing this, adjufting them in fuch a manner, that the water will flow evenly out of them, from end to end. The fhorter the acting trenches are made, the more eafily they may be regulated without the incumbrance of checks, which fhould be avoided as much as poffible.

4th. Watering floping Grounds that have been raifed into Ridges by Cultivation, and are in the State of Grafs.—In watering ridges on flopes, or fuch fhelving grounds as have formerly been in a ftate of aration, in which they have been raifed into high wide convex beds, refembling thofe advifed above, for flat meadowy furfaces, and have been laid down to grafs in that form; a practice which, it is fuppofed, has been common to many parts of the kingdom, efpecially where the common-field fyftem prevailed; the direction of the ridges being moftly directly downward of the flope. In this cafe, it would be in vain to attempt to fpread water over the furface, in the manner ufually practifed on more even flopes. And if it be thrown into open trenches, cut along the tops of the ridges, agreeably to the practice in ufe for level grounds, and according to the ordinary practice of watering the lands now under confideration, the operation becomes very imperfect. For, if the defcent be confiderable, the water will unavoidably flow out of the trenches in ftreams immediately above the checks; and the fides of the ridges will confequently be watered partially. Thefe difficulties in fpreading water evenly over ridges on fteeply fhelving furfaces, have led fome induftrious managers to throw down the ridges, and return the flopes to their natural ftates. But this, where the ridges are high and wide, is very troublefome and expenfive if done by hand; and if performed by the plough, is greatly injurious and hurtful to the land for many years. A better method has therefore been had recourfe to by the writer. Inftead of leading the water down the ridges, it is thrown into the furrows, and fpread over the fides of the beds by means of crooked trenches, winding, in the feftoon manner, horizontally, or nearly fo, acrofs them, and led more effectually over their tops by pointed trenchtels depending from the feftooned parts. Thefe winding trenches, like thofe acrofs plain floping furfaces, act both as feeding-trenches and as drains, or collecting trenches, to refpread the water evenly over the ground, immediately below them: thus keeping the entire ridge covered with an even fheet of brifkly moving water. When the upper ends of the ridges are fufficiently watered, the water is to be let down the furrows to the parts below; or if the ridges are fhort, their whole length may be watered at once, by letting the water partially down the furrows to the lower parts, by the means of cuts of proper widths, made with a fharp tool acrofs the lower fides of the trenches, where they crofs the furrows: thefe fimple regulators acting as checks in the common modes of watering. The diftances between the trenches, as well as their form, muft always vary with the fteepnefs of the flope or defcent, and the fhape of the ridge.

Confiderable tracts of land in North Wales have been watered in fomewhat this manner of late years.

In concluding, it may be ftated on the beft authority, that the beneficial practice of watering, by fome of the methods which have been fuggefted above, may be greatly extended and applied in different parts of the country where it has yet been but little tried, as on the fenny lands of the counties of Lincoln, Norfolk, Cambridge, Northampton, and, perhaps, fome others, where it is particularly defirable, as well as the bottoms of the chalk-hills in different diftricts, as Yorkfhire and Suffex, and the vales of Hertfordfhire, the chalky parts of Buckinghamfhire, Oxfordfhire, and Suffolk, which are peculiarly fitted for the purpofe; befides many others where good waters are afforded for making fuch improvements on grafs-lands.

WATERING *Live-Stock*, in *Agriculture*, the bufinefs of giving and providing them with water. The work is effected in different ways, and by different means. See DRINKING-PONDS, *Made* STREAMS, WATER-*Cifterns*, WATER, *Rain, Collecting of*, SPRING, *Artificial*, WELL, *Field*, &c.

WATERING *Plants and Fruit-Trees, in Hot-houfes, Stoves*, &c. in *Gardening*, the practice of throwing water over them in different intentions. The common modes of applying water have been fpoken of in confidering the general practice

of

of garden-watering, and under the heads of the different plants, as they may require it; but the nature of its application, in these cafes, may be explained in the prefent place.

For plants in thefe fituations, Mr. Fordyce has advifed the ufe of fimple water only, in clearing them from different nuifances to which they are expofed, though lime-water in other cafes may be more powerful and have a better effect, as will be feen below. It is directed to be applied in this manner. About four o'clock in the afternoon a barrow-engine is to be filled with foft water, or fuch as has been expofed to the fun through the day, and wheeled along the foot-paths of the houfes, where they are wide enough to receive it, and the whole of the plants fprinkled with the fluid, by preffing the finger on the top of the pipe of the engine, in order to fpread the water fomewhat in the manner of a fine fhower of rain, playing the engine and throwing the fluid likewife againft the top-lights and fhelves of the houfes, until the water ftands an inch deep in the paths of the houfes. A fmall copper engine may be made ufe of, and anfwers very well, when a barrow-engine cannot be got into the houfes. It may be had in moft places. But if an engine fhould not be conveniently at hand, which can be got into the houfes, the front-lights may be opened, or, where there are no front-lights, the top-lights may be flided down, and the water be thrown in at the fronts or tops. When this operation is begun, if in the infide, every light muft be clofe fhut down; and if the water be thrown in at the fronts or tops, one light only is to be kept open, which is immediately to be fhut, when that part of the houfe, which is oppofite to it, is fufficiently watered; then proceeding to open others until the whole be properly watered. The houfes after this are to be kept clofe until the next morning; which will caufe fuch an exhalation from the glafs of the houfes, and the beds that may be in them, if there fhould be any, that the plants will, it is faid, be covered all over with fteam or vapour; which will infallibly deftroy and clear them of the vermin and other hurtful matters that may be upon them, efpecially thofe of the plant-loufe and coccus kinds. This fort of watering is, however, to be repeated every afternoon, in the time of hot weather only. By it a great deal of labour in watering will be faved; but fuch plants as ftand in need of much watering, fhould have the water given them before the fprinkling of the houfes is begun. In moft cafes, the plants will have imbibed all the moifture before morning, and the paths of the houfes will be perfectly dry.

As it fometimes happens that in hard winters, when ftrong fires are under the neceffity of being kept in the ftoves or other houfes night and day, that the plants which ftand on fhelves in thofe of the dry kind, are fo parched up, that the leaves drop off, as from deciduous trees in the autumnal feafon, which renders them very difagreeable in their appearance; it fhould be prevented or remedied by watering, in the manner directed below by the fame writer. About eight o'clock in the morning, when the fun fhines out, and there is the appearance of a fine day, water is to be thrown into the houfes until the floors are covered to the depth of nearly two inches; they being kept fhut the whole day, unlefs the heat rifes very high, which is feldom the cafe at fuch a feafon of the year, but when it does happen, the doors may be opened to admit a little air. By the middle of the day, the water becomes entirely exhaled, and the floors quite dry. The operation may be repeated two or three times in a week in funny weather. The plants in the courfe of a week's time begin to recover, or throw out new foliage, and in a fortnight or three weeks become in full leaf again, difplaying themfelves in a fine manner.

This fort of watering is greatly ufeful on many other occafions, as in the growth of plants in the pits of fuch houfes.

Fruit-trees in fuch houfes may alfo be watered in the fame manner with much benefit in fome cafes; but for thofe againft walls, a lime-water prepared by putting thirty-two gallons of foft water to half a peck of unflaked lime is recommended to be ufed in this manner. With the clear liquid, after the lime has fubfided, the engine is to be filled, and a good watering given to the trees, throwing a confiderable part of it forcibly under the leaves, and fpreading it finely by the means directed above; at the fame time, wheeling it backwards and forwards, that no parts of the trees may be miffed. This fhould be performed when the weather is cloudy, or when the fun is off the wall that contains the trees. Where the trees are on an eaft wall, the watering may be begun about half paft eleven o'clock; if on a north wall, the watering may be done the firft thing in the morning; and when they are on a fouth wall, it may be executed about four o'clock in the afternoon: it is to be repeated once a day for fix or feven days in fucceffion. If, however, there fhould be cold northerly or eafterly winds, or frofty nights, fuch watering fhould be difcontinued until the weather becomes more mild and temperate. Care is conftantly neceffary that the trees get dry before night, and that no watering takes place while the fun is upon them. Care is likewife to be taken not to water them with any of the grounds of the limey liquid, which would injure the leaves, and make the trees look very unfightly.

This fort of watering, with the ufe of lime and wood-afh duft to the under-fides of the leaves, are found extremely effectual in deftroying and clearing away every thing noxious about the trees, and in rendering them healthy and productive. See Watering, in *Gardening*.

Watering-*Pots*, *Pans*, *or Cans*, are fuch contrivances of this nature as are fuited for pouring water over feeds, plants, trees, &c. in pots or otherways in a fine fhowery divided ftate, they being provided with ftrainers or rofes of a finer or coarfer kind for the purpofe, well adapted to their fpouts. They are particularly convenient for potted plants of all forts, as well as many other kinds. They form the principal mode of hand-watering.

Watering *Sheep*, in *Agriculture*, the fupplying them with water. This is particularly neceffary in the management of flocks in fome fituations, as on the South Downs; and as there is there no other water than what is to be collected by fome artificial method, ponds are conftructed for retaining fuch water as falls in rain; thofe, for this ufe, are commonly made circular, and very gently floping to the centre; the bed very ftrongly rammed down to prevent any lofs by foaking through the chalk. As ponds are liable to become leaky, and to be fpoiled by a hard froft, they are made by lining them with chalk, puddled and trod down until it makes a fort of plaifter floor. If a little good ftone lime were fifted evenly over the whole and trod well in with the chalk, it would probably effect the bufinefs of rendering them perfectly retentive of the water under all circumftances.

In Italy the fheep-flocks were regularly watered morning and evening, as is evident from Columella, and the practice has probably confiderable utility, efpecially in dry fituations.

Watering-*Syringe*, in *Gardening*, a large kind of garden fyringe employed for throwing water to fome height over trees or plants, in rather a forcible manner, in the way of a ftream, for clearing away infects and other matters, as well as fome other purpofes.

Watering *the Soil of Tillage Land*, in *Agriculture*, the practice of improving ploughed ground, and the crops upon it, by the application of water.

The outlines of a plan for watering arable or tillage crops and lands, that has long been familiar to the writer on the Management of Land, are firſt to form the ſoil into flat beds or ridges, with intervals, or trenches, directed ſomewhat obliquely acroſs the ſlope, or general deſcent of the field or ground; namely, ſo as to dip from one quarter to one half *per cent.* beneath the dead level; this declination being equally calculated to communicate and carry off water. The width of the beds is to be regulated by the nature of the land. Abſorbent ſoils may be laid into wider beds than thoſe which are repellent, or of the ſtiff heavy kind, that are leſs prone to draw away the water.

The depth of the trenches ſhould vary according to the quality of the water, and the intention of uſing it. For merely moiſtening the land, in a dry ſeaſon, with ordinary water, the trenches, it is conceived, ſhould be deep, ſo as to lodge the water in the ſubſoil, rather than the ſoil above it. But when an enriched water is to be uſed to fertilize the ſoil, and encourage the growth of the crop during its early ſtages, it requires to be communicated immediately to the paſture of the plants; conſequently, in this caſe, the beds ſhould be narrow, and the trenches no deeper than juſt to prevent the water from overflowing.

When the water is neceſſarily required to be conducted to the uppermoſt corner of the field or open ground, to be continued and conducted down the ſlope, acroſs the higher ends of the beds, and to be forced into the trenches, by the means of regulated checks, placed below their mouths, as occaſion may require; it ſhould be either ſuffered to run with moderate ſtreams along the trenches; or, if the quantity be ſmall in proportion to the extent of ground, it may be checked at proper diſtances, ſo that the whole of it ſhall be abſorbed, thus going over the ground, and repeating the watering as the quantity of water, or the ſufficiency of moiſture may direct.

Watering, in the *Manufactures.* To water a ſtuff is to give it a luſtre, by wetting it lightly, and then paſſing it through the preſs, or the calender, whether hot or cold. See Tabbying.

WATERLAND, Daniel, D.D. in *Biography*, was born in 1683, at Waſely, in Lincolnſhire, where his father was rector, and ſent to Magdalen college, Cambridge, in 1699, for the completion of his education; of this college he was elected a fellow in 1704, took his degree of M.A. in 1706, and became a private tutor. His tract, entitled "Advice to a young Student, with a Method of Study for four Years," publiſhed at this time, was popular, and paſſed through ſeveral editions. In 1713 he was nominated maſter of his college, and preſented to the rectory of Ellingham in Norfolk. On occaſion of taking his degree of B.D. in 1714, he diſtinguiſhed himſelf by defending before the regius profeſſor of divinity the negative of his theſis, "Whether Arian ſubſcription be lawful?" Being choſen chaplain in ordinary to king George I., he was nominated, on his majeſty's viſit to Cambridge, D.D., and incorporated in the ſame degree at Oxford. Diſtinguiſhed as a champion of orthodoxy by his "Vindication of Chriſt's Divinity, being a Defence of ſome Queries relating to Dr. Clarke's Scheme of the Holy Trinity," printed in 1719, he was appointed in the following year the firſt preacher of lady Moyer's lecture in favour of the divinity of Chriſt. He alſo publiſhed an anſwer to Dr. Whitby on the ſame ſubject, and in 1721 he was preſented by the dean and chapter of St. Paul's with the rectory of St. Auſtin and St. Faith. His "Hiſtory of the Athanaſian Creed," vindicating it againſt the objections of Dr. Clarke, was publiſhed in 1723, and his preferments to the canonry of Windſor, the vicarage of Twickenham, and the archdeaconry of Middleſex, kept pace with his publications of this nature. His remarks on Dr. Clarke's "Expoſition of the Church Catechiſm," printed in 1730, engaged him in a controverſy with Dr. Sykes on the ſacrament of the Lord's ſupper. Againſt Tindal's "Chriſtianity as old as the Creation," he publiſhed his "Scripture Vindicated," and his "Chriſtianity Vindicated againſt Infidelity." On theſe treatiſes, Dr. Middleton publiſhed remarks, and they were defended by Dr. Zachary Pearce. In 1734 Dr. Waterland made an attempt for refuting Dr. Clarke's opinions in a "Diſcourſe of the Argument *à priori* for proving the Exiſtence of a Firſt Cauſe;" and in this year, having declined the office of prolocutor of the lower houſe of convocation to which he was choſen, he publiſhed his treatiſe "On the Importance of the Doctrine of the Trinity," which he regarded as fundamental, avowing his high reſpect for the authority of the fathers in this and other articles of faith. In 1736 he commenced a ſeries of archdiaconal charges on the ſubject of the euchariſt, arguing againſt the opinion of Hoadley on the one hand, that it was a mere communicative feaſt, and againſt that of Johnſon and Brett, on the other, that it was a proper propitiatory ſacrifice. But a complaint under which he laboured, and which required repeated ſurgical operations, endured by him with exemplary patience, at length terminated his life in December 1740, in the 58th year of his age. A collection of his ſermons was publiſhed after his death. "As a controverſialiſt," ſays one of his biographers, "though firm and unyielding, he is accounted fair and candid, free from bitterneſs, and actuated by no perſecuting ſpirit." Gen. Biog.

Waterland, in *Geography*, an iſland in the South Pacific ocean, diſcovered by Le Maire and Schouten, in the year 1616. It is repreſented as a low uninhabited iſland, ſandy, and full of rocks, with plenty of trees on the border, but neither cocoa-nuts nor palmettoes. Some creſſes and Indian ſalad were found, and ſome freſh water in ditches. No ſoundings for anchorage were diſcovered. S. lat. 14° 46′. W. long. 149° 30′.

WATERLANDIANS, in *Eccleſiaſtical Hiſtory*, a ſect of thoſe that were called the groſs or moderate Anabaptiſts, conſiſting at firſt of the inhabitants of a diſtrict in North Holland, called *Waterland;* whence their name. They were alſo called Johannites from John de Reis, who, aſſiſted by Lubert Gerard, compoſed their confeſſion of faith in 1580. This confeſſion far ſurpaſſes, in reſpect both of ſimplicity and wiſdom, all the other confeſſions of the Mennonites; though it has been alleged, that it is not the general confeſſion of the Waterlandians, but that merely of the congregation, of which its author was the paſtor.

This community, ſays Moſheim, has abandoned the ſevere diſcipline and ſingular opinions of Menno, whom, nevertheleſs, they generally reſpect as their primitive parent and founder. They are, however, divided into two diſtinct ſects, which bear the reſpective denominations of Freislanders and Waterlandians; and are both without biſhops, employing no other eccleſiaſtical miniſters than preſbyters and deacons. Each congregation of this ſect is independent on all foreign juriſdiction, having its own eccleſiaſtical council or conſiſtory, which is compoſed of preſbyters and deacons. The ſupreme ſpiritual power is, nevertheleſs, in the hands of the people, without whoſe conſent nothing of importance can be carried into execution. Their preſbyters are, generally ſpeaking, men of learning, and apply themſelves with ſucceſs to the ſtudy of phyſic and philoſophy; and there is a public profeſſor, feffor, fupported by the fect at Amfterdam, for the inftruction of their youth in the various branches of philofophy, and facred erudition. One of thefe Waterlandian fects was divided, in 1664, into two factions, of which the one were called GALENISTS, and the other APOSTOOLIANS, from their refpective leaders. Mofheim's Eccl. Hift. vol. iv. vol. v.

WATERLOO, ANTHONY, in *Biography*, a Flemifh landfcape painter of great abilities, is generally fuppofed to have been born at Utrecht, about the year 1618; it is certain that he refided there the greater part of his life, and the fcenery of his pictures is found in the environs of that city.

His landfcapes are characterized by the greateft fimplicity of compofition; the entrance into a foreft, a broken road with a bank and a few trunks of trees, a folitary cottage, a mill, &c. are made interefting by the exquifite touch, and beautiful colour and chiaro ofcuro, with which he treated them. His fkies are clear, and his clouds float in air; his colouring, however, is fometimes too ftrongly contrafted with yellow foregrounds and blue diftances, and offend the eye for want of being more broken. He marked the characters of his trees admirably, in form and colour. His pictures are by no means common, as they are not numerous. He occupied himfelf very much in etching his own defigns and views, and his productions in that art are as valuable as his pictures, in point of truth and fkill; and will always continue to be a fource of pleafure and improvement to the artift and the connoiffeur. His plates, according to Bartfch, amount in number to 150, not entirely completed with the point, but finifhed with the graver, to foften and to invigorate them. It is to be lamented that he funk an early prey to habits of intemperance.

WATERLOO, in *Geography*, a village of the Netherlands, between 12 and 13 miles from Bruffels, fituated behind the fkirts of the fine beech foreft of Soignies, rendered famous by one of the moft fevere and fanguinary battles which modern hiftory of war records, fought in its vicinity on Sunday the 18th of June, 1815, between the duke of Wellington, who commanded the Britifh, Hanoverian, German, and Belgic army, and Napoleon Buonaparte, who conducted the operations of the French forces. The ground on which the battle was fought is faid not to exceed two miles from north to fouth, including the whole from the rear of the Britifh to the rear of the French pofition; and from eaft to weft, from the extremity of the left to that of the right wing of the contending armies, is about a mile and a half in extent; fo that the fanguinary refult of the battle has been attributed in fome degree to the limited fpace in which they were engaged, and the confequent intermixture of the two armies. The pofition of the French troops is reprefented as the beft, becaufe the eminence occupied by them was higher, and the afcent fteeper than ours, and better adapted to attack and defence. The village of Waterloo, which is not feen from the field of battle, was occupied on the Saturday night previous to the battle by the duke of Wellington, the principal officers of his ftaff, the prince of Orange, lord Uxbridge, fir Thomas Picton, fir William de Lancey, and other general officers. The French army in the Netherlands, is faid to have amounted to 130,000; and after the loffes of the 15th and 16th, and the detachment of two corps under marfhal Grouchy, there muft have remained at leaft 90,000 men, with which Napoleon took the field on the 18th of June; while, after allowing for the loffes of the allies on the 16th, which were very ferious, it muft appear that there was a great difparity in regard to numbers; as it may be deduced from a ftatement, founded upon the lateft return to the Horfe Guards, previous to the battles of the 16th and 18th, that the extreme force Britifh and German was 46,221 men, under the duke of Wellington, to which we may add 22,000 for Brunfwickers and Dutch, fo that the whole could not exceed 68,221 men; or, as it is elfewhere ftated, there could not be in action a greater number than 64,000 men to fupport the attack of the whole French army. From the adjutant-general's office, 6th November 1816, it appears that the effective ftrength of the Britifh army, prefent at the battle of Waterloo on the 18th of June 1815, was 74,040, including the army of obfervation. It is moreover obferved, that the hoftile army confifted of the beft troops of France; that it was a regular and difciplined army, even before the Bourbons quitted France, and that from the return of Buonaparte every thing had been done to render it effective; it was indeed the force which had been felected and combined to act upon the northern frontier. Whereas the allied army, the Britifh part excepted, was almoft wholly a green army; the allies, particularly the Dutch, Belgians, Hanoverians, and troops of Naffau, being chiefly young foldiers.

Previoufly to the grand and decifive battle of Waterloo, the campaign had commenced on the 15th of June by an attack upon the outpofts of the Pruffian army, commanded by field-marfhal prince Blucher. The points of concentration of the feveral corps of his army were, Fleurus, Namur, Ancy, and Hannut. Buonaparte advanced the fecond corps of his army by Thuin, along the banks of the Sambre, upon the town of Charleroi, and drove the advanced pofts of general Ziethen's corps back upon the bridge of Marchienne. After a very fmart action, the Pruffian general was obliged to retire behind the river, and collect his corps near Fleurus: and as he confidered Charleroi untenable, the troops ftationed in that town were withdrawn, and the French cavalry entered it about mid-day. The Pruffians defended their advanced pofts with bravery; and it was only the overwhelming force that was brought againft Ziethen's corps, which induced that general to withdraw his advance, in order that he might concentrate his whole force near Fleurus.

On the evening of this day an officer arrived at Bruffels from marfhal Blucher, to announce that hoftilities had commenced. The duke of Wellington received his difpatches, whilft he was fitting after dinner with a party of officers. The troops were ordered to hold themfelves in readinefs, to march at a minute's notice. Before midnight a fecond officer arrived from Blucher, and the difpatches were delivered to the duke of Wellington in the ball-room of the duchefs of Richmond; and he gave his orders to one of his ftaff-officers, who inftantly left the room. In the midft of the repofe that feemed to reign over Bruffels, the drums fuddenly beat to arms, and the loud call of the trumpet was heard from every part of the city. The whole town became inftantly an univerfal fhow of buftle. The foldiers affembled with their knapfacks, and every kind of warlike preparation threw the town into a ftate of agitation. But before eight in the morning, the ftreets, which had been filled with bufy crowds, were empty and filent; the great fquare of the Place Royale, which had been filled with armed men, and with all the appurtenances of war, was now quite deferted. The duke of Wellington had fet off in great fpirits, obferving, that as Blucher had moft probably fettled the bufinefs, he fhould perhaps return to dinner.

When the direction by which Buonaparte intended to penetrate into Belgium had been afcertained, the duke of Wellington immediately gave orders for the army under his command

command to concentrate on the extreme of its poſition, near the great road from Bruſſels to Charleroi, and in a line between Nivelles and Namur. The fifth diviſion of the Britiſh army, with the corps of the duke of Brunſwick-Oels, left Bruſſels about 2 A. M. on the 16th, and advanced towards the poſition where the whole army was ordered to aſſemble.

One brigade of the Dutch troops, which was in advance towards Charleroi, had been attacked, when the Pruſſians fell back on the 15th, and driven from its advanced poſition near Fraſnes; but the prince of Orange having moved up another brigade of the ſame army, they were able to repulſe the enemy, and in the evening they regained the greater part of the ground which had been loſt throughout the day. On the morning of the 16th, prince Blucher, who was determined to meet Buonaparte with all his ſtrength, had poſted the army under his command on the heights between the villages of Brie and Sombref, and to ſome diſtance beyond Sombref. In front of this line, he occupied the villages of St. Amand and Ligny with a very conſiderable force.

Buonaparte, as ſoon as he had paſſed the Sambre, directed the great body of his force againſt the Pruſſian line. Marſhal Ney, who commanded the left wing, was directed to advance by Goſſelies and Fraſnes, and attack the Britiſh poſition; his force conſiſting of the firſt and ſecond corps of infantry, and four diviſions of cavalry.

The third, fourth, and ſixth corps, with the guard in reſerve, were ordered to attack the Pruſſian poſition in front, while the fifth corps under Grouchy, and a diviſion of cavalry, were detached towards Sombref, on the Namur road, with the view of manœuvring on that flank.

On debouching from Fleurus, Buonaparte had an opportunity of reconnoitring the poſition of marſhal Blucher with more preciſion. He immediately placed the firſt corps belonging to the left wing under Ney, with two diviſions of heavy cavalry, behind the village of Fraſnes, on the right, and at a little diſtance from the Bruſſels road, where it was to form a reſerve, that could be brought up to ſupport either his attack upon the Pruſſians, or Ney's attack upon the Britiſh. The third corps was ordered to advance in column to carry the village of St. Amand, while the fourth corps, ſupported by the guard and the cavalry, was ordered to attack Ligny.

The enemy advanced in overpowering maſſes upon St. Amand, where the action firſt commenced on the morning of the 16th. The brave Pruſſians defended this part of their advanced poſition with great firmneſs, and it was not till after a long and ſanguinary conflict, that they were obliged to yield for a time to ſuperior numbers. The fourth corps commenced its attack upon the village of Ligny about mid-day, and by one o'clock P. M. the action may be ſaid to have become general throughout the whole of the extended line of the allied Britiſh and Pruſſian armies. Grouchy by that time had attacked the extreme left beyond Sombref, and Ney had come in contact with the advance of the army under the duke of Wellington, near Fraſnes. But it was in the villages of St. Amand and Ligny, that the greateſt ſtruggle for victory took place, between the contending armies. There the battle continued for five hours, it may be ſaid, almoſt in the villages themſelves, as the movements forwards and backwards, during that period, were confined to a very narrow ſpace. Freſh troops were conſtantly moved up on both ſides; and as each army had immenſe maſſes of infantry behind that part of the village which it occupied, theſe ſerved to maintain the combat, as they were continually receiving reinforcements from the rear. Upwards of 200 pieces of cannon were directed againſt the villages, and they were frequently on fire in many places.

About 4 o'clock, prince Blucher placed himſelf at the head of a battalion of infantry, and charged with them into the village of St. Amand. After a dreadful ſtruggle, he gained poſſeſſion of the greater part of it. The enemy were panic-ſtruck, and the victory ſeemed ſo doubtful, that Buonaparte was obliged to ſend in all haſte for the firſt corps, which he had left in reſerve near Fraſnes; at the very moment too, that it had become equally neceſſary to marſhal Ney, whoſe columns, having been repulſed by the fifth diviſion of Britiſh infantry, were retiring in great confuſion.

The advantage which Blucher had ſo nobly gained, was of little importance to the general action in which his troops were engaged. At Ligny, the battle ſtill raged with unabated vigour; and though the evening was far advanced, the victory remained undecided. The badneſs of the roads, and the difficulties which general Bulow had to encounter in his march, prevented his corps from getting up on the 16th; ſo that Blucher had only three corps of his army in poſition; and though they had repulſed every attack which had been made upon them, the danger was becoming urgent, as all the diviſions were engaged, or had already been ſo, and there was no reſerve at hand.

As the night advanced, the enemy, favoured by the darkneſs, made a circuit round the village of Ligny, with a diviſion of infantry on one ſide; and, without being obſerved, got into the rear of the main body of the Pruſſian army, at the ſame moment that ſome regiments of cuiraſſiers forced their paſſage on the other ſide of the village. This movement decided the day, and field-marſhal Blucher was obliged to commence his retreat; yet his brave columns, though ſurpriſed, were not diſmayed. They formed themſelves into ſolid maſſes, and, repulſing every attack which the enemy made upon them, retired in perfect good order to their original ground, upon the heights above the village, and from thence continued, unmoleſted, their retrograde movement upon Wavre.

This movement of the marſhal's rendered neceſſary a correſponding one on the part of the duke of Wellington; and he retired from the farm of Quatre Bras upon Genappe, and thence upon Waterloo, the next morning of the 17th at 10 o'clock.

The duke of Wellington, having given orders for the army under his command to concentrate on the left, proceeded with the fifth diviſion and the duke of Brunſwick-Oels' corps, in the direction of Charleroi. About two o'clock on the afternoon of the 16th, the head of the Britiſh column reached the farm of Quatre Bras, ſo named from its ſtanding near where the roads from Bruſſels to Charleroi, and from Nivelles to Namur, croſs each other. The advance of the enemy under Ney, who had again driven the Dutch troops from their poſition near Fraſnes, had nearly reached the ſame ſpot; and general Kempt's brigade had ſcarcely time to deploy from the great road, before it was attacked by the enemy's cavalry, ſupported by heavy maſſes of his infantry. Nothing could exceed the daring intrepidity of the French troops at this moment; their ſucceſs on the 15th, and confidence in their leader, added to the natural bravery of the troops, made them advance with almoſt a certainty of victory. The ſudden appearance of overwhelming maſſes of cavalry, and the rapidity with which they charged our infantry, before they had time to throw themſelves into ſquares, created ſome little confuſion in one or two regiments. Indeed, ſo daring were the

French

French cuiraffiers, that a regiment actually cut into the fquare of the forty-fecond Highlanders; but they paid dear for their temerity, as few ever returned to their lines; and the Highlanders had ample revenge for the lofs of their brave colonel fir Robert Macara. The third battalion of the Royal Scots, twenty-eighth, and firft battalion of the ninety-fifth, were warmly engaged for feveral hours on the left of the Bruffels road; while general Pack's brigade, confifting of the forty-fourth, feventy-ninth, and ninety-fecond regiments, with the forty-fecond already mentioned, fucceeded completely in repelling the enemy on the right, after an equally arduous conteft.

About 4 o'clock, the firft divifion under major-general Cooke, and third under lieutenant-general fir Charles Alten, came up, and were alfo immediately engaged. The enemy was now driven from his ground, and obliged to retire to the pofition which he had occupied the night before, and where he had fome difficulty in maintaining himfelf, until the darknefs put an end to the combat. The troops of the duke of Brunfwick diftinguifhed themfelves very much on the afternoon of the 16th; and his ferene highnefs was unfortunately killed at the head of his brave huffars.

At day-light on the morning of the 17th, the duke fhewed his whole force, and challenged the enemy to fight; but they did not feem difpofed to accept the challenge; and therefore both he and prince Blucher took up their refpective pofitions; their movements having been communicated to each other, and Blucher having been requefted to fupport the duke in cafe of an attack on the next day with two divifions of his army. On the 17th no movement of any confequence took place.

The pofition which the Britifh army now took up, had been chofen with great judgment, from its proximity to the extenfive foreft of Soignies. The village of Waterloo lies upon the great road from Bruffels to Charleroi, embofomed in the foreft; and a few fcattered houfes extend to another fmall village called Mont-Saint-John: about a quarter of a mile in front of this latter village, there is a rifing ground which croffes the great road already mentioned, and extends from a farm-houfe called Ter-la-Haye on the left, to the village of Merbe-le-Braine on the right, croffing alfo the road from Bruffels to Nivelles, which diverges from the road to Charleroi at the village of Mont-Saint-John. It was on this rifing ground that the allied army, commanded by field-marfhal the duke of Wellington, or more properly the firft corps of that army, took up its pofition on the evening of the 17th of June. The fecond corps, under the command of lord Hill, (with the exception of the fourth divifion and the troops of the Netherlands, under prince Frederick of Orange, who were left to guard an important pofition at Halle,) was placed in referve on the right of the pofition, and in front of the village of Merbe-le-Braine, with its right refting on Braine-la-Leud. The infantry bivouacked a little under the ridge of the rifing ground, and the cavalry in the hollow ground in rear of the infantry. Excepting a few round fhot which the enemy occafionally fired while our troops were deploying into their pofition, nothing of any moment occurred during that afternoon or the whole of the night.

It had rained almoft inceffantly during the greater part of the 17th, and the weather was very tempeftuous during the night. The ground afforded no cover for the troops; fo that generals, officers, and men, were equally expofed to the rain, which fell in torrents. Buonaparte flept at the farm-houfe of Caillou near Planchenois; and his army halted in the neighbourhood of Genappe. The duke of Wellington flept at a fmall public houfe in the village of Waterloo.

As foon as day-light appeared on the morning of the 18th, the Britifh army could perceive, from its pofition, immenfe maffes of the enemy moving in every direction, and before two o'clock the whole of his force appeared to be collected on the heights and in the ravines, which ran parallel with the Britifh pofition.

The French army, when concentrated in front of the pofition of the allies, confifted of four corps of infantry including the guard, and three corps of cavalry, the whole number of men being uncertain, and probably overrated by thofe who ftate them at 120,000.

At 11 o'clock every thing feemed to indicate that the awful conteft would foon commence;—a conteft in which victory was obftinately and valiantly difputed on both fides, but which at laft terminated in the complete triumph of the duke of Wellington, and total defeat and political annihilation of Buonaparte. The weather had cleared up, and the fun fhone a little as the battle began, and the armies within 800 yards of each other, the duke of Wellington, with his ufual quicknefs, had foon perceived the nature of the attacks that would be made upon his line; and when the troops ftood to their arms in the morning, he gave orders that they fhould be formed into fquares of half battalions, and in that ftate await the enemy's attack.

Marfhal Ney, as foon as Buonaparte's order was communicated to him, directed the divifion of infantry commanded by Jerome Buonaparte, to advance upon Hougomont; and about half paft eleven o'clock, the firft columns of this divifion made their appearance upon the ravine, or rather hollow ground, which leads down from the public-houfe of La Belle Alliance to the Chateau. The two brigades of artillery belonging to general Cooke's divifion had taken up a pofition on the ridge of the hill in front of the line of infantry, and the moment the enemy made his appearance, our nine-pounders opened upon his columns. The artillery officers had got the range fo accurately, that almoft every fhot and fhell fell in the very centre of his maffes; fo great was the effect produced by thefe few guns, that all Jerome's bravery could not make his fellows advance, and in a moment they were again hid by the rifing ground from under cover of which they had but juft emerged. This, which was the commencement of the action, was confidered a very favourable omen by our brave fellows who witneffed it; and for a fhort time they were much amufed with the manœuvres of Jerome's divifion, and the cautious manner in which it feemed to emerge from its hiding-place.

This ftate of things, however, did not continue long, as other great movements were obferved to be preparing throughout the enemy's line. A powerful artillery was brought to bear upon our guns that had fo annoyed his firft advance, and general Jerome's troops gained the outfkirts of the wood, where they became engaged with our light troops. By mid-day the cannonade was general.

The great object of Buonaparte, in this important battle, was evidently to force our centre, and at the fame time turn our right flank; fo that by furrounding and taking prifoners, as it were, one half of our line, he might completely paralyfe and deftroy the effect of the other half. Unfortunately, our centre was the weakeft part of our pofition, and upon that part he directed his firft grand attack to be made about noon.

An immenfe mafs of infantry, followed by a column of upwards of twelve thoufand cavalry, advanced upon the points occupied by the third and fifth divifions, and the left of the Guards, covered by a fire from upwards of one hundred pieces of artillery. Thefe columns, which feemed to advance with a certainty of fuccefs, were led by count d'Erlon in perfon. They advanced almoft to the muzzles of our mufkets; but here they foon found they had Britons to contend with; our fellows gave them a volley; and, cheering, rufhed on to the charge, which they did not ftand to receive, and our cavalry emerging from the hollow ground where they had hitherto been concealed from the enemy's view, paffed through the openings between the fquares, and charging the enemy's cavalry, fucceeded completely in difperfing them, and driving them back upon their own line.

In this conflict, which was dreadful while it lafted, the enemy was baffled in all his attempts, and, befides the killed and wounded, loft feveral thoufand prifoners and an eagle; but the Britifh army had alfo to lament the lofs of its brighteft ornaments, and his majefty, one of his beft officers. The gallant fir Thomas Picton fell, mortally wounded, in leading on the fifth divifion.

About 3 o'clock, when Buonaparte found that Jerome's divifion could not drive the guards from Hougomont, he ordered the chateau to be fet on fire. The fhells from feveral mortars which were brought to bear upon the houfes, foon had the defired effect: but our troops, retiring into the garden, did not yield one inch of their ground; and the only thing which the enemy gained by this cruel meafure, was the deftruction of a few of our wounded, who were too ill to be removed, and who fell a prey to the flames. The troops in La Haye Sainte, having expended their ammunition, were obliged to retire for a moment from that point, and the enemy got poffeffion of the houfe and garden; but as foon as a reinforcement of our troops could be moved up, he was driven from that as well as from every other point which he had attacked: and at no period during the day, notwithftanding the heavy maffes of infantry and cavalry which were advanced againft our centre, time after time, was he ever able to force our pofition; and the poffeffion of the advanced poft of La Haye Sainte for a few minutes, may be faid to have been the greateft advantage he ever gained. The battle continued to rage with unabated fury, and the number of brave men who were continually falling on both fides was very great, while the rapidity with which the columns of attack fucceeded each other, feemed to indicate for a time, that the refources of the enemy were inexhauftible. The artillery on both fides was well ferved: but Buonaparte had upwards of two hundred and fifty pieces in the field; while the train of the allied army under the duke of Wellington did not exceed one hundred guns, nine-pounders and fix-pounders. Notwithftanding our inferiority in this arm, which was ftill more apparent from the fize of the enemy's guns (being twelve-pounders) than from their numbers, ours were fo well fought, that it is allowed by all, they did equal execution.

About 2 o'clock, the duke of Wellington difpatched an officer of his ftaff to the head-quarters of field-marfhal Blucher, to afcertain his movements, and to know when it was probable his advance would come in contact with the enemy. This officer found the Pruffian general at the village of Lafnes, where he gained the information required.

At half paft 7 o'clock, the iffue of the battle was ftill doubtful. The greater part of lord Hill's corps of the Britifh army had been moved up at different periods to the fupport of the firft corps. The whole of Bulow's corps, and part of the fecond corps of the Pruffian army, had arrived at their pofition near Frichermont, and their attack in that direction was fufficiently powerful to oblige the enemy to give way on his right; which Buonaparte having obferved, conceived that the moment was now arrived when he muft put an end to the engagement. He informed his generals that the firing on the right was occafioned by the arrival of Grouchy's corps. This gave frefh hopes to his troops already beginning to defpair, and immediately he gave orders to form the laft column of attack. This column was compofed principally of the guard, which had hitherto fuffered but little; he gave directions for the whole of the line to fecond this effort, upon which he faid the victory depended, and placing himfelf at their head, they advanced in double quick time.

Thefe veteran warriors, fo long efteemed the firft troops in Europe, advanced acrofs the plain which divided the two armies, with a firmnefs which nothing could exceed; and though our grape and canifter fhot made dreadful havoc in their ranks, they were never difconcerted for a fingle moment. Our infantry remained firm in their pofition, until the enemy's front line was nearly in contact with them, when, with the ufual falute of a well-directed volley, and a Britifh cheer, they rufhed on to the charge with bayonets. This charge even the Imperial guard could not ftand againft, and thofe undaunted troops, who at one time confidered themfelves the conquerors of the world, were obliged to give way. In this attack the Britifh and French guards were, for the firft time, perhaps, fairly oppofed to each other. The fhock for a moment was dreadful. The enemy refufed to take or give quarter, and the carnage was horrible. At laft the whole of their ranks was broken, all difcipline was at an end, and they began to give way in the utmoft confufion. The duke of Wellington, who was on the fpot, was not inattentive to the manner in which the enemy retired from this attack, and, though his left was ftill preffed, he ordered the whole line of infantry, fupported by the cavalry and artillery, to advance. This order was no fooner given, than our brave fellows rufhed forward from every point. In a moment they carried the enemy's pofition, and obliged him to retire in great diforder, leaving in our poffeffion a number of prifoners, and upwards of one hundred and fifty pieces of cannon, with their ammunition, befides two eagles. Before the diforganized maffes of the French had cleared the ravine by which they retired, the right and left of the Britifh line were nearly in contact, and the enemy in a manner furrounded. What added greatly to the confufion of the beaten foe, was a gallant charge by general Ziethen's corps upon his right flank, at the moment the Britifh advanced in front. Blucher, who had joined with his firft corps at the time this decifive charge was going on, advanced with his gallant troops; and about nine o'clock the two field-marfhals met at the fmall public-houfe called La Belle Alliance, and mutually faluted each other as victors.

The Britifh army, which had been fo warmly engaged for upwards of nine hours, was now halted, and the purfuit left to the brave Pruffians. Though they had already marched many leagues, all fatigue was forgotten when in the prefence of their enemy. About half-paft nine field-marfhal Blucher affembled the whole of his fuperior officers, and gave orders for them to fend every man and horfe in purfuit.

It is not eafy to afcertain the number of thofe who were killed and wounded, from the 15th to the 18th days of June inclufively. The lofs of the guards, in killed and wounded, in the defence of Hougomont, amounted to 28 officers, and about 800 rank and file. The foreign corps (Naffau and Brunfwickers) loft about 100. Within half an hour, it is faid, 1500 men were killed in the fmall orchard

of

of about four acres at Hougomont. The loſs of the French was enormous. The diviſion of general Foy alone loſt about 3000, and their total loſs in the attack of this poſition is eſtimated at 10,000 in killed and wounded. Above 6000 men of both armies periſhed in the farm of Hougomont; 600 French fell in the attack on the chateau and the farm; 200 Engliſh were killed in the wood; 25 in the garden; 1100 in the orchard and meadow; 400 near the farmer's garden; 2000 of both parties behind the great orchard. The bodies of 300 Engliſh are buried oppoſite the gate of the chateau; thoſe of 600 French have been burnt at the ſame place. The wounded at Quatre Bras, 16th of June, are ſtated upon the report of the adjutant-general, to be 5000; but no eſtimate is given of the killed, who muſt have been very numerous. On occaſion of Blucher's retiring to Wavre, he is ſaid to have had 14,000 men killed and wounded. The loſs of the Britiſh, as ſtated in a letter dated June 19th, ſince the 16th, muſt have exceeded 5000. In the battle of Ligny and Quatre Bras, Napoleon is ſaid to have loſt 10,000 men. The total of the killed and wounded of the Britiſh ſoldiers, as returned from the War-office July 1815, amounts to 9755 perſons. The total of the killed, wounded, and miſſing of the royal artillery in the battles of the 16th and 18th of June 1815, comprehends 32 officers, 15 ſerjeants, 285 rank and file, and 529 horſes. The loſs of the Dutch in killed, wounded, and miſſing, is ſtated to be 4136. The Pruſſians are ſaid to have loſt 33,120.

According to the French accounts their loſs, at the battle of Fleurus on the 15th, was 10 killed and 80 wounded, and that of their enemy 2000, of whom 1000 were priſoners. The loſs of the Pruſſians on the 16th could not be leſs, as they ſay, than 15,000 men, and their own 3000 killed and wounded. At Quatre Bras they ſay, that the Engliſh loſt from 4 to 5000 men; and that theirs, which was very conſiderable, amounted to 4200 killed and wounded. They make no ſtatement of that of the 18th.

The total loſs of the Britiſh, Hanoverians, and German legions from official reports, from June 16th to the 26th, 1815, is 11,084; and the computed loſſes of the Dutch and Pruſſians during the campaigns in the Netherlands were, that of the Dutch as above ſtated 4136, and that of the total Pruſſian loſs 33,132.

It appears from the liſt of killed and wounded from the official returns, June 16 to June 26, 1815, that an immenſe number of officers, ſeveral of whom were high in rank, is included in one or other of theſe claſſes. In the former, are the names of the duke of Brunſwick-Oels, colonel Cameron, lieutenant-colonel Canning, lieutenant-colonel ſir F. d'Oyly, colonel ſir H. W. Ellis, lieutenant-colonel ſir A. Gordon, colonel ſir W. de Lancey, and colonel ſir R. Macara, lieutenant-general ſir T. Picton, major-general ſir W. Ponſonby, &c. &c.; and in the latter we find the prince of Orange, the earl of Uxbridge, colonel Hon. A. Abercromby, lieutenant-general ſir C. Alten, major-general ſir E. Barnes, major Beckwith, lieutenant ſir H. Berkeley, lieutenant-colonel ſir H. Bradford, major Cameron, lieutenant-colonel Cameron, lieutenant-colonel R. H. Cooke, colonel ſir J. Ellay, captain Hon. E. S. Erſkine, lieutenant-colonel ſir R. C. Hill, lieutenant-colonel Macdonald, colonel Hon. F. Ponſonby, lieutenant-colonel Fitzroy Somerſet, earl of Uxbridge, &c. &c.

After the moſt diligent reſearch, amidſt confuſed and contradictory accounts, it is difficult, if not impoſſible, to aſcertain the exact number of the killed and wounded, on both ſides, in this ſanguinary and deciſive conflict.

Honourable and proſperous as was the iſſue of this battle, we cannot forbear regretting that ſo many valuable lives ſhould be ſacrificed on occaſions of this kind, and we alſo lament the condition of thoſe who are wounded and maimed, and rendered helpleſs for the reſidue of their years. We applaud the ſpirit that has actuated ſuch multitudes, and diſpoſed them to confer honour on the name and memories, or to impart to the ſuccour and ſupply, of thoſe who have fallen or ſuffered in the ſervice of their country.

The ſingular importance of this victory, the pre-eminent talents of the commander-in-chief, and the heroiſm diſplayed by the officers, commiſſioned and non-commiſſioned, and by all the privates, on this intereſting occaſion, entitled them to the gratitude of the government and of the country, and to ſuch tokens of reſpect as were thought to be moſt appropriate to the occaſion. Accordingly, it was reſolved on the 23d of June, that the thanks of both houſes of parliament ſhould be given to his grace the duke of Wellington, prince Blucher, and the allied armies, officers and ſoldiers. The prince regent alſo granted the dignity of a marquis to earl Uxbridge and his heirs. The houſe of commons agreed June 29th 1815, in an addreſs to the prince regent, requeſting him to direct a national monument to be erected in honour of the ſplendid victory of Waterloo, and to commemorate the fame of the officers and men of the Britiſh army, who fell glorioufly upon the 16th and 18th of the ſaid month; and more particularly of lieutenant-general ſir Thomas Picton, and major-general the Hon. ſir William Ponſonby; and that funeral monuments be alſo erected in memory of each of theſe two officers in the cathedral church of St. Paul, London. The prince regent has alſo been pleaſed, in the name and on behalf of his majeſty, to grant promotion to 52 majors, recommended for brevet-rank, for their conduct in the battle of Waterloo, to be lieutenant-colonels in the army; and to 36 captains to be majors, with commiſſions reſpectively, dated from June 18, 1815. His royal highneſs has alſo appointed major-general ſir James Kempt, to be knight grand croſs of the moſt honourable military order of the Bath; and major-generals G. Cooke, Maitland, and F. Adam, to be knights commanders of the ſaid order, and a number of other officers to be companions of the moſt honourable military order of the Bath, upon the recommendation of the duke of Wellington. The king of the Netherlands has given the duke of Wellington the title of prince of Waterloo, and the ſtates-general have ſettled upon his family an eſtate annually producing 20,000 Dutch florins, (2000*l.*) conſiſting of woods, &c. in the neighbourhood of La Belle Alliance, Hougomont, &c. The king of Saxony has alſo conferred upon the duke his family order of "The Crown of Rue:" and the grand duke of Baden has conferred upon him his order of "Fidelity" of the firſt claſs, accompanied with a gold ſnuff-box, enriched with diamonds of great value. The emperor of Auſtria has conferred upon a number of officers the croſs of a commander, and of a knight reſpectively of the order of "Maria Thereſa." The emperor of Ruſſia has alſo conferred decorations of different claſſes of the orders of St. George, Anne, and Wladimir, on a number of officers. The king of the Low Countries has alſo conferred decorations of different claſſes of the "Wilhelm's" order upon certain officers. The king of Bavaria has conferred decorations of the different claſſes of the order of "Maximilian Joſeph," on certain officers; all theſe in teſtimony of their reſpective approbation of their ſervices and conduct. The prince regent has granted the dignity of a baron of the United kingdom of Great Britain and Ireland unto the right honourable lieutenant-general Rowland baron Hill and to his heirs; and in token of his high approbation of the diſtinguiſhed bravery and

and good conduct of the firſt and ſecond life-guards at the battle of Waterloo, he has declared himſelf colonel in chief of both theſe regiments. He alſo declares that he ſhall approve all the Britiſh regiments of cavalry and infantry which were engaged in the battle of Waterloo, being permitted to wear on their colours and appointments, in addition to all other badges and devices, the word "Waterloo," in commemoration of their diſtinguiſhed ſervices on the 18th of June 1815; and he alſo approves of all the enſigns of the three regiments of foot-guards having the rank of lieutenants, and that ſuch rank ſhall be attached to all the future appointments to enſigncies in the foot-guards, in the ſame manner as the lieutenants of thoſe regiments obtain the rank of captain; and he alſo approves of the firſt regiment of foot-guards being a regiment of grenadiers, and ſtyled "The Firſt or Grenadier Regiment of Foot-Guards." An alteration has alſo taken place in regard to the penſions allowed to wounded officers in favour of thoſe who have ſerved in the battle of Waterloo; and it is alſo ordered that henceforth every non-commiſſioned officer, trumpeter, drummer, and private man, who ſerved in the battle of Waterloo, or in any of the actions which immediately preceded it, ſhall be borne upon the muſter-rolls and pay-liſts of their reſpective corps as "Waterloo Men;" and that every "Waterloo Man" ſhall be allowed to count two years' ſervice in virtue of that victory, in reckoning his ſervices for increaſe of pay, or for penſion when diſcharged.

It is alſo ordered, that the lieutenants of cavalry and infantry, who had ſerved more than five years as ſuch, on the 18th of June 1815, or who may ſubſequently have completed that period of ſervice, are to receive one ſhilling *per diem* for every day's ſervice as lieutenant beyond five years, it being fully underſtood that the retroſpect is, in no inſtance, to exceed two years. In like manner, the corporals and privates, diſtinguiſhed as "Waterloo Men," are to receive the benefit of the two years' ſervice retroſpectively, in caſes in which, by the addition of the two years, they would have completed their reſpective terms of ſervice, on or previouſly to the 18th of June 1815, and the two years' ſervice will, of courſe, be reckoned in all claims ſubſequently accruing.

Sir Charles Alten is honoured with the title of count, and the Hanoverian troops, who were preſent in the battle, may bear on their colours and uniform the word "Waterloo." Other regiments alſo that are particularly ſpecified, are to have the word "Waterloo" in commemoration of their diſtinguiſhed ſervices, June 18th, 1815. The prince regent has commanded, that in commemoration of the brilliant and deciſive victory of Waterloo, a medal ſhall be conferred upon every officer, non-commiſſioned officer, and ſoldier of the Britiſh army, preſent upon that memorable occaſion. It is alſo appointed, that from the date of the battle of Waterloo, 18th June 1815, the penſions to officers and widows ſhall increaſe according to the officer's further advance.

It is a farther inſtruction with regard to the Waterloo grant, that lieutenants of cavalry and infantry, who had ſerved more than five years on the 18th of June, are to receive one ſhilling *per* day for every day beyond five years' ſervice, provided the retroſpect be not beyond two years: non-commiſſioned officers and privates are alſo to benefit proportionately from the ſame retroſpect. The charge for officers is to be made in their ordinary accounts; thoſe for men diſtinct in a pay liſt ſupplementary, according to a preſcribed form.

Prize-money was alſo granted by parliament to the army which ſerved under the command of field-marſhal his grace the duke of Wellington in the battle of Waterloo and capture of Paris. This was advertiſed in the London Gazette, June 21, 1817. Thoſe ſhares that have not been claimed before the 24th of September 1817, may afterwards be received from the deputy treaſurer of Chelſea hoſpital, if claimed within the period of ſix years.

The ſhares of each individual in the following claſſes are:

Commander-in-chief's proportion is eſtimated at	£61,000	0	0
Claſs 1. General officers	1,274	10	10¾
2. Field-officers and colonels	433	2	4¼
3. Captains	90	7	3¾
4. Subalterns	34	14	9½
5. Serjeants	19	4	4
6. Corporals, drummers, and privates	2	11	4

Notice has alſo been given in the Dutch, Flanders, and German papers, that his highneſs the prince of Waterloo, duke of Wellington, has given orders for the payment of the prize-money to all the allied troops, who fought under his command at Quatre Bras and Waterloo, at the taking of Paris.

His highneſs has fixed the proportions into claſſes as above. This diſtribution includes the Dutch, Belgic, Naſſau, Hanoverian, and Brunſwick troops.

The total amount of receipts for the Waterloo ſubſcription to May 31, 1817, has been 518,288*l.* 9*s.* 11*d.* The total expenditure for payments and donations, and incidental charges, leaves a balance at the bankers 18th of June 1817 of 1,222*l.* 13*s.* 5*d.*

Statement of the appropriation is as follows:

Annuities granted for Life.

To the widows of officers, non-commiſſioned officers, and privates killed	£9,594	
To the wounded non-commiſſioned officers, and privates totally diſabled	1,649	
To dependent relatives	540	
Amount of annuities for life		11,783

Annuities granted for limited Periods.

To the children of officers, non-commiſſioned officers, and privates	8,314	
To orphans	895	
Amount of annuities for limited periods		9,209
Total amount of annuities		20,992

Voted in Money.

To the wounded officers, non-commiſſioned officers, and privates		71,126
To the parents and dependent relatives of officers, non-commiſſioned officers, and privates killed, leaving no widows or children		28,577

To the Foreign Troops, viz.

Pruſſians, Brunſwickers Hanoverians, and Netherlanders	45,000	
Additional for the excluſive benefit of their orphans rendered ſuch by the campaign of 1815	17,500	
		62,500
Total amount voted in money		162,203

A conſiderable ſubſcription, amounting to 3905*l.* 14*s.* 9*d.* received

received from Demerary, has been lately announced, February 24, 1818.

On the ſecond anniverſary of the battle of Waterloo, the noble ſtructure of the bridge over the Thames from Surrey to the ſcite of the Savoy, was firſt opened for public accommodation; and with a view of commemorating the ever-memorable victory of Waterloo, its name was changed from that of the "Strand Bridge," to the more dignified and triumphal appellation of "Waterloo Bridge." The ceremony was conducted with great dignity and ſplendour.

This bridge exhibits a very ſtriking diſplay of the eminent abilities and taſte of Mr. Rennie, the engineer, as well as of the liberality of the proprietors, who have provided the funds neceſſary for its conſtruction. Its ſituation is judiciouſly ſelected, as, independently of the advantage which commerce and the convenience of perſonal intercourſe may derive from it, it gives the grandeſt view we have of the river in its beautiful meander, diſplays the riſing creſcent of buildings on the north ſide, and brings out Somerſet Terrace in the moſt favourable way; while on the ſouth it opens the beautiful proſpect of the Surrey hills.

The following are ſome detailed particulars of the bridge, which is conſtructed of Corniſh granite; the baluſtrades are of granite from Aberdeen.

Dimenſions of the Bridge.

		Feet.
The length of the ſtone bridge within the abutments		1,242
Length of the road ſupported on brick arches on the Surrey ſide of the river - -		1,250
Length of the road ſupported on brick arches on the London ſide - - - - -		400
Total length from the Strand, where the building begins, to the ſpot in Lambeth where it falls to the level of the road - - -		2,892
Width of the bridge within the baluſtrades -		42
Width of pavement or foot-way on each ſide -		7
Width of road for horſes and carriages -		28
Span of each arch - - - -		120
Thickneſs of each pier - - -		23
Clear water-way under the nine arches, which are equal, 120 ft. each - - -		1,080
Brick arches on the Surrey ſide -	40	
Ditto on the London ſide - -	16	
Granite ditto for the water-courſe -	9	
Total number of arches from the Strand to the Lambeth level - -	65	

In building the arches, the ſtones (ſome of which weigh upwards of ſix tons) were ſo accurately jointed and carefully laid, that upon the removal of the centres, none of the arches ſunk more than an inch and a half. In ſhort the excellency of the workmanſhip vies with the beauty of the deſign, and with the ſkill and arrangement, to render the "Bridge of Waterloo" a monument of the public ſpirit, taſte, and glory of the age, of which the metropolis, and the Britiſh empire, have abundant reaſon to be proud.

We ſhall cloſe our account of the battle of Waterloo, with ſtating a fact not unworthy of being recorded. The ſtates-general deſiring to give to his royal highneſs the prince of Orange a teſtimony of the national gratitude, for the bravery which he employed, as well in the defence of the poſition of Quatre Bras as at the battle of Waterloo, have propoſed to his majeſty, to purchaſe at the expence of the State a palace, ſituated in the city of Bruſſels, which, after being properly furniſhed, may be given in full property to his royal highneſs the hereditary prince, as well as the park of Toweuren, in the foreſt of Soigné, with a hunting-ſeat; and that theſe eſtates be transferred to the prince of Orange, free of all charges and expence. His majeſty approved of this propoſal. See Battle of Waterloo, &c. 2 vols. 8vo. London, 1817.

WATERMEN are ſuch as row in boats, or ply on the river Thames, ultimately ſubject to the direction and government of the lord-mayor of London, and court of aldermen, who ſettle their fares, and, as well as other juſtices of peace, have authority to hear and determine offences, &c.

The names of watermen are to be regiſtered; and their boats muſt be twelve feet and a half long, and four and a half broad, or be liable to forfeiture; and watermen, taking more than the fares aſſeſſed, ſhall forfeit 40*s.*, and ſuffer half a year's impriſonment; and refuſing to carry perſons for their fare, ſhall be impriſoned for twelve months. None ſhall ply on the river, but ſuch as have been apprentices to watermen for ſeven years. 2 & 3 P. & M. cap. 16. 29 Car. II. cap. 7.

The lightermen and watermen conſtitute a company; and the lord-mayor and aldermen yearly elect eight of the latter, and three of the former, to be rulers, and the watermen chooſe aſſiſtants; the rulers and aſſiſtants being empowered to make rules, which are required to be obſerved, under penalties. The rulers on their court-days ſhall appoint forty watermen to ply on Sundays, for carrying paſſengers acroſs the river, who pay them for their labour, and apply the overplus to the poor decayed watermen; and no perſons are allowed to travel on a Sunday with boats, unleſs they are licenſed and allowed by a juſtice, on pain of forfeiting 5*s.* 11 & 12 W. III. cap. 21.

No apprentice ſhall take upon him the care of a boat, till he is ſixteen years of age, if a waterman's ſon, and ſeventeen, if a landman's, unleſs he hath worked with ſome able waterman for two years, under the penalty of 10*s.*; and if any perſon, not having ſerved ſeven years to a waterman, &c. row any boat in the river Thames for hire, he ſhall forfeit 10*l.*, gardeners' boats, dung-boats, fiſhermen's, wood-lighters, weſtern barges, &c. excepted. No apprentice is to be taken under fourteen years, who ſhall be bound for ſeven years, and inrolled in the book of the watermen's company, on pain of 10*l.* No tilt-boat, row-barge, &c. ſhall take more than thirty-ſeven paſſengers, and three more by the way; nor any other boat above eight, and two by the way, on forfeiture of 5*l.* for the firſt offence, and 10*l.* for the ſecond, &c. And in caſe any perſon be drowned, where a greater number is taken in, the waterman ſhall be deemed guilty of felony, and tranſported. 10 Geo. II. cap. 31.

Tilt-boats uſed between London-bridge and Graveſend ſhall be fifteen tons, and the other boats three tons. Rulers of the watermen's company are required to appoint two officers, one at Billingſgate at high-water, and another at Graveſend, to ring a bell for the tilt-boats, &c. to put off; and thoſe which do not immediately proceed with two ſufficient men, ſhall forfeit 5*l.* The fares of watermen, aſſeſſed by the court of aldermen, are, from London-bridge to Lime-houſe, Ratcliffe-croſs, &c. for oars 1*s.*, and ſcullers 6*d.*; Wapping-dock, Rotherhithe-church ſtairs, &c. for oars 6*d.*, and for ſcullers 3d.; from either ſide of the water above the bridge to Lambeth and Vauxhall, for oars 1*s.*, and ſcullers 6*d.* For all the ſtairs between London-bridge and Weſtminſter, oars 6*d.*, and ſcullers 3*d.*

WATERS, among *Farriers*, the name given to a diſtemperature of horſes. See WATERY *Sores.*

WATERSAY, in *Geography*, one of the Weſtern iſlands of Scotland, about one mile ſouth from South-Uiſt, from which it is ſeparated by a channel, called "Chiſamul Bay." This iſland is about three miles long, and one broad. N. lat. 56° 54'. W. long. 7° 30'.

WATERTIGHT STUFF denotes clay, or any other tenacious and compact ſoil, which will hold water.

WATERTOWN, in *Geography*, a town of Maſſachuſetts, in the county of Middleſex, containing 1531 inhabitants; 7 miles W.N.W. of Boſton.—Alſo, a town of Connecticut, in the county of Litchfield, containing 1714 inhabitants; 26 miles N.N.W. of New Haven.

WATERTOWN, a poſt-townſhip of New York, the capital of Jefferſon county, and a place of depoſit for the military ſtores of the ſtate of New York. It lies near the mouth of Black river, about 80 miles N.W. of Utica, and was firſt created into a town in March 1810, from a part of Mexico, then in Oneida county, and compriſed alſo Rutland and Hounsfield. Its extent is about ſix miles ſquare. The inhabitants are principally emigrants from the eaſtern ſtates. Here are about 200 dwelling-houſes, eight ſchool-houſes, a court-houſe and gaol, together with a lodge and arſenal for military ſtores. Here are alſo eight griſt and ſaw-mills, one paper-mill, one wool-carding machine, five diſtilleries, two breweries, a printing-office and weekly paper, a ſmall air-furnace, and many common mechanics. It promiſes to be a place of much buſineſs. Pot and pearl aſhes are manufactured in abundance, and ſent in boats to Montreal. By the cenſus of 1810, the population conſiſts of 1849 perſons; and here are 308 ſenatorial electors.

WATERTOWN, or *Jefferſon Village*, is a flouriſhing poſt-village of Watertown, in Jefferſon county, on the ſouth bank of Black river, four miles from Brownville, and at the ſame diſtance from navigable water communicating with lake Ontario. The village contains about 50 dwelling-houſes, ſome of which are elegant. In its vicinity are a quarry of good building lime-ſtone, clay, and ſand. Pine and other timber are plentiful.

WATERVILLE, a town of the diſtrict of Maine, and county of Kennebeck, containing 1314 inhabitants.

WATERVLIET, a large townſhip of New York, in the north-eaſt corner of Albany county, 6 miles N. of Albany; extending 10 miles along the Mohawk, and 6½ miles along the Hudſon, and having an area of about 52 ſquare miles, excluſive of ſeveral iſlands in the Hudſon. Much of the land is poor and barren, and the population is very unequally diſtributed. Along the Hudſon are ſome fine flats, and in many places the river-hills are moderately ſteep, and afford good farming lands. The interior abounds with ſandy ridges, ſome marſhes, and wet land, wooded with pine and a variety of dwarf ſhrubbery, of little value. In this townſhip are two ſmall villages, *viz.* Waſhington, five miles north of Albany, and Gibbon's Ville, oppoſite Troy, ſix miles. The Cahoos, which are the principal falls of the Mohawk, are between Watervliet and Halfmoon, in Saratoga county. The whole river Mohawk deſcends in one ſheet at high water, about 70 feet; and below the falls the ſpreading branches form iſlands, which are attached to this town: theſe are Haver iſland, Van Schaick's iſland or Cahoos iſland, and Green iſland In this town are 1092 white males, 1070 white females, 128 ſlaves, and 75 other perſons; in all 2365; and 215 ſenatorial electors. The ſettlement of the people called "Shakers" lies in the north-weſt part of this town, at a place called Niſkayuna, 8 miles N.W. of Albany. They have a houſe of worſhip, and the village contains about 150 houſes. A manufactory of iron ſcrews has lately been erected on the Mohawk, near Cahoos bridge.

WATERVLIET, a town of Flanders; 12 miles E. of Sluys.

WATERY HEAD. See HYDROCEPHALUS.

WATERY *Humour*. See AQUEOUS and HUMOUR.

WATERY *Lands*, in *Agriculture*, all ſuch as are largely impregnated with and retentive of moiſture or wetneſs.

Wherever water reſts much upon lands, it ſours them, and deſtroys the finer herbage; the remaining plants being made to become coarſe and ſtrong, but moſtly unpalatable, and of little value for ſtock. They ſhould, of courſe, have the ſuperabundant water removed from them, and then be improved by ſuitable ſubſtances applied as manures, and by other means, ſuch as being flooded, in ſome caſes.

By ſuch methods, according to the nature of their wetneſs, ſuch lands may moſtly be brought into a good ſtate of improvement. See BOG, FEN, MORASS, MARSH, and SWAMP; alſo the lands of their ſeveral natures.

WATERY *Poke*, a name ſometimes given to a diſeaſe in ſheep, from their having a ſort of poke or bag hanging below the top of their throats, ſuppoſed to be cauſed by water. See SHEEP and ROT.

WATERY *Sores*, diſeaſes of the legs and paſterns of horſes and ſome other animals, in which there are watery ſwellings and ſores, which diſcharge an acrid watery fluid. They moſtly ariſe from bad feeding, and improper management in dreſſing and the uſe of exerciſe.

The cure will commonly be effected by giving ſtrengthening remedies, with calomel and ſquills in moderate doſes, and by the gradual uſe of elaſtic bandages to the parts.

WATFORD, in *Geography*, a market-town in the hundred of Caſhio, and county of Hertford, England, is 8 miles S.E. from St. Alban's, 20 miles W.S.W. from the county-town, and 14 miles N.W. from London. Previous to the Conqueſt, Watford formed part of Caſhio, and under that appellation was given by king Offa to the abbey of St. Alban's, to which it continued attached till the time of the diſſolution, when the ſtewardſhip of this and other adjacent manors was given to John, lord Ruſſel. James I., in the ſeventh year of his reign, granted Watford to the lord chancellor Egerton, in whoſe deſcendants, the dukes of Bridgewater, it remained veſted till about the year 1760, when it was purchaſed by the then earl of Eſſex, and is now the property of the preſent earl. The town conſiſts principally of one ſtreet; the houſes being ranged on the ſides of the high road, and extending in a north-weſterly direction rather more than a mile. The buildings are chiefly of brick, and many of them very reſpectable. The police is under the direction of the reſident and neighbouring magiſtrates. A market, which is now held on Tueſdays, was granted to the abbots of St. Alban's for Watford by Henry I.; and Edward IV. gave them liberty to hold two annual fairs, which are now increaſed to four. The market-houſe is a long building, rough-caſt above, and ſupported on wooden pillars beneath. Corn is ſold here in very large quantities; and the number of cattle, ſheep, calves, and hogs, is proportionable. Employment for the labouring claſſes is chiefly derived from agriculture; but an additional ſource is furniſhed by the throwing of ſilk, three ſilk mills having been eſtabliſhed in or near the town. The pariſh of Watford comprehends, with the town, the hamlets of Caſhio, Leveſdon, and Oxhey. In the population return in the year 1811, the number of inhabitants was ſtated to be 3976, occupying 766 houſes. The church, a very ſpacious edifice, conſiſts of a nave, three aiſles, and a chancel; with a maſſive embattled tower at the weſt end, about 80 feet high. The church contains ſeveral fine monuments, among which are two by Nicholas Stone. At the ſouth ſide of the church-yard is a free-ſchool, founded and endowed in the year 1704, by Mrs. Elizabeth Fuller, for the education and clothing of forty boys and twenty girls: the government is veſted in nine truſtees, choſen out of the principal inhabitants of the town. Here are alſo eight alms-houſes, for the maintenance of ſo many poor widows.

About

About one mile north-west of the town is *Cashiobury*, the seat of the earl of Essex. The mansion is a spacious edifice, situated in an extensive and well-wooded park, through which flows the river Gade; and to which is the line of the Grand Junction Canal. The house was originally begun in the time of Henry VIII. by Richard Morison, esq., and completed in the style of that age by his son, sir Charles Morison. It has since been greatly altered and improved, particularly under the direction of the present noble owner, and contains a number of elegant apartments, together with a kind of cloister, the windows of which have been recently ornamented with painted glass, executed in a very superior style. In its general appearance, the whole mansion, with its offices, has the character of a monastic dwelling. The rooms are adorned with numerous portraits, and other pictures of the first degree of merit. The park is between three and four miles in circumference, and affords rich scenery and noble timber; the pleasure-grounds and gardens are extensive, and have lately undergone some judicious alterations. A particular description of this splendid seat, by Mr. Britton, is contained in Havell's "Views of Gentlemen's Seats," &c. which also contains a print of it.—Salmon's History of Hertfordshire, fol. 1728. Beauties of England and Wales, vol. vii. Hertfordshire, by E. W. Brayley, 1808.

WATH, in *Rural Economy*, a term often used provincially to signify a ford.

WATHULT, in *Geography*, a town of Sweden, in the province of Smaland; 47 miles W.N.W. of Wexio.

WATKIN's POINT, a cape on the S.W. coast of Maryland, in the Chesapeak. N. lat. 37° 59′. W. long. 76°.

WATLING's ISLAND, one of the Bahama islands, about 18 miles long, and 4 broad. N. lat. 23° 50′. W. long. 74° 16′.

WATLING-*Street*, in *Roman Antiquity*. See WAY.

WATLINGTON, in *Geography*, a small market-town in the hundred of Pirton, and county of Oxford, England, is situated between the two high roads leading from London to Oxford, about half a mile N. by W. from the Ikeneild-street, at the distance of 5 miles S. from Tetsworth, 15 miles S.E. from Oxford, and 46 miles W. by N. from London. The streets are narrow, and the houses, with a few exceptions, mean and ill built. There is no staple manufacture of any consequence: the making of lace, however, prevails to some extent, and forms the chief employment of the labouring females. A school has been formed expressly for the purpose of teaching this art, and is usually attended by from forty to fifty pupils. The town is watered on the south side by a brook, rising in the vicinity, which now works, within two miles from its source, four corn-mills. A weekly market is held on Saturdays, which was originally granted to Roger Bigod, earl of Norfolk, in the reign of Richard I. But this market is thinly attended; and the business of the day is invariably conducted in the parlours of the principal inn. Here are likewise two annual fairs. In the centre of the town is the market-house, a substantial building, erected by Thomas Stonor, esq. in the year 1664: he also founded and endowed a grammar-school for ten boys; according to the will of the donor, the master was to be a graduate of one of the universities; but imperative circumstances have caused this article to be dispensed with: four boys have been added to the original number, and the whole are taught in a commodious room above the market-house, in which are likewise held the courts leet and baron of the manor. The magistrates hold a petty sessions once in a fortnight during the winter, but in summer not so often. According to the population return of the year 1811, this town then contained 239 houses, the number of inhabitants being 1150, which was a decrease of 156, since the enumeration of the year 1801. The church is a respectable ancient building, situate N.W. of the town: in the chancel are several neat monuments, and a handsome burial-place of the Horne family. Lands and tenements have been left by will for the repairs of the church, without any parish-rate for that purpose; and there have also been considerable sums bequeathed for the use of the poor. Previous to the Reformation, the abbot and canons of Osney were patrons, to whom the church was appropriated in 1263, by the bishop of Lincoln. In this parish was anciently a chapel, founded by the lord of the manor of Watcomb; but on a complaint made by the abbot and canons of Osney, pope Urban III. dissolved it: no traces can now be discovered of the scite occupied by this structure. Wesleyan Methodists and Baptists have each a place of worship in the town; but the number of these societies is comparatively small. The Methodists were established here during the life of John Wesley, who occasionally preached in the open street: a substantial meeting-house has lately been erected, but not more than thirty persons are in the habit of attending. The Baptists are scarcely so numerous; and their meetings are held in a very humble building. The manor of Watlington was given by Henry III. in 1231, to his brother Richard, earl of Cornwall. By Edward II. it was granted to Piers Gaveston. On his disgrace it reverted to the crown, and was given by Edward III. to sir Nicholas De la Becke, who obtained permission, in 1338, to build a spacious castle, some traces of which were discernible within the last century. The building stood on a slightly elevated spot to the south-east of the church, and it may yet be perceived that the structure was encompassed by a moat. King Charles I. granted the manor, in 1628, to four citizens of London, who sold it in the following year. Soon after this period it became so divided and parcelled out, that in the year 1664 there were about fifty persons participating in the manorial rights; and previous to the enclosure of the parish, which took place in 1809, the shares of the manor were sixty-four in number.

On *Britwell-hill*, about a quarter of a mile east of the Ikeneild-street, some remains of trenches point out the scite of an ancient encampment.

Within half a mile from Watlington is one of the most complete agricultural establishments to be found in the county. The whole of the very extensive farm-yard is encompassed by buildings covered with slate, and presents the spectacle of a new and handsome village. This noble range was erected under the immediate inspection of William Hayward, esq., and was completed in the space of one year. His primary object appears to have been to produce utility on the simplest and most scientific plan.

About a mile to the north of Watlington is Pirton, an inconsiderable village, though it gives name to the hundred. Near Pirton is *Shirbourn-Castle*, the seat of the earl of Macclesfield. A castellated edifice was first erected on this spot in the fourteenth century by sir Wariner de l'Isle. The castle and manor were purchased at the beginning of the eighteenth century by Thomas, earl of Macclesfield. The building forms an oblong square, and is encompassed by a broad and deep moat, over which are three draw-bridges; the chief entrance is guarded by a portcullis: at each angle of the edifice is a circular tower. The interior is disposed in a style of modern elegance and comfort that contains no allusion to the external character of the structure, except in one long room fitted up as an armoury, and containing coats of mail, shields, tilting-spears, and offensive arms of a modern as well as ancient date. A park of about sixty acres is attached

attached to the manſion.—Beauties of England and Wales, vol. xii. Oxfordſhire. By J. N. Brewer, 1813.

WATO, a town of Sweden, on an iſland in the Baltic, near the coaſt of the province of Upland; 10 miles E.N.E. of Nortelge. N. lat. 59° 54′. E. long. 18° 43′.

WATOLMA, a town of Sweden, in the province of Upland; 10 miles N. of Upſal.

WATRAP, a town of Hindooſtan, in Madura; 33 miles S.W. of Madura.

WATSCH, or VATSCHE, a town of the dutchy of Carniola; 16 miles S.E. of Stein.

WATSNESS, a cape on the weſt coaſt of the iſland of Shetland. N. lat. 60° 19′. W. long. 2° 6′.

WATSON, ROBERT, D.D., in *Biography*, a Scottiſh hiſtorian, was born at St. Andrew's about the year 1730, commenced his courſe of education for the miniſtry at the ſchool and univerſity of St. Andrew's, and with ſingular aſſiduity proſecuted his ſtudies at the univerſity of Glaſgow, and alſo in that of Edinburgh. He paid particular attention to grammar and eloquence, and with the advice of lord Kaimes, delivered a courſe of lectures on theſe ſubjects, which gained the approbation of Mr. Hume, and other men of genius and learning. Having failed in his endeavours to ſupply a vacancy in one of the churches of St. Andrew's, he was ſoon after made profeſſor of logic, and by a patent from the crown, profeſſor of rhetoric and belles lettres. In his lectures on logic and metaphyſics, he deviated from the old plan of ſyllogiſms, modes, and figures, and introduced ſubſtantial improvement by furniſhing his pupils with an analyſis of the powers of the mind, and by leading them to inveſtigate the various kinds of evidence, of knowledge or truth. His hiſtory of Philip II. advanced his reputation during the period of his life; and it was farther enhanced by his hiſtory of Philip III., which was publiſhed after his death; of which latter he only wrote the firſt four books, the other two being ſupplied by Dr. William Thomſon, the editor, at the deſire of the guardians of his children. He ſucceeded Tulideph as principal of the univerſity by the intereſt of the earl of Kinnoul; but his death, in 1780, ſoon deprived him of this honour. By his wife, who was daughter of Mr. Shaw, profeſſor of divinity in St. Mary's college, St. Andrew's, he had five daughters, who ſurvived him. Gen. Biog.

WATSON, RICHARD, an Engliſh prelate, eminently diſtinguiſhed by his talents, acquirements, and character, was born at Haverſham, in Weſtmoreland, in Auguſt 1737. He was the deſcendant of an ancient family, deriving its remote origin from Scotland, and occupying, for ſeveral generations, a ſmall eſtate at Hardendale, near Shap, where his father was born in the year 1672. In 1698 his father was appointed head maſter of Haverſham-ſchool, which he conducted with great reputation for nearly forty years. Among other pupils who enjoyed the benefit of his inſtruction, we may mention Ephraim Chambers, the well-known author of the Dictionary of Arts and Sciences (ſee his article), Mr. Preſton, afterwards biſhop of Ferns, in Ireland, and the ſubject of this memoir. To this ſchool belonged two exhibitions, (now of 50*l.* a year each,) one to Trinity college, in Cambridge, and the other to Queen's college, Oxford; the former of which was enjoyed by Mr. Preſton, and afterwards by his ſchool-fellow, Mr. Watſon. In the year 1788, theſe two ſcholars, being then biſhops, teſtified their regard for the place of their education by repairing the ſchool-houſe, and by affixing to it a Latin inſcription, expreſſing their reſpect for the memory of its pious founder, and of Mr. Watſon's father. To his mother alſo Mr. Watſon pays a tribute of grateful and affectionate remembrance, deſcribing her as a charitable and good woman, to whom he was indebted for imbuing his young mind with principles of religion, which never forſook him; and obſerving more generally, that "the care of the mother precedes that of the ſchool-maſter, and may ſtamp upon the *raſa tabula* of the infant mind, characters of virtue and religion which no time can efface." Soon after the death of his father, in November 1753, Mr. Watſon was ſent to the Univerſity, and admitted a ſizer of Trinity college, in Cambridge, on the 3d of November, 1754. Apprized that his patrimony, which was 300*l.*, would be barely ſufficient to defray the charges of his education, and having no expectations from any of his relations, he determined to fabricate his own fortune, and applied with aſſiduity and ardour to his academic ſtudies. Before he had been ſix months at college, a circumſtance occurred which indicated his talents for metaphyſical diſquiſition, and which contributed in no ſmall degree to his reputation in this department of ſcience. As he attended the college-lectures, which were then delivered to the under-graduates in the hall, immediately after morning-prayers, during term-time, he was aſked by Mr. Brocket, the head lecturer, whether Clarke had demonſtrated the abſurdity of an infinite ſucceſſion of changeable and dependent beings? to which queſtion he replied *non;* and being aſked his reaſons for ſo thinking, he ſtammered out, as he ſays, in barbarous Latin, "that Clarke had enquired into the *origin* of a ſeries, which, being from the ſuppoſition *eternal*, could have no origin; and into the *firſt* term of a ſeries, which, being from the ſuppoſition *infinite*, could have no firſt." This circumſtance was recollected four years afterwards, when he took his bachelor's degree, and laid the foundation of his acquaintance with Dr. Law, then maſter of Peterhouſe, and reckoned one of the beſt metaphyſicians of his time; from which he derived, as he acknowledges, much knowledge and liberality of ſentiment in theology. Not ſatisfied with his rank of ſizer, he aſpired to a ſcholarſhip, and ſucceeded in obtaining it, on the 2d of May, 1757, a year before the uſual time. Thus advanced in rank, his expences increaſed, but they were more than counterbalanced by the advantage attending it. Dr. Smith, who was then maſter of the college, took occaſion to nominate him to a particular ſcholarſhip (lady Jermyn's); and at the ſame time recommended Saunderſon's Fluxions, juſt publiſhed, and ſome other mathematical books, to his peruſal; thus, as he ſays, "giving a ſpur to my induſtry, and wings to my ambition." At this time he had reſided in college two years and ſeven months, without leaving it for a ſingle day; and during this period, he had acquired ſome knowledge of Hebrew, improved himſelf greatly in Greek and Latin, made conſiderable proficiency in mathematics and natural philoſophy, and ſtudied with much attention Locke's Works, King's book on the Origin of Evil, Puffendorf's Treatiſe "De Officio Hominis et Civis," and ſome other books on ſimilar ſubjects. Conceiving himſelf entitled to ſome degree of relaxation, he ſet out, in May, 1757, on a viſit to his elder and only brother at Kendal, who was the firſt curate of a new chapel erected there, and to the building of which he had liberally contributed. This brother lived freely, ſpent his fortune, injured his conſtitution, and died when the ſubject of our memoir was about the age of 33. With the affection of a brother and ſingular liberality, he paid his debts, to the amount of almoſt his whole property. In the beginning of September he returned to college, with a purpoſe to make his alma mater the mother of his fortunes. He was then only a "junior ſoph;" but ſuch was his reputation, that he was ſolicited to become private tutor to Mr. Luther and Dr. Strachey. From the

time

time in which he undertook this charge he was employed for thirty years, and as long as his health lafted, in inftructing others, without much inftructing himfelf, as he fuggefts, and in prefiding at difputations in philofophy or theology, from which, after a certain time, he derived little intellectual improvement. Addicted, whilft an under-graduate, to affociate with thofe whom collegians call the beft company, fuch as idle fellow-commoners, and other perfons of fortune: he foon perceived that he was purfuing a miftaken courfe: and this conviction was more fenfibly felt, when he often faw, on his return home at one or two in the morning, from fome of his evening feftivities, a light in the chamber of a fellow-ftudent of the fame ftanding with himfelf. His jealoufy was thus excited, and the fucceeding day was always devoted to hard ftudy; nor would he allow himfelf the leifure for dinner. In his folitary walks he profecuted the ftudy of mathematics and philofophy without book, or pen and paper; and went through tedious and intricate demonftrations by the mere exercife of his mental powers. Thefe walks were fo frequent, that among thofe who did not know how he was employed, he incurred the charge of being a lounger; but the fequel of his hiftory fufficiently proves the injuftice of the charge.

Whilft abftract ftudies occupied his chief attention, he did not neglect other purfuits. Every day he impofed upon himfelf the tafk of compofing a theme in Latin or Englifh. Among the firft of his compofitions of this kind, the fubject of that written in Englifh was "Let tribunes be granted to the Roman people," and that of the Latin was "Sociis Italicis datus Civitas:" the fubjects of both were fuggefted to him by a perufal of Vertot's "Roman Revolutions;" and to his account of this incident he adds, "Were books of fuch kind put into the hands of kings during their boyhood, and Tory-trafh at no age recommended to them, kings in their manhood would fcorn to aim at arbitrary power through corrupted parliaments." He alfo introduces this reflection on the choice of his fubjects: "They fhew that a long commerce in the public world has only tended to confirm that political bent of my mind in favour of civil liberty, which was formed in it before I knew of what felfifh and low-minded materials the public world was made." In the courfe of Mr. W.'s claffical reading, to which he devoted the afternoon, whilft the morning was occupied by mathematics, he informs us, that Demofthenes was the orator, Tacitus the hiftorian, and Perfius the fatirift, whom he moft admired. At an early period of his life, Mr. W. inclined to the opinion which has in later times been more prevalent, that the foul is not a diftinct fubftance from the body; though he profeffes not to have troubled himfelf much with perplexing difquifitions concerning liberty and neceffity, matter and fpirit; fhewing, however, on all occafions, his faith in Chriftianity, as founded on teftimony, and more efpecially on the teftimony concerning the refurrection of its divine founder; and his belief of a future ftate of retribution and immortality. His fpeculations on matter and fpirit are not likely, in our judgment, to illumine the darknefs, and to refolve the difficulties that involve this fubject. As to the ftory, recorded in the French Encyclopædia (art. *Mort*), of a man who came to life after having been fix weeks under water, we cannot help confidering it as fabulous; but whether it be true or falfe, it appears to us to afford little fatiffaction with regard to the queftion in difpute. Nor does his reafoning about the effential properties of extenfion, folidity, mobility, divifibility, and inactivity, as common properties, belonging equally to a table, tree, oyfter, and man, and the addition of life to the matter of the tree, of life and perceptivity to that of the oyfter, and to that of the man, life, perceptivity, and thought, feem to have given very great fatisfaction to himfelf. "Whether life can exift without perceptivity," he fays, "or perceptivity without thought, are fubtle queftions, not admitting perhaps, in our prefent ftate, a pofitive and clear decifion either way. Phyfical and metaphyfical difficulties prefent themfelves on every fubject, and ultimately baffle all our attempts to penetrate the darknefs in which the divine mind envelopes his operations of nature and grace."

In January 1759, Mr. W. took his degree of bachelor of arts. In the firft year of his being moderator, he introduced an alteration in the mode of obtaining this degree, which has been continued ever fince. "At the time of taking it, the young men are examined in claffes, and the claffes are *now* formed according to the abilities fhewn by individuals in the fchools. By this arrangement, perfons of nearly equal merits are examined in the prefence of each other, and flagrant acts of partiality cannot take place. Before this alteration was made, they were examined in claffes, but the claffes confifted of members of the fame college, and the beft and the worft were often examined together." In the firft year of his being moderator, Mr. Paley, afterwards fo well known, and a Mr. Frere of Norfolk, were examined together; and Mr. Paley, being Mr. Frere's fuperior, was made fenior wrangler, though it was reported that the grandfather of Mr. Frere had propofed to give 1000*l.* if he were admitted to this honour. This gentleman afterwards candidly acknowledged that he deferved only the fecond place; and this declaration was obvioufly the refult of their having been examined together. One of the queftions propofed by Mr. Paley for his act was "Æternitas pœnarum contradicit Divinis attributis." This queftion, though accepted by Mr. W., occafioned an alarm; but in order to allay all difquieting apprehenfions, Mr. P. was allowed to put in *non* before *contradicit*, and the alarm fubfided. This, however, fays Mr. W., is a fubject of great difficulty. "It is obferved, on all hands, that the happinefs of the righteous will be, ftrictly fpeaking, everlafting; and I cannot fee the juftnefs of that criticifm which would interpret the fame word in the fame verfe in a different fenfe. (Matt. xxv. 46.) On the other hand, reafon is fhocked at the idea of God being confidered as a relentlefs tyrant, inflicting everlafting punifhment which anfwers no benevolent end. But how is it proved that the everlafting punifhment of the wicked may not anfwer a benevolent end, may not be the means of keeping the righteous in everlafting holinefs and obedience? How is it proved, that it may not anfwer, in fome other way unknown to us, a benevolent end in promoting God's *moral* government of the *Univerfe*?"

In October, 1760, Mr. W. was elected a fellow of Trinity college, although by that appointment he was put over two of his feniors of the fame year; and in the following November became affiftant tutor to Mr. Backhoufe. Soon after this he declined accepting the curacy of Clermont; and he alfo relinquifhed his defign of going out as chaplain to the factory at Bencoolen. "You are far too good," faid the mafter of the college to him, "to die of drinking punch in the torrid zone." Afterwards he reflected with gratitude and felf-complacency on his difappointment of an opportunity of becoming an Afiatic plunderer. "I might not," he fays, "have been able to refift the temptation of wealth and power, to which fo many of my countrymen have yielded in India."

At the commencement of 1762 he took his degree of M.A., and in the following October was made moderator for Trinity college. In his "Memoirs," he recites the queftions which were at that time the fubjects of fcholaftic exercifes,

ercifes, and from their nature and variety he juftly infers the importance of thefe exercifes.

In February 1764 an occafion was afforded him of manifefting his friendly attachment to Mr. Luther, one of the members for Effex, who had been formerly his pupil, and his difinterefted anxiety for his happinefs. Having heard that he had feparated from his wife, and was haftily gone abroad, he immediately prepared to feek him, and to impart to him, if poffible, fome confolation. Although he had no money, and could not fpeak a word of French, he determined on his journey; and having borrowed 50*l.*, and provided a French and Englifh Dictionary, he pofted to Dover, and haftened to Paris, where he found his difconfolate friend. After twelve hours ftay at Paris, he returned to England; and having croffed the channel four times, and travelled 1200 miles in very bad weather within a fortnight, he brought his friend back to his country and his family. Of Mr. Luther, he fays that "he was a thorough honeft man, and one of the friends I ever loved with the greateft affection."

In November 1764, he was unanimoufly elected by the fenate to fucceed Dr. Hadley, as profeffor of chemiftry; and though at this time he knew nothing of chemiftry, he procured an operator from Paris, and immured himfelf in his laboratory, fo that in 14 months from his election he read a courfe of chemical lectures to a very full audience, and another in November 1766. For the fourth time he was made moderator in October 1765, and in 1766 made his laft fpeech in Latin to the fenate. Befides other improvements in the univerfity education, which he had propofed on former occafions, he now recommended the inftitution of public annual examinations, in prefcribed books, of all the orders of ftudents. In 1774 this fubject was revived and enforced by Mr. Jebb. The defign was unequivocally approved by the chancellor of the univerfity, the duke of Grafton. After a long difcuffion of the fubject, the regulations drawn up by the fyndics were propofed to the fenate, and were rejected by the "Non Regent Houfe," 47 againft 43. In 1764 application was made for a ftipend to the profeffor of chemiftry; and after confiderable delay, 100*l.* a year was obtained: and this grant paved the way for fimilar ftipends to the profeffors of anatomy, botany, and common law. In October 1767, Mr. Watfon fucceeded Mr. Backhoufe as head tutor in Trinity college, and, for the fhort period during which he retained the office, difcharged its duties with confcientious diligence. "In this," he fays, "and the two following years, I read chemical lectures to very crowded audiences, in the month of November. I now look back with a kind of terror at the application I ufed in the younger part of my life. For months and years together, I frequently read three public lectures in Trinity college, beginning at 8 o'clock in the morning; fpent four or five hours with private pupils, and five or fix more in my laboratory, every day, befides the incidental bufinefs of prefiding in the fophs fchools."

In 1768 he compofed and printed his "Inftitutiones Metallurgicæ," and about the fame time prefented to the Royal Society a paper on the folution of falts, and was elected a fellow of that fociety. In the following year he publifhed his Affize Sermon, which he dedicated to Mr. Luther. Upon the vacancy in the office of regius profeffor of divinity, occafioned in October 1771 by the death of Dr. Rutherforth, Mr. Watfon propofed to become a candidate; but he was then neither bachelor nor doctor in divinity; and without being one of thefe, he could not be admitted as a candidate. Prompt, however, in the execution of all his meafures, though he had only feven days for the accomplifhment of his object, he obtained the king's mandate for a doctor's degree, and was created a doctor on the day previous to that appointed for an examination of the candidates. The fubjects on which he was to write were, the reconciliation of the genealogies in Matthew and Luke, and the interpretation of the paffage, "What fhall they do that are baptized for the dead?" 1 Cor. xv. 29. He was alfo appointed to read a Latin differtation on Gen. x. 32.

At length he was unanimoufly elected, having, as he fays, by hard and inceffant labour for 17 years, attained, at the age of 34, the firft office for honour in the univerfity, and, exclufive of the mafterfhip of Trinity college, he made it the firft for profit; having advanced it from 330*l.* a year to at leaft 1000*l.* Having been promoted to this honourable and important office, he devoted himfelf, with his accuftomed refolution and perfeverance, to the ftudy of divinity; making the Bible the object of his inveftigation, and feeling no concern about the opinions of councils, fathers, churches, bifhops, or other men, as little infpired as himfelf. Although he was called by the mafter of Peterhoufe, αυτοδιδακτος, the felf-taught divine; and though the profeffor of divinity had been nicknamed "Malleus Hæreticorum," he profeffes that his mind was wholly unbiaffed; without prejudice againft or predilection for the church of England; and actuated only by a fincere regard for the church of Chrift, and an infuperable objection to every degree of dogmatical intolerance. "I never troubled myfelf," thus he proceeds, "with anfwering any arguments which the opponents in the divinity fchools brought againft the articles of the church, nor ever admitted their authority in decifion of a difficulty. But I ufed, on fuch occafions, to fay to them, holding the New Teftament in my hand, '*En facrum codicem!* Here is the fountain of truth; why do you follow the ftreams derived from it by the fophiftry, or polluted by the paffions of men? If you can bring proofs againft any thing delivered in this book, I fhall think it my duty to reply to you: articles of churches are not of divine authority; have done with them; for they may be true, they may be falfe; and appeal to the book itfelf.' This mode of difputing gained me no credit with the hierarchy; but I thought it an honeft one, and it produced a liberal fpirit in the univerfity."

About the clofe of the year 1771 our author printed an Effay on the fubject of chemiftry, which was difperfed among fome few friends; but it was unjuftly charged by the authors of the "Journal Encyclopedique," with favouring the "Syfteme de la Nature." The author remonftrated, and the periodical journalifts made an apology. In the following year Dr. Watfon publifhed two letters to the members of the houfe of commons, under the feigned name of a Chriftian Whig, the fecond of which was infcribed to fir George Savile. In 1773, upon maturely weighing the queftion concerning the abftract right which a national church may claim of requiring fubfcription to human articles of faith from its public minifters, he publifhed "A brief State of the Principles of Church Authority," which he delivered as a charge to the clergy of his diocefe, in June 1813. In this tract it is maintained, that every church has a right of explaining to its minifters what doctrines it holds; and of permitting none to minifter in it, who do not profefs the fame belief with itfelf. With refpect to another queftion, *viz.* whether the majority of the members of any civil community have a right to compel all the members of it to *pay* towards the maintenance of a fet of teachers appointed by the majority to preach a particular fyftem of doctrines, this may admit a ferious difcuffion. Our author once thought the majority had this right in *all* cafes, and he afterwards apprehended that they have it in *many*. But a cafe may happen,

happen, in which the eſtabliſhed religion of a country may be the religion of a minority of the people, that minority at the ſame time poſſeſſing a majority of the property, out of which the miniſters of the eſtabliſhment are paid; and if this ſhould occur, our author ſeems to be undecided in his judgment. His ſentiments as to the *expediency* of requiring from the miniſters of the eſtabliſhed church a ſubſcription to the preſent articles of religion, or to any human confeſſion of faith, further than a declaration of belief in the ſcriptures, as containing a revelation of the will of God, may be collected from his two pamphlets, ſubſcribed " A Chriſtian Whig," and " A Conſiſtent Proteſtant."

In adverting to theſe tracts, our author reflects with ſatisfaction on the coincidence of his ſentiments, on many points civil and religious, with thoſe of biſhop Hoadly, though he has been ſarcaſtically and injuriouſly called " A republican biſhop."

On the 21ſt of December 1773, Dr. Watſon married the eldeſt daughter of Edward Wilſon, eſq. of Dallum Tower, in Weſtmoreland; and the connection was a ſource of uninterrupted ſatisfaction and felicity. Having obtained, by the intereſt of the duke of Grafton with the biſhop of St. Aſaph, a ſinecure in Wales, he exchanged it, by the ſame intereſt, on his return to Cambridge, for a prebend of Ely; and this favour was granted, though the duke and Dr. Watſon held different political opinions. They afterwards differed alſo in their religious ſentiments; the duke having avowed himſelf an Unitarian. Referring to him under this denomination, Dr. Watſon, with laudable liberality, declares, " that he is happy in ſeeing a perſon of his rank profeſſing with intelligence and ſincerity Chriſtian principles. If any one thinks that an Unitarian is not a Chriſtian, I plainly ſay, without being myſelf an Unitarian, that I think otherwiſe."

Dr. Watſon's political principles are well known. From his earlieſt youth to his dying day he was a Whig, in that ſenſe of the term which is well underſtood, and need not here be explained. In 1776 it came to his turn to preach the reſtoration and acceſſion ſermons before the univerſity; and they were both printed. The firſt was entitled " The Principles of the Revolution vindicated." Although it was written with great caution, a report was circulated in London that it was treaſonable; but when Mr. Dunning (afterwards lord Aſhburton) was aſked what he thought of it, he replied, " that it contained ſuch treaſon as ought to be preached once a month at St. James's." However, it gave great offence to the court, and, in Dr. Watſon's opinion, continued to be an obſtacle to his preferment. The author was much abuſed, in conſequence of the publication of this ſermon, by miniſterial writers, as a man of republican principles; but by Mr. Fox, and others of his claſs, it was very highly commended.

In the ſame year, 1776, Dr. Watſon publiſhed his " Apology for Chriſtianity," in reply to Mr. Gibbon's obnoxious chapters in his " Hiſtory of the Decline and Fall of the Roman Empire." His treatment of the hiſtorian was liberal and conciliatory, and was acknowledged with great courteſy and reſpect. In February 1780, Dr. Watſon preached, at the requeſt of the vice-chancellor, the faſt ſermon before the univerſity, which became very popular, and was widely circulated. In May of this year he publiſhed a charge to the clergy of the archdeanery of Ely, at his firſt viſitation; the primary object of which charge was to recommend an eſtabliſhment at Cambridge, for the expreſs purpoſe of tranſlating and publiſhing Oriental MSS., wherever found. Dr. Keene, biſhop of Ely, expreſſed his approbation of this charge; but as he reflected on the author's politics, he retorts it by obſerving in a letter to his lordſhip, " My politics may hurt my intereſt, but they will not hurt my honour. They are the politics of Locke, Somers, and Hooker; and in the reign of George II., they were the politics of this univerſity." In February 1781, our author was preſented by the duke of Rutland with the rectory of Knaploft, in Leiceſterſhire; and as he was juſt then printing the firſt two volumes of Chemical Eſſays, he availed himſelf of this opportunity of dedicating them to his grace. In 1782, Soame Jenyns publiſhed his Diſquiſitions on various ſubjects, the ſeventh of which advanced principles very oppoſite to thoſe which were contained in the " Principles of the Revolution vindicated," with occaſional glances at that ſermon. Although our author was ſcarcely recovered from a dangerous illneſs, he drew up, in the courſe of a few hours, " An Anſwer to the Diſquiſitions, &c." Upon a change of miniſtry, lord Shelburne was induced to confer the biſhopric of Landaff on Dr. Watſon; and on the 26th of July 1782, he kiſſed hands on his promotion. But he was not very much gratified by this advancement; becauſe lord Shelburne had expreſſed to the duke of Grafton his expectation that he would occaſionally write a pamphlet for their adminiſtration. The duke, however, did the new prelate the juſtice to aſſure his lordſhip, that he had totally miſtaken the character of the biſhop; for though he might write as an abſtract queſtion, concerning government, or the principles of legiſlation, it would not be with a view of aſſiſting any adminiſtration. " I had written," ſays the independent and high-ſpirited biſhop, " in ſupport of the principles of the revolution, becauſe I thought thoſe principles uſeful to the ſtate, and I ſaw them vilified and neglected. I had taken part in their petitions againſt the influence of the crown, becauſe I thought that influence would deſtroy the conſtitution, and I ſaw that it was increaſing. I had oppoſed the ſupporters of the American war, becauſe I thought that war not only to be inexpedient, but unjuſt. But all this was done from my own ſenſe of things, and without the leaſt view of pleaſing any party: I did, however, happen to pleaſe a party, and they made me a biſhop. I have hitherto followed, and ſhall continue to follow, my own judgment in all public tranſactions: all parties now underſtand this, and it is probable that I may continue to be biſhop of Landaff as long as I live. Be it ſo. Wealth and power are but ſecondary objects of purſuit to a thinking man, eſpecially to a thinking Chriſtian." Lord Shelburne ſeems to have courted an intimate acquaintance with the biſhop; alleging that he had Dunning to aſſiſt him in law points, and Barry in army concerns, and expreſſing his wiſh to conſult him in church matters. The biſhop availed himſelf of this overture, and propoſed to the miniſter a plan by which ſervice might be done to religion and to the eſtabliſhed church. Being invited to dine with his lordſhip, he put into his hand a paper, containing the following ſcheme of reform, comprehending the doctrine, the juriſdiction, and the revenue of the church of England. The two following hints on the ſubject of the revenue he ſubmitted to the conſideration of his lordſhip:—" Firſt, a bill to render the biſhoprics more equal to each other, both with reſpect to income and patronage; by annexing, as the richer biſhoprics became vacant, a part of their revenues, and a part of their patronage, to the poorer. By a bill of this kind, the biſhops would be freed from the neceſſity of holding eccleſiaſtical preferments *in commendam;* a practice which bears hard on the rights of the inferior clergy. Another probable conſequence of ſuch a bill would be, a longer reſidence of the biſhops in their ſeveral dioceſes; from which the beſt conſequences fequences both to religion, the morality of the people, and to the true credit of the church, might be expected: for the two great inducements to wifh for tranflations, and confequently to refide in London, namely, fuperiority of income, and excellency of patronage, would in a great meafure be removed. Second, a bill for appropriating, as they become vacant, one half, or a third part, of the income of every deanery, prebend, or curacy, of the churches of Weftminfter, Windfor, Canterbury, Chriftchurch, Worcefter, Durham, Ely, Norwich, &c. to the fame purpofes, *mutatis mutandis*, as the firft fruits and tenths were appropriated by queen Anne. By a bill of this kind, a decent provifion would be made for the inferior clergy, in a third or fourth part of the time which queen Anne's bounty alone will require to effect it. A decent provifion being once made for every officiating minifter in the church, *the refidence of the clergy in their cures might more reafonably be required* than it can be at prefent, and the licence of holding more livings than one be reftricted." Lord Shelburne wifhed to be informed if nothing could be gotten from the church to relieve the burdens of the ftate; to which the bifhop replied, that the whole revenue of the church would not yield, if it were equally divided, which could not be thought of, above 150*l*. a year to each clergyman, which could not be thought too ample; and in a political view it would be highly inexpedient, unlefs government would be contented to have a beggarly and illiterate clergy, which no wife minifter would ever wifh to fee. In profecution of the fame plan, the bifhop fent a letter to the archbifhop of Canterbury, and a copy to lord Shelburne, the duke of Grafton, the duke of Rutland, and lord John Cavendifh refpectively. The minifter difcouraged the bufinefs, and earneftly diffuaded the bifhop from any immediate publication of it. Upon the refignation of lord Shelburne, who, by an exercife of prerogative, had been nominated by the king without the recommendation of the cabinet, the coalition miniftry, formed of lord North, and others who had for many years reprobated his political principles, came into power. This circumftance of the coalition roufed our prelate's indignation, and led him to entertain a very unfavourable opinion of the difintereftednefs and integrity of thofe to whom he had been invariably attached. Although the badnefs of the peace, and the fuppofed danger of trufting power in the hands of lord Shelburne, were the oftenfible reafons for this coalition, perfonal diflike of him, and a defire to be in power themfelves, were, in the bifhop's judgment, the real ones. This diffenfion of the Whigs, he fays, did more injury to the conftitution than all the violent attacks on the liberty of the fubject, which were fubfequently made during Mr. Pitt's adminiftration. "This apoftacy from principle in the coalition miniftry ruined," as he conceived, "the confidence of the country, and left it without hope of foon feeing another refpectable oppofition on conftitutional grounds; but it ftamped on the hearts of millions an impreffion which will never be effaced, that *patriotifm is a fcandalous game played by public men for private ends, and frequently little better than a felfifh ftruggle for power*."—"It is," he adds, "a principle with all parties to require from their adherents an implicit approbation of all their meafures: my fpirit was ever too high to fubmit to fuch a difgraceful load of political connection."—"To *forget all benefits*, and to conceal the *remembrance of all injuries*, are maxims by which political men lofe their honour, but make their fortunes."

Our prelate's letter to the archbifhop of Canterbury was publifhed in the interval between lord Shelburne's refignation and the appointment of the duke of Portland to the head of the treafury; but though a copy of it was fent to each bifhop, none thought proper to acknowledge it except Dr. Porteus, then bifhop of Chefter. Soon after the failure of Mr. Fox's Eaft India bill, to which Dr. Watfon was adverfe, Mr. Pitt was appointed firft lord of the treafury; and though he had continued in office for feveral weeks previoufly to the diffolution of parliament, March 25th, 1784, in direct oppofition to the majority of the houfe of commons, which in the judgment of our prelate eftablifhed a dangerous precedent, yet deference to the fenfe of the nation declared by numberlefs addreffes to the king againft the coalition miniftry, induced him to acquiefce. In July of this year he wrote a letter to Mr. Pitt, recommending an union of Britain and Ireland on an equal and liberal footing; but it was not accomplifhed till fixteen years after this period, and not, as the bifhop obferves, "in the liberal way it ought to have been done." Enlarged and liberal as were his fentiments of toleration, he neverthelefs regarded the church of Rome as a *perfecuting* church; and he thought it was more neceffary to guard againft the danger to be apprehended by Proteftants in a country where popery is fimply tolerated than where it is the eftablifhed religion. On another occafion he expreffes fentiments which muft lead the friends of Catholic emancipation to conclude, that he was not favourable to this object. "The perfecuting fpirit of the Roman church remains in the hearts of the generality of its members," he fays, "and whilft it does remain, popery muft be watched, intimidated, and reftrained." In a letter to Mr. Wakefield written in 1784, he avows his belief of the preexiftence of Chrift as the doctrine of the New Teftament; but at the fame time he is far from concurring with thofe who brand the fupporters of it as enemies to the Chriftian fyftem. In the fame year he addreffed a letter to Mr. Wyvill, expreffing his warmeft wifhes for parliamentary reform, which Mr. Pitt feemed at the commencement of his adminiftration inclined to promote. In 1785 he publifhed his "Collection of Theological Tracts," in fix volumes, intended for the benefit of young perfons, who could not afford to purchafe many books in divinity; the defign was laudable, and was generally approved; though, he fays, the bifhops were not pleafed with his having printed fome tracts originally written by Diffenters. In January 1786 he loft his friend Mr. Luther, with whom he had lived on terms of the moft affectionate intercourfe for thirty years; and in mentioning this circumftance he gratefully acknowledges his generous bequeft, which enabled him to preferve his independence, and to provide for his family. To his Suffex eftate, from the fale of which he derived 20,500*l*., this generous teftator added the entail of his eftate in Effex. Having, in the year 1782, publifhed a third volume of his Chemical Effays, he prefented to the public a fourth volume in 1786. About this time application was made to him by government for advice relating to the improvement of gun-powder; and he fuggefted a plan of making charcoal by diftilling the wood in clofe veffels, which was carried into execution at Hythe in 1787, and which produced a confiderable faving in the manufacture of this article.

Dr. Watfon, having been attacked with a diforder in 1781, which continued and rendered the difcharge of his duty, as profeffor of divinity, very irkfome to his feelings, and likely to haften the termination of his life, intimated to Mr. Pitt his wifhes for fome kind of preferment that would enable him to refign his profefforfhip; his church income, exclufive of it, being only about 1200*l*. a year. This application he very reluctantly renewed, but it produced no effect; and the confequence was a kind of remonftrance, in the tone of complaint, on the part of the bifhop to the minifter.

nifter. About this time Mr. Pitt confulted the bifhops about the repeal of the Teft and Corporation Acts; and of all the bifhops who were affembled for the difcuffion of the fubject bifhop Watfon and bifhop Shipley were the only two who voted, that they ought not to be maintained. The queftion was afterwards loft in the commons by a majority of 78; 178 to 100. When it was brought forward again in 1789, it was loft by a majority of 20; 122 to 102. But in 1790, the majority againft it was 194; 299 to 105: the clamour of "the church is in danger" having in the mean while been widely and loudly circulated, under the fanction of fome imprudent or mifunderftood expreffions in the publications of Dr. Hartley and Dr. Prieftley. The bifhop's intereft with the minifter was not promoted by the part which he took on this occafion, and much lefs by his parliamentary fpeech againft Mr. Pitt's commercial treaty with France. Soon after this he was very much enfeebled by a dyfentery; and upon his return from Bath to Cambridge in 1787, the fenate appointed Dr. Kipling to be his deputy as profeffor, with a falary amounting in a courfe of time to two-thirds of the value of the profefforfhip, when Dr. Watfon firft undertook it. At the enfuing commencement he delivered a kind of farewell addrefs to the univerfity, in which he expreffed his warmeft wifhes for its profperity; after having been inceffantly engaged in its bufinefs for more than thirty-three years. After the commencement he took a journey to Weftmoreland, with a view to the re-eftablifhment of his health. He now determined to become an agriculturift; and his purfuits in this department, as an improver of land and planter of trees, were fo favourable to his health, and upon the whole fo profitable, that he fays in the year 1809, "I feel much fatisfaction at this moment in having, by my own exertions, wholly counteracted the effects which might otherwife have followed the neglect I have experienced from the court or from its minifters, or from both, that I fincerely pity, and cordially forgive the littlenefs of mind, which, in fome one or other, has occafioned it." The bifhop relates an incident which occurred on occafion of his attending a levee in November 1787, and which fufficiently evinced the pains that had been taken to inftil wrong notions of his political principles into his majefty's mind. "I was ftanding," he fays, "next to a Venetian nobleman; the king was converfing with him about the republic of Venice, and haftily turning to me faid, 'there now, you hear what he fays of a republic.' My anfwer was, 'Sir, I look upon a republic to be one of the worft forms of government.' The king gave me, as he thought, another blow about a republic. I anfwered that I could not live under a republic. His majefty ftill purfued the fubject: I thought myfelf infulted and firmly faid, 'Sir, I look upon the tyranny of any one man to be an intolerable evil, and upon the tyranny of a hundred to be a hundred times as bad;' thus ended the converfation."

Although Dr. Watfon, as profeffor of divinity, had been for many years a chartered member of the fociety for propagating the gofpel in foreign parts, he had never fubfcribed to it nor attended its meetings; becaufe its miffionaries were more bufily employed in bringing over Diffenters to epifcopacy than in converting heathens to Chriftianity.

In the year 1788 he publifhed a charge which he had delivered at his vifitation, entitled "An Addrefs to Young Perfons after Confirmation." Towards the clofe of this year and the commencement of the next, he took an active part in the bufinefs of the regency, occafioned by the king's mental derangement; and in an elaborate fpeech delivered in the houfe of lords January 22d, 1789, he difcuffed, with fingular ability, the fubject in debate between Mr. Fox, who afferted "that theprince of Wales had a right to affume the regency," and Mr. Pitt, who had faid, "that the prince of Wales had no more right to affume the regency than any other man in the kingdom had." The part he took on this occafion is faid to have offended the queen; who, as he fays, "diftinguifhed by different degrees of courtefy on the one hand, and by meditated affronts on the other, thofe who had voted with, and thofe who had voted againft the minifter." At the drawing-room, held on the king's recovery, the bifhop was received with a degree of coldnefs, "which would have appeared to herfelf ridiculous and ill-placed could fhe have imagined how little fuch a mind as mine regarded, in its honourable proceedings, the difpleafure of a woman, though that woman happened to be a queen." The prince of Wales, who was witnefs to this conduct, paid particular attention to the bifhop, invited him to dine at Carlton-houfe, and entered into a familiar conference with him; the bifhop on the occafion "advifing him to perfevere in dutifully bearing with his mother's ill-humour, till time and her own good fenfe fhould difentangle her from the web which minifterial cunning had thrown around her." When the bifhop, before the clofe of the interview, declared that he was fick of parties, and fhould retire from all public concerns, "No," faid the prince, "and mind who it is that tells you fo, you fhall never retire; a man of your talents fhall never be loft to the public." The bifhop's reflection fubjoined to this anecdote is, "I have now lived many years in retirement, and, in my 75th year, I feel no wifh to live otherwife." About ten years after the publication of the tract which he had given to the young perfons of his diocefe, already mentioned, Mr. Afhdown of Canterbury addreffed two letters to him, in which he contended that the diftinction of ordinary and extraordinary operations of the Holy Spirit is not founded in fcripture, and that if it were, both operations ceafed with the apoftolic age. In reference to this opinion, the bifhop declares, "I am not afhamed to own, that I give a greater degree of affent to the doctrine of the extraordinary operation of the fpirit in the age of the apoftles, than I do to that of his immediate influence, either by illumination or fanctification, in fucceeding ages. Notwithftanding this confeffion, I am not prepared to fay, that the latter is an unfcriptural doctrine: future inveftigation may clear up this point, and God, I truft, will pardon me an indecifion of judgment proceeding from an inability of comprehenfion. If it fhall ever be fhewn, that the doctrine of the *ordinary* operation of the Holy Ghoft is not a fcripture doctrine, Methodifm, Quakerifm, and every degree of enthufiafm, will be radically extinguifhed in the Chriftian church; men, no longer believing that God does that by more means which may be done by fewer, will wholly rely for religious *inftruction*, confequent *converfion*, and fubfequent *falvation*, on his *Word*."

In the fummer of 1789, our bifhop, in purfuit of his plan for retiring from public life, laid the foundation of his houfe on the banks of the Winandermere; where he continued till his death. On occafion of the publication of "Hints to the New Affociation, recommending a Revifal of the Liturgy, &c." in 1789, by the duke of Grafton, two pamphlets were in the following year publifhed in oppofition to thefe "Hints." The bifhop made a reply to thefe attacks; and took a comprehenfive view of the fubject. Although he was diffuaded from publifhing his tract, it foon appeared under the title of "Confiderations on the Expediency of revifing the Liturgy and Articles of the Church of England," by a Confiftent Proteftant. Moreover, it was propofed, in converfation with the duke of Grafton, to commence a reform, by the introduction of a bill into the houfe of lords, for expunging the Athanafian creed from the Liturgy; but on account of the French revolution, the defign was poftponed. In this connection, we cannot forbear mentioning what is called the Windfor anecdote. It is as follows; and given by the bifhop on the authority of Dr. Heberden: "The clergyman there, on a day when the Athanafian creed was to be read, began with *Whofoever will be faved*, &c. the king, who ufually refponded with a loud voice, was filent; the minifter repeated, in a higher tone, his *Whofoever*; the king continued filent; at length the Apoftle's creed was repeated by the minifter, and the king followed him throughout with a diftinct and audible voice." "I certainly diflike," fays the bifhop, "the *impofition* of all creeds formed by human authority; though I do not diflike them, as ufeful fummaries of what *their compilers believe* to be true, either in natural or revealed religion." In a letter to the duke of Grafton, dated October, 1791, he briefly ftates his fentiments on feveral fubjects of importance. Amongft other obfervations that deferve attention, he fays, "In England we want not a fundamental revolution; but we certainly want a reform both in the civil and ecclefiaftical part of our conftitution; men's minds, however, I think, are not yet generally prepared for admitting its neceffity. A reformer of Luther's temper and talents would, in five years, perfuade the people to compel the parliament to abolifh tithes, to extinguifh pluralities, to enforce refidence, to confine epifcopacy to the overfeeing of diocefes, to expunge the Athanafian creed from our liturgy, to free Diffenters from teft acts, and the minifters of the eftablifhment from fubfcription to human articles of faith. Thefe, and other matters refpecting the church, ought to be done: I want not courage to attempt doing what I think ought to be done; and I am not held back by confiderations of perfonal intereft; but my temper is peaceable, I diflike contention, and truft that the ftill voice of reafon will at length be heard.—As to the civil ftate, it cannot long continue as it is, &c. &c." In a charge delivered in 1792, the bifhop touched on feveral fubjects of importance and general intereft; and among other things on the injuftice and impolicy of our Teft and Corporation Acts. "There feem to me," fays our prelate, "but two reafons for excluding any honeft man from eligibility to public office;—want of capacity to ferve the office, and want of attachment to the civil conftitution of the country. That the Diffenters want capacity will not be afferted; that they want attachment to the civil conftitution of the country is afferted by many, but proved by none."—"The Diffenters are neither Tories nor Republicans, but friends to the principles of the revolution;" but their conduct fince the revolution, and at and fince the reftoration, proves that they have no defign to undermine the conftitution of the country.

"But it may be faid, that inafmuch as the Diffenters are enemies to the church eftablifhment, and that the ftate is fo *allied* to the church, that he who is unfriendly to the one muft wifh the fubverfion of both. I think this reafoning is not juft; a man may certainly wifh for a change in an ecclefiaftical eftablifhment, without wifhing for a change in the civil conftitution of a country. An Epifcopalian, *e.g.* may wifh to fee bifhops eftablifhed in all Scotland, without wifhing Scotland to become a republic: and he may wifh that epifcopacy may be eftablifhed in all the American ftates, without wifhing that monarchy may be eftablifhed in any of them. The protection of life, liberty, and property, is not infeparably or exclufively connected with any particular form of church-government. The bleffings of civil fociety depend upon the proper execution of good laws, and upon the good morals of the people; but no one will attempt to prove, that the laws and morals of the people may not be as good in Germany, Switzerland, Scotland, under a Prefbyterian, as in England or France, under an epifcopal form of church-government," with much more to the fame purpofe.

In the year 1795 our bifhop made a fpeech in the houfe of lords in favour of a motion by the duke of Bedford, "that no form of government which may prevail in France fhould preclude a negociation with that country, or prevent a peace whenever it could be made confiftently with the honour, intereft, and fecurity of the nation." In the following fummer he publifhed a charge, and two fermons, one of them entitled "Atheifm and Infidelity refuted from Reafon and Scripture;" and the other "The Chriftian Religion no Impofture." In 1796 he publifhed "An Apology for the Bible," in defence of it againft the fcurrilous abufe of Thomas Paine. Of this tract many thoufands were diftributed at a low price, both in England and Scotland; and we have reafon to believe produced the moft beneficial effects, not only in Great Britain, but in Ireland and America. In 1798 the bifhop publifhed an addrefs to the people of Great Britain, which was of great fervice in raifing the fpirit of the nation. In 1799 he delivered a fpeech, recommending and vindicating againft objections a cordial union with Ireland, as an event which would enrich Ireland without impoverifhing Great Britain: and that would render the empire, as to defence, the ftrongeft in Europe. When Mr. B. Flower was brought to the bar of the houfe of lords for a breach of privilege in publifhing fomething againft the above-mentioned fpeech, the bifhop, when he heard of it, declared, "that he fhould feel much more fatisfaction in forgiving the man's malignity than in avenging it."

In 1805 the petition of the Roman Catholics of Ireland was taken into confideration by both houfes of parliament, and rejected by great majorities in both. Previoufly to the difcuffion on this queftion, bifhop Watfon communicated his fentiments on the fubject in a letter addreffed to the duke of Grafton. As this is a queftion ftill *fub judice*, we fhall here introduce the general heads of argument fuggefted in relation to it by the bifhop. "1. The abfolute juftice of tolerating religious opinions, fince no civil government can juftly poffefs more power over its fubjects than what individuals have *confented* to transfer to it when they entered into fociety; and no individual can give up the right of worfhipping God according to his confcience, and therefore no government can juftly abridge that right. 2. No civil government has any right to take cognizance of opinions either political or religious, but merely of men's actions. This principle, however, is liable to exception with refpect to the public teachers of religion. 3. The eftablifhed religion of every country ought to be the religion of the majority of the people; unlefs an exception be admitted, when the minority of the inhabitants poffeffes a majority of the property by which the eftablifhment is maintained; and even in that cafe, humanity and policy, if not ftrict juftice, require a co-eftablifhment of the religion of the minority. 4. Great credit ought to be given to men of probity and talents, difclaiming, in exprefs terms, the moft obnoxious principles of the church of Rome; the odium of paft tranfactions ought not to be thrown upon thofe who had no concern in them. 5. Conftitutionally fpeaking, the Catholic peers and commons have no more right to fit in parliament than a Catholic king has to fit upon the throne; and if the change of times is not yet fuch that a Proteftant would endure the thought of a Catholic king upon the throne, it may be inquired upon what principle it is that a Proteftant can

endure

endure the thought of a Catholic legiſlator. The principle may be the little comparative influence of a Catholic legiſlator, and his abjuration of temporal tenets formerly profeſſed by Catholics. 6. The progreſs of ſcience has ſubdued the bigotry formerly too apparent not only in the church of Rome, but in all the reformed churches: and it will never be able, till a ſtate of ignorance and barbariſm recurs, to rear up its head again. There is no probability of intolerance and ſuperſtition ever more pervading Europe; and the Catholic religion will continue to derive light from the labour of learning. The learned Catholics are beginning every where to ſoften the aſperities of their religious tenets, and to apologize for what they cannot excuſe. The Iriſh gentry partake of the illumination of the age; and the peaſantry will imitate the example of their ſuperiors. 7. It may be ſaid that the *church* of Rome has not formally renounced any of the doctrines maintained at the council of Trent, and that the *court* of Rome has not abandoned any of its pretenſions to temporal dominion; yet Catholic, as well as Proteſtant, ſtates have every where ſpurned theſe pretenſions; and ſomething very like a formal renunciation of one of the moſt dangerous tenets of that church took place in Ruſſia more than twenty years ago. The empreſs Catharine gave permiſſion to the Roman Catholics in her dominions merely to exerciſe their religion; and to have biſhops of their own perſuaſion for the government of their church. She was preſent at the conſecration of the firſt Catholic archbiſhop. When the ceremony had proceeded to the adminiſtration of the oath uſually taken by the biſhops of that church, the archbiſhop (that was to be) refuſed to repeat the clauſe "Hæreticos ſchiſmaticos et rebelles domino noſtro papæ pro poſſe perſequar et impugnato." On this refuſal, the ceremony was ended, freſh inſtructions were required from Rome, and the then pope ordered the clauſe to be omitted; and it has been ſince omitted, by the authority of the pope, in the oath taken by the Iriſh biſhops."

"My great objection," ſays Watſon, "to the church of Rome is the uncharitable principle of the inſalvability of perſons out of its pale; for this principle produces a perſecuting principle, and I muſt ever deteſt every ſpecies of perſecution. I cannot however believe that Catholic emancipation will tend to the increaſe of the number of Catholics, either in Ireland or in England; on the contrary, I think the number would, by ſuch a meaſure, be leſſened. Nothing unites men ſo much as any degree of perſecution. Individuals, otherwiſe of no conſequence, either from talents or fortune, become conſpicuous, and acquire a degree of weight, when connected with a party. Men claim merit from what they call their ſufferings, who would have no ground for claiming it on any other ſpecies of deſert."

In ſubſequent letters addreſſed to lord Grenville in 1810, and to ſir John Cox Hippeſley in 1812, he gives the following opinion of the *veto:* "the appointment of the Iriſh Catholic biſhops ought to be in the king, if they are to be paid by the ſtate; and if they are to be paid by the Catholics themſelves, it ought to be in them; but excluſive of all foreign influence, recommendation, or confirmation. If they do not accede to this, or to ſomething ſimilar to this, they will act on a *principle which I did not expect, nor can approve.*" In a letter to lord Hardwicke, dated April 2, 1812, he ſays, "I make no ſecret of my opinion; a cordial reception of Catholics and Diſſenters into the boſom of the conſtitution, by the extinction of all diſqualifications, is become neceſſary to ſecure the independence of the empire, and the ſafety of the country."

In conſequence of an imputation of want of orthodoxy, partly occaſioned by a ſermon publiſhed by the biſhop, and entitled "A Second Defence of revealed Religion," he makes the following reflections on the ground of this charge. "What is this thing called orthodoxy, which mars the fortunes of honeſt men, miſleads the judgment of princes, and occaſionally endangers the ſtability of thrones? In the true meaning of the term, it is a ſacred thing, to which every denomination of Chriſtians lays an arrogant and excluſive claim, but to which no man, no aſſembly of men, ſince the apoſtolic age, can prove a title. It is frequently, among individuals of the ſame ſect, nothing better than ſelf-ſufficiency of opinion, and phariſaical pride, by which each man eſteems himſelf more righteous than his neighbours. It may, perhaps, be uſeful in cementing what is called the *alliance* between the church and ſtate; but if ſuch an alliance obſtructs candid diſcuſſions, if it invades the right of private judgment, if it generates bigotry in churchmen, or intolerance in ſtateſmen, it not only becomes inconſiſtent with the general principles of Proteſtantiſm, but it impedes the progreſs of the kingdom of Chriſt, which we all know is not of this world."

The next public occaſion on which our biſhop diſtinguiſhed himſelf was on the debate which took place in the houſe of lords, March 23, 1807, concerning the abolition of the ſlave-trade. For the affirmative of this queſtion he delivered a ſpeech, abounding with hiſtorical information and ſound argument. When the adminiſtration that had been formed on the death of Mr. Pitt was diſmiſſed, he expreſſed in ſtrong terms his diſapprobation of the oſtenſible reaſon alleged for its diſmiſſion, which was the king's diſlike of a meaſure which had been brought forward in parliament reſpecting the Iriſh Catholic officers; and the requiſition on the part of his majeſty of a pledge that this adminiſtration would never more bring forward the queſtion of granting farther indulgence to the Iriſh Catholics. This requiſition was conſidered by many as having a tendency dangerous to the conſtitution; and to Dr. W. it appeared "to be not in words, but in fact, a declaration of a *ſic volo.*" On occaſion of the diſmiſſion of this "half Whig, and half Tory adminiſtration," as he calls it, he communicated to lord Grenville a reſolution, which he conceived to be fit to be introduced in the houſe of lords, whenever the ſubject ſhould be brought forward, and which lord Grenville actually adopted *in toto*, as better in his opinion than any thing which had occurred either to himſelf or to his friends. The reſotion was as follows: "Reſolved, that whoever has adviſed, or ſhall in future adviſe, his majeſty to require from his confidential ſervants a pledge, that they will, on any occaſion, abſtain from ſubmitting to his conſideration any meaſure of government which they, in their conſciences, believe to be conducive to the public weal, is and ought by this houſe to be declared to be an enemy to the conſtitution of this country." Soon afterwards he ſent to the duke of Grafton a leſs firm reſolution, which he thought might be more acceptable to the then houſe of lords. Neither of theſe reſolutions, however, was ultimately adopted; but the reſolution that was actually propoſed was, after a debate which laſted till 7 o'clock in the morning, negatived by a great majority. A violent alarm againſt Popery and of the church's danger prevailed, during which the biſhop declared his opinion, "that it was both juſt, and in the ſtate of Buonaparte's ſtrength and temper towards us, highly expedient, to receive both Catholics and Diſſenters into the boſom of the conſtitution; but that it was improper to preſs any innovation till the people were prepared to receive it; and that" (in his opinion) "the time was not yet come for the general adoption of ſuch a political and equitable principle of government. Toleration was in every man's mouth; but dominion over the faith of other men, exclufion from privileges poffeffed by themfelves, and a difpofition to the exercife of *power without right*, were in the hearts of a great part, probably of a majority of the people of Great Britain."

In reply to a letter, in which the writer expreffes a wifh, that the bifhop would anfwer Mr. Malthus's book, intitled "An Effay on Population," and in which, as he reprefents it, the author endeavours to eftablifh a code of morality in oppofition to the morality of the gofpel, Dr. W. obferves that Mr. Malthus appeared to him to be "endeavouring to fhew the utility of bringing down the population of the earth to the level of the fubfiftence requifite for the fupport of man," (a propofition wanting no proof, fince where there is no food, man muft die,) "and that in his judgment, his time and talents would have been better employed in the inveftigation of the means of increafing the fubfiftence to the level of the population." He fays, however, that after having looked into this book, he was juftified in neglecting to perufe it, as it thwarted the ftrongeft propenfity of human nature, and contradicted the moft exprefs command of God, "Increafe and multiply;" more efpecially as he was perfuaded, "that the earth had not, in the courfe of 6000 years from the creation, ever been replenifhed with any thing like one half the number of inhabitants it would fuftain."

The bifhop might indeed well regret, as he frequently, perhaps *too frequently* does, the inattention to his merits, and claims on higher preferment than a poor Welfh bifhopric, which he had long experienced, after a long courfe of literary labour and public fervice. Mr. Pitt profeffed himfelf well difpofed towards him, but alleged "that a *certain perfon* would not hear of it." "Notwithftanding this anecdote," fays the bifhop, "I cannot bring myfelf to believe that the king was either the firft projector, or the principal actor in the forry farce of neglecting a man whom they could not difhonour, of diftreffing a man whom they could not difpirit, which has been playing at court for near 26 years." Acquitting Mr. Pitt, though he knew that no minifter would be very zealous in promoting a man who profeffed and practifed parliamentary and perfonal independence, from the charge of forgetting either obligations or connections in the purfuit of his ambition, he lays the blame on a more exalted perfonage. "As to the king's diflike of me, unlefs his education had made him more of a Whig, it was natural enough. My declared oppofition to the increafed and increafing influence of the crown had made a great impreffion on his majefty's mind."

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On the fubject of Lancafterian fchools and bible focieties, he declares his opinion to be, "that certain zealous men in the eftablifhed church have fuffered their apprehenfions for its fafety to outftrip all probability of danger arifing to it, from the inftitution of either Lancafterian fchools or auxiliary bible focieties. The church is in no danger from Proteftant or Catholic Diffenters; but the ftate muft ever be in danger from difcontent breeding difaffection, whilft a large portion of its members is looked upon by government with a jealous and repulfive eye." On another occafion, in a letter to Mr. Wyvill, Oct. 21, 1813, he expreffes fentiments of a fimilar kind: "the ftruggle for the liberty of Europe has been moft nobly fuftained by Great Britain, and might it not at this period be fuccefsfully terminated by our government granting emancipation to the Catholics, and a repeal of the Teft and Corporation acts to the Diffenters? Thefe conceffions would be more powerful means of defence than all the confcriptions of our enemy can ever be to the contrary." We cannot forbear fubjoining a paragraph from Mr. Wyvill's reply: "Mr. Fox proved the fincerity of his attachment to liberty, civil and religious, by the long fervice of 30 years, almoft wholly fpent in parliament, under the frowns of power: your lordfhip, I believe, has given a fimilar proof of your attachment to that beft of caufes. You have endured a fimilar profcription from men who acted on the fame unworthy motives, and the confequence has been almoft the fame: you have at Landaff been fo long fhut out from the road to the higher honours of the church. But how much higher have you rifen by having obtained the undifputed dignity of virtue, benevolence, patriotifm, and the true fpirit of Chriftianity!" Well might the bifhop reply to Mr. Wyvill, "I am proud of *your* honourable teftimony to that political confiftency of principle, which unites my name to that of Mr. Fox."

From this period the health of the bifhop rapidly declined; and though his mental faculties continued unimpaired, yet bodily exercife and literary compofition became irkfome to him. He expired on the 4th of July, 1816, in the 79th year of his age; illuftrating, as the publifher of his Memoirs fays, in death the truth of his favourite rule of conduct through life: "Keep innocency, and take heed unto the thing that is right, for that fhall bring a man peace at the laft."

Having availed ourfelves of the work now before us, we make no apology for extending this article beyond the ufual limits of our biographical fketches. From the honour of an early acquaintance with the fubject of this article, and from a full conviction of his uniform integrity, as well as his pre-eminent talents, we felt a peculiar intereft in the perufal of the memoirs of his life. Diftinguifhed by mental powers of a fuperior order, and by public fervices which have feldom been paralleled, we pay this tribute of refpect to his memory. His character needs no delineation befides the "Anecdotes" which his own pen has furnifhed. In every department which he occupied, firft as a ftudent, and afterwards as a tutor and profeffor in the univerfity of Cambridge, as a prelate and a member of the legiflature, and in the

the latter period of his life as an agriculturift, his affiduity and activity were indefatigable and perfevering. To fay nothing of his folicitude for the beft interefts of his friends and his family, the ardour of his zeal in promoting the honour and profperity of the church and civil community to which he belonged, by thofe means which, according to his comprehenfive and liberal views, he thought to be moft conducive to this purpofe, muft approve itfelf in a high degree to thofe who entertained fentiments fimilar to his own, and it will need little apology in the candid judgment of thofe who moft differ from him in their opinion of public men and public meafures. As he always fpoke and acted from the conviction of a well-informed and upright mind, and counteracted his own fecular intereft by the courfe he purfued, his fentiments claim deference, and his conduct will command refpect. If it fhould occur to any who perufe the anecdotes now before us, that he was too ambitious of preferment, it muft be recollected, that the merit of his fervices, both to the church and ftate, of which he could not be unconfcious, and the elevated connections which his ftation in the univerfity had led him to form, encouraged reafonable expectations of a higher rank in the church than a poor bifhopric in Wales; fo that he could not otherwife than feel himfelf neglected and difappointed. His private fortune, though his patrimony had been expended, was rendered ample by the liberality of his friend Mr. Luther, and therefore he had no juft reafon for complaint on this account; and yet it fhould be confidered that he had a family, for which he wifhed to provide in a manner fuitable to the circumftances in which his aggregate income had placed them. Anecdotes of the Life of Richard Watfon, bifhop of Landaff, written by himfelf at different intervals, and revifed in 1814, 4to., publifhed by his fon, Richard Watfon, LL.B. prebendary of Landaff and Wells. Lond. 1817.

Watson, in *Geography*, a town of Virginia; 35 miles S.W. of Richmond.

Watson's *Ifland*, an ifland in the Mergui Archipelago, of an oval form, and about 12 miles in circumference. N. lat. 9° 36′.

WATSONIA, in *Botany*, was fo called by Miller, after the late fir William Watfon, knight, M.D. F.R.S., well known by his numerous papers in the Philofophical Tranfactions, on many fubjects connected with the hiftory of Botany, and eminently diftinguifhed for his cultivation of feveral branches of philofophical and medical knowledge. Miller's genus being funk by Linnæus in *Antholyza*, the *Büttneria* was called *Watfonia* by Boehmer; but the original one, reftored by Mr. Ker, is now generally, and with great propriety, adopted.—Mill. Ic. 184. Ker in Sims and Kon. Ann. of Bot. v. 1. 229. Dryand. in Ait. Hort. Kew. v. 1. 93.—Clafs and order, *Triandria Monogynia*. Nat. Ord. *Enfatæ*, Linn. *Irides*, Juff.

Gen. Ch. *Cal.* Spatha inferior, fhorter than the corolla, of two oblong, clofe-preffed, permanent valves. *Cor.* of one petal, fuperior: tube cylindrical throughout, fomewhat enlarged, but not fpreading, in the elongated throat, curved: limb nearly regular, in fix deep, flat, fpreading, almoft equal fegments. *Stam.* Filaments three, inferted into the tube at the origin of the throat, thread-fhaped, afcending, fhorter than the corolla; anthers oblong, fomewhat parallel, incumbent. *Pift.* Germen inferior, oblong, furrowed; ftyle thread-fhaped, longer than the ftamens; ftigmas three, flender, deeply cloven, fpreading, recurved. *Peric.* Capfule oblong, bluntly triangular, cartilaginous, of three cells and three valves. *Seeds* numerous, imbricated downwards, angular in their lower part, dilated into more or lefs of a wing at the upper end.

Eff. Ch. Spatha of two valves. Corolla tubular, with a cylindrical throat; its limb in fix deep, nearly equal, fegments. Stigmas three, thread-fhaped, deeply cloven, the fegments recurved. Capfule cartilaginous. Seeds numerous, angular.

This genus differs from Gladiolus in its almoft regular *corolla*, with a cylindrical throat; narrow, divided, not dilated, *ftigmas*; and angular, fcarcely winged, feeds: Antholyza, as now limited, is diftinguifhed from it, by having a ringent *limb*, of unequal and diffimilar fegments; fimple *ftigmas*; and nearly globular *feeds*. See thofe articles.

1. W. *fpicata*. Hollow-leaved Watfonia. Ker in Curt. Mag. at p. 553. Ait. n. 1. (Ixia fpicata; Willd. Sp. Pl. v. 1. 200. I. cepacea; Redout. Liliac. t. 96. I. fiftulofa; Curt. Mag. t. 523. I. alopecuroidea; Linn. Suppl. 92. Gladiolus fpicatus; Linn. Sp. Pl. 53. Thunb. Gladiol. n. 13. G. fiftulofus; Jacq. Hort. Schoenbr. v. 1. 8. t. 16.)—Leaves cylindrical, hollow.—Gathered by Thunberg, on the higheft hills of Hottentot's Holland, at the Cape of Good Hope, flowering in December and January. By fir Jofeph Banks's herbarium, this fpecies appears to have been cultivated by Mr. W. Malcolm, in 1791. It blooms in the European green-houfes in May, but not very readily, often bearing fmall oat-like bulbs in the place of flowers. The *bulb* is fmall, round, with a fibrous coat. *Stem* leafy, from eight to twelve inches high. *Leaves* alternate, very remarkable for their cylindrical inflated form, gradually fwelling upwards, obtufe, with a fmall point; their furface very fmooth; their bafe fheathing. *Flowers* either light blue or pale purple, very numerous, clofely imbricated in a two-ranked tapering fpike, with reddifh crenate *fheaths*. *Corolla* regular, expanding rather more than half an inch. We do not find that the *ftigmas* of this plant are cloven, as the generic character requires, and we fhould rather have left it in *Ixia*, till it could otherwife have been difpofed of. The fame remark applies to the following. The name *fpicata* is not fo exclufively appropriate as *fiftulofa* or *cepacea* would have been, but it is the oldeft name, and liable to no objection. This is certainly, as far as we can make out, the original *Gladiolus fpicatus* of Linnæus, though he, long after its publication, very inadvertently laid into his herbarium, under that name, a Siberian fpecimen of a fmall-flowered variety of *G. communis*.

2. W. *plantaginea*. Plantain-fpiked Watfonia. Ker in Curt. Mag. t. 553. Ait. n. 2. (Ixia plantaginea; Willd. Sp. Pl. v. 1. 200. Gladiolus alopecuroides; Linn. Sp. Pl. 54. Amoen. Acad. v. 4. 301. Thunb. Gladiol. n. 14.)—Upper leaves linear-fwordfhaped, many-ribbed: lowermoft hollow, compreffed. Flowers imbricated in two rows.—Gathered by Thunberg in feveral places near the town, at the Cape of Good Hope, often in the highways. This differs effentially from the fpecies juft defcribed, in having the ufual fword-fhaped *foliage* of its natural order. Their *flowers* nearly refemble each other. Thefe are in the prefent fpecies either blue or white, very numerous, forming a denfe two-ranked *fpike*, with membranous-edged *fheaths*, recalling the idea of fome kind of Plantain. Sometimes each *ftem* bears two or three fuch *fpikes*, which are then very large and luxuriant; but in our cultivated fpecimens they are ufually folitary, as well as much fmaller. The *flowers* are without fcent.

3. W. *punctata*. Dotted-flowered Watfonia. Ker in Ann. of Bot. n. 1. Ait. n. 3. (Ixia punctata; Andr. Repof. t. 177.)—Leaves linear-awlfhaped, compreffed. Spike about three-flowered.—Sent from the Cape of Good Hope, in 1800, by Mr. Niven, to his employer Geo. Hibbert,

minion over the faith of other men, excluſion from privileges poſſeſſed by themſelves, and a diſpoſition to the exerciſe of *power without right*, were in the hearts of a great part, probably of a majority of the people of Great Britain."

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WAT-TAUPAUMENE, or St. Peter, in *Geograph* a river of North America, which runs into the Miffiffipp N. lat. 44° 42′. W. long. 93° 38′.

WATTEAU, Anthony, in *Biography*, one of the mo agreeable painters of the French fchool, was born at Valer ciennes in 1684. His parents were in indigent circumftance and he was placed with an obfcure artift in his native city, t cultivate a talent which manifefted itfelf early. When he wa about 16 years old, having already furpaffed his preceptor he connected himfelf with a fcene-painter on his way to Paris and for fome time affifted his affociate in decorating the opera-houfe in that city. When this engagement was com pleted Watteau found it difficult to refcue himfelf from the obfcurity and embarraffment into which he fell, when happily he became acquainted with Claude Gillot, a painter of grotefque and fabulous fubjects, who was pleafed with his works and difpofition. Gillot afforded him an afylum in his own houfe, and then inftructed him in all he knew of the art, and found an apt and agreeable fcholar in his protegée. With the help he thus received from Gillot, and his own admiration and attentive ftudy of the Luxembourg gallery, he formed a tafte for colouring, which if not as grand, is at leaft as agreeable, as ever was employed by any one.

He attempted to prepare himfelf for hiftorical painting, and ftudied at the academy with that view; he even was fo fuccefsful as to obtain the firft prize there for an hiftorical picture; but happily he difcovered a character of fubject quite original and exactly fuited to his tafte, for which he wifely deferted hiftory, and which has fince formed plenty of afpirants, but has never been fo fuccefsfully practifed. The theatre, the opera, fêtes champetres, mafquerades, pantomimes, puppet-fhows, afforded him his figures; the gardens of the Luxembourg and of the Thuilleries, of Verfailles and St. Cloud, furnifhed the fcenes. In thefe nature prevails only in the colouring, and that is exquifite, rich, delicate, clear, and full; bright without gaudinefs, and deep without blacknefs; laid on with a freedom, fulnefs, and delicacy of touch, which no one ever furpaffed; but the airs of his figures are generally affected to the higheft degree; people of rank and fafhion, aping the enjoyments of rural life: and when he attempted to paint domeftic or rural fcenes, he carried the fame tafte into his practice. The true character of Watteau's pictures is French gentility, gay, cheerful, debonnaire, of which felf-fatisfaction is the fureft bafis. "In his halts and marches of cavalry, the carelefs ftrut of his foldiers retains the air of a nation that afpires to be agreeable as well as victorious." Watteau vifited England in the reign of George I., but did not enjoy his health here, and returned to France in about a year, where he died in 1721, at the early age of 37.

WATTEN, in *Geography*, a town in Scotland, in the county of Caithnefs; 7 miles N.W. of Wick.—Alfo, a town of France, in the department of the North, on the Aa; 4 miles N. of St. Omer.

WATTENSCHIED, a town of Germany, in the county of Mark; 5 miles S.W. of Bockum.

WATTER, a river which rifes in the county of Waldeck, and runs into the Erpe, near Volckmarfen.

WATTERPUTTEN, a town of Hindooftan, in Concan; 5 miles S. of Geriah.

WATTINAD, a town of Hindooftan, in the Carnatic; 20 miles S.S.E. of Tanjore.

WATTLE, in *Agriculture* and *Rural Economy*, a kind of hurdle formed by means of fplit wood, or fmall rods, and ufed for making folds for fheep. The term alfo fignifies a flefhy excrefcence growing from under the top of the throats

of

bert, efq. in whofe green-houfe at Clapham it flowered the fpring following. *Bulb* roundifh, depreffed. *Stem* leafy, flender, about a foot high. *Leaves* few, alternate, very narrow, fpreading in two directions. *Flowers* agreeing in fize and difpofition with thofe of *Ixia maculata*, about three in number, of a fine purple, marked with dotted or beaded veins; their fegments regular, elliptical, longer than the tube, three of them rather fmaller than the reft. *Stigmas* three, deeply divided; or rather, we fhould fay, fix, ftrap-fhaped, obtufe, revolute, downy. The character of the *ftigmas* anfwers to *Watfonia*, but the habit is very unlike the other fpecies.

4. W. *marginata*. Broad Bordered-leaved Watfonia. Ker in Curt. Mag. t. 608. Ait. n. 4. (Gladiolus marginatus; Linn. Suppl. 95. Willd. Sp. Pl. v. 1. 217. Thunb. Gladiol. n. 20.)—Leaves fword-fhaped, with thick callous edges. Spike fomewhat compound. Mouth of the corolla with fix teeth.—Abundant on graffy hills at the Cape of Good Hope, as well as on the Table-mountain, and other elevated ground, flowering from October to December often in fuch profufion, as to cover the hills as it were with a beautiful rofe-coloured carpet. *Thunberg*. In our green-houfes it readily bloffoms from June to Auguft, efpecially if planted in deep pots, and as readily increafes, being, as Mr. Ker obferves, become within a few years one of the commoneft of its tribe. The great fize of the plant, its thick-edged *leaves*, not indeed well expreffed in the Botanical Magazine, and the copious, rofe-coloured *flowers*, fmelling like Hawthorn, or Heliotrope, render this one of the moft defirable and ftriking of the Cape bulbs. The *corolla* is regular, with a tube about equal to its limb, having a fhort cylindrical throat. *Stigmas* long, each in two divaricated revolute fegments.

5. W. *rofea*. Pyramidal-fpiked Watfonia. Ker in Ann. of Bot. n. 5. Curt. Mag. t. 1072. Ait. n. 5. (Gladiolus glumaceus; Thunb. Prodr. 186. Vahl Enum. v. 2. 105. G. marginatus δ; Thunb. Gladiol. n. 20. G. iridifolii varietas; Jacq. Ic. Rar. t. 235. G. pyramidatus; Andr. Repof. t. 335.)—Leaves fword-fhaped, thickened at the edges. Spike compound. Mouth of the corolla naked.—Native of the Cape of Good Hope. It appears to have flowered, for the firft time in England, at the Dowager Lady de Clifford's, in Auguft 1803. One of the largeft of its tribe, being fometimes four feet high. We cannot wonder at this having been taken for a variety of the laft, at leaft while the fpecies of this difficult order of plants were but fuperficially examined. The prefent is, however, the larger and more ftately plant of the two, with even more beautiful rofe-coloured *flowers*, whofe *corolla* wants the fix marginal teeth round the mouth, which effentially diftinguifh the preceding.

6. W. *brevifolia*. Short-leaved Watfonia. Ker in Curt. Mag. t. 601. Ait. n. 6. (Antholyza fpicata; Andr. Repof. t. 56. Gladiolus teftaceus; Vahl Enum. v. 2. 105.) — Leaves ovate-fwordfhaped, equitant, very fhort. Tube, throat, and limb, of the corolla equal in length; mouth naked.—Native of the Cape of Good Hope, from whence it was imported by Meffrs. Lee and Kennedy, through the hands of Mr. Pringle of Madeira, in 1794. The *leaves* are about four, almoft perfectly radical, remarkable for their fhortnefs, being but two or three inches long, though near an inch wide; their edges cartilaginous, though very narrow. *Stem* twelve or eighteen inches high. *Spike* long, erect, fimple, or fometimes branched, but not compofed of little fpikelets. *Flowers* of a tawny red, about the fize of *W. marginata*, but the proportion of their *tube*, and efpecially their *throat*, is longer compared with the *limb*. Their *colour* would lead us to expect fome fragrance, in the evening at leaft, but this is faid not to be the cafe. They have, however, the advantage of being much more lafting than fome of their allies. The *ftigmas* are deeply cloven.

7. W. *iridifolia*. Flag-leaved Watfonia. Ker in Ann. of Bot. n. 12. Ait. n. 7. (Gladiolus iridifolius; Jacq. Ic. Rar. t. 234. Willd. Sp. Pl. v. 1. 215, excluding the fynonym of G. cardinalis.)—β. var. fulgens; Curt. Mag. t. 600. (Antholyza fulgens; Andr. Repof. t. 192. Gladiolus marginatus γ; Thunb. Gladiol. n. 20.)—Throat of the corolla curved, longer than the tube, and rather longer than the acute limb. Leaves fword-fhaped, erect, with a prominent midrib.—Native of the Cape of Good Hope, from whence it was fent by Mr. Maffon, in 1795. The variety β is preferred, on account of the fplendid fcarlet colour of its flowers, in which alone it is faid to differ from the pale greyifh-flowered plant, figured by Jacquin. We have not feen the latter, but if the figure be correct, the *tube*, and the cylindrical *throat*, are, each of them, fhorter in proportion to the *fheath*, and to the *limb*, than in the fcarlet kind. The *leaves* in both are long, erect, and fcarcely thickened at the edges, having more of a midrib than the feveral foregoing fpecies. The *fpathas*, in the fcarlet variety, are not much above half the length of the flender *tube*, which is about two-thirds as long as the greatly-extended, cylindrical, curved, and ftrongly deflexed *throat*. The latter exceeds the length of the elliptical, acute, recurved, nearly equal, fegments of the *limb*. *Anthers* violet. *Stigmas* cloven half way down, divaricated.

8. W. *Meriana*. Red Watfonia. Ker in Ann. of Bot. n. 11. Curt. Mag. t. 1194. Ait. n. 8. (Watfonia; Mill. Ic. t. 276. Antholyza Meriana; Linn. Sp. Pl. 54. Curt. Mag. t. 418. Gladiolus Merianus; Willd. Sp. Pl. v. 1. 214. Vahl Enum. v. 1. 94. Jacq. Ic. Rar. t. 230. Redout. Liliac. t. 11. Meriana flore rubello; Trew. Ehret. t. 40.)

β. W. angufta; Ker Ann. of Bot. n. 9. (G. Merianæ var. Jacq. Ic. Rar. t. 231.) — Throat of the corolla curved, rather longer than the tube, and longer than the obtufe limb; tube longer than the fpatha. Leaves fword-fhaped, erect, with a prominent midrib.—Native of the Cape of Good Hope. Raifed from feed, before 1750, in Chelfea garden, by Miller, who firft gave it the name of *Watfonia*. A large and handfome fpecies nearly akin to the laft, but fufficiently diftinct, and characterized by the blunt fegments of its *corolla*. The proper hue of the *flowers* is a peculiar falmon-coloured red, rather than a fcarlet, as may be feen in Miller's and Jacquin's figures, and efpecially Curtis's t. 418. But the *corolla* varies in this refpect, as well as in fize, of which the two extremes are the Botan. Mag. t. 1194, and Jacq. Ic. Rar. t. 231. The latter, which we have never feen in England, was referred to this fpecies by the late Mr. Dryander, from a drawing fent by Jacquin, how juftly can only be a matter of opinion, unlefs living fpecimens were accurately compared. The fpecies before us flowers with other Cape bulbs in May and June, increafing plentifully by offsets.

9. W. *humilis*. Crimfon Watfonia. Mill. Ic. t. 297. f. 2. Ker in Curt. Mag. t. 631. 1195. Ait. n. 9. (Gladiolus laccatus; Jacq. Ic. Rar. t. 232. Willd. Sp. Pl. v. 1. 215.)—Throat of the corolla curved, rather longer than the acute limb; tube the length of the fpatha. Leaves fword-fhaped, erect, with a prominent midrib.—Native of the Cape of Good Hope, from whence the feeds were obtained by Miller, in 1754. Much fmaller than feveral of the laft defcribed, being feldom above a foot high,

high, with linear *leaves*. The *flowers* are of a crimſon, or roſe-coloured, hue, not verging towards a ſcarlet, or tawny red. They vary in ſize, as may be ſeen by the two figures in the Botanical Magazine. The *throat* is correctly cylindrical; tube generally ſhorter than the *ſpatha*, not longer. We are obliged to content ourſelves with the above ſpecific characters, founded on the proportion of theſe parts, for want of better. Mr. Ker and Mr. Dryander have done much towards the correct diſcrimination of genera and ſpecies in this favourite tribe, but the ſubject is far from being exhauſted.

10. W. *roſeo-alba*. Long-tubed Watſonia. Ker in Curt. Mag. t. 537. Ait. Epit. 376. (Gladiolus roſeoalbus; Jacq. Hort. Schoenbr. v. 1. 7. t. 13. Vahl Enum. v. 2. 93.)

β. Variegated with red. Ker in Curt. Mag. t. 1193. Ait. Epit. 376.—Tube about twice the length of the throat, limb, or ſpatha, making nearly a right angle with the throat. Leaves ſword-ſhaped, with a midrib.—Native of the Cape of Good Hope. The *tube* is one and a half or two inches long, erect; throat ſuddenly deflexed, cylindrical, rather ſlender, an inch long; ſegments of the limb lanceolate, acute, the length of the throat. *Anthers* but juſt projecting out of the mouth of the flower, violet-coloured. *Stigmas* in linear ſegments. The *corolla* is either cream-coloured, with roſe-coloured tints about the mouth and throat, or fleſh-coloured blotched with ſcarlet, or all over crimſon. The *flowers* are more numerous and crowded than in *W. Meriana* and its allies. We cannot doubt the diſtinctneſs of this ſpecies.

11. W. *aletroides*. Aletris-flowered Watſonia. Ker in Ann. of Bot. n. 7. Ait. n. 10. Curt. Mag. t. 533. (Gladiolus tubuloſus; Jacq. Ic. Rar. t. 229. Antholyza tubuloſa; Andr. Repoſ. t. 174. A. Merianella; Curt. Mag. t. 441, excluding the reference to Miller.)—Throat deflexed, four times as long as the ſegments of the limb.—Found at the Cape of Good Hope by Mr. Maſſon, who ſent bulbs to Kew garden in 1774. This elegant ſpecies bears numerous drooping *flowers*, of a rich crimſon, ſometimes ſpeckled with a darker tint, or with white, and remarkable for their ſmall ſlightly-ſpreading *limb*, ſo ſhort in proportion to the long tubular deflexed *throat*, that they reſemble the flowers of an *Aletris* or *Aloe*. The *leaves* are ſword-ſhaped, narrow, with a central rib not very ſtrongly marked, and ſeveral ſmall lateral ones.

12. W. *ſtrictiflora*. Straight-flowered Watſonia. Ker in Curt. Mag. t. 1406. Ait. Epit. 376.—Tube thread-ſhaped, twice the length of the ſpatha; throat erect, very ſhort, ſlightly dilated; ſegments of the limb elliptical, obtuſe, half the length of the tube. Leaves ſword-ſhaped, with a prominent midrib.—Native of the Cape of Good Hope, from whence it was imported by the honourable W. Herbert. The *ſtem* is about twelve or eighteen inches high, with ſeveral ſhortiſh taper-pointed *leaves* at the bottom, and bears about two handſome crimſon *flowers*, reſembling ſome of the larger *Ixiæ*, in the ſhape, ſize, and poſture of the *limb*, with a very long ſtraight ſlender *tube*. *Stigmas* divided, as in true *Watſoniæ*, the only character in which this plant anſwers to the genus. On the contrary, *Gladiolus Watſonius*, Jacq. Ic. Rar. t. 233. Willd. Sp. Pl. v. 1. 214. Ait. v. 1. 96. Curt. Mag. t. 450 and 569, (ſee Gladiolus,) has every character and appearance of a *Watſonia*, even a regular *flower*, except the narrow deeply cloven *ſtigmas*. We are obliged, therefore, to confeſs, that theſe genera do not at preſent reſt on any natural diſtinction, however different ſome of their ſpecies may be from each other.

WAT-TAUPAUMENE, or St. Peter, in *Geography*, a river of North America, which runs into the Miſſiſſippi, N. lat. 44° 42′. W. long. 93° 38′.

WATTEAU, Anthony, in *Biography*, one of the moſt agreeable painters of the French ſchool, was born at Valenciennes in 1684. His parents were in indigent circumſtances, and he was placed with an obſcure artiſt in his native city, to cultivate a talent which manifeſted itſelf early. When he was about 16 years old, having already ſurpaſſed his preceptor, he connected himſelf with a ſcene-painter on his way to Paris, and for ſome time aſſiſted his aſſociate in decorating the opera-houſe in that city. When this engagement was completed Watteau found it difficult to reſcue himſelf from the obſcurity and embarraſſment into which he fell, when happily he became acquainted with Claude Gillot, a painter of groteſque and fabulous ſubjects, who was pleaſed with his works and diſpoſition. Gillot afforded him an aſylum in his own houſe, and then inſtructed him in all he knew of the art, and found an apt and agreeable ſcholar in his protegée. With the help he thus received from Gillot, and his own admiration and attentive ſtudy of the Luxembourg gallery, he formed a taſte for colouring, which if not as grand, is at leaſt as agreeable, as ever was employed by any one.

He attempted to prepare himſelf for hiſtorical painting, and ſtudied at the academy with that view; he even was ſo ſucceſsful as to obtain the firſt prize there for an hiſtorical picture; but happily he diſcovered a character of ſubject quite original and exactly ſuited to his taſte, for which he wiſely deſerted hiſtory, and which has ſince formed plenty of aſpirants, but has never been ſo ſucceſsfully practiſed. The theatre, the opera, fêtes champetres, maſquerades, pantomimes, puppet-ſhows, afforded him his figures; the gardens of the Luxembourg and of the Thuilleries, of Verſailles and St. Cloud, furniſhed the ſcenes. In theſe nature prevails only in the colouring, and that is exquiſite, rich, delicate, clear, and full; bright without gaudineſs, and deep without blackneſs; laid on with a freedom, fulneſs, and delicacy of touch, which no one ever ſurpaſſed; but the airs of his figures are generally affected to the higheſt degree; people of rank and faſhion, aping the enjoyments of rural life: and when he attempted to paint domeſtic or rural ſcenes, he carried the ſame taſte into his practice. The true character of Watteau's pictures is French gentility, gay, cheerful, debonnaire, of which ſelf-ſatisfaction is the ſureſt baſis. "In his halts and marches of cavalry, the careleſs ſtrut of his ſoldiers retains the air of a nation that aſpires to be agreeable as well as victorious." Watteau viſited England in the reign of George I., but did not enjoy his health here, and returned to France in about a year, where he died in 1721, at the early age of 37.

WATTEN, in *Geography*, a town in Scotland, in the county of Caithneſs; 7 miles N.W. of Wick.—Alſo, a town of France, in the department of the North, on the Aa; 4 miles N. of St. Omer.

WATTENSCHIED, a town of Germany, in the county of Mark; 5 miles S.W. of Bockum.

WATTER, a river which riſes in the county of Waldeck, and runs into the Erpe, near Volckmarſen.

WATTERPUTTEN, a town of Hindooſtan, in Concan; 5 miles S. of Geriah.

WATTINAD, a town of Hindooſtan, in the Carnatic; 20 miles S.S.E. of Tanjore.

WATTLE, in *Agriculture* and *Rural Economy*, a kind of hurdle formed by means of ſplit wood, or ſmall rods, and uſed for making folds for ſheep. The term alſo ſignifies a fleſhy excreſcence growing from under the top of the throats of of animals, ſuch as the cock, turkey, and ſome others. See HURDLE.

WATTLE-*Bird*. See GLAUCOPIS *Cinerea*.

WATTLES, in *Rural Economy*, a term applied, in ſome places, to the rods that are laid upon a roof to be thatched on. This is found an uſeful and cheap mode for farm buildings in ſome of the ſouthern diſtricts. See THATCHING.

WATTON, in *Geography*, a ſmall market-town in the hundred of Wayland and county of Norfolk, England, is ſituated on the confines of what is called the Filand, or open part of the county, at the diſtance of 21 miles W. by S. from Norwich, and 91 miles N.N.E. from London. Since the making of the turnpike-road through the hundred, Watton has become a place of conſiderable thoroughfare. It has three annual fairs, and a reſpectable weekly market on Wedneſdays. Great quantities of butter are ſent hence for the ſupply of the London markets. In the enumeration of the population for the year 1811, the pariſh was ſtated to contain 177 houſes, with a population of 794 perſons. The church is very ſmall, being only twenty yards long and eleven broad: the tower is round at the bottom, and octangular at the top. Blomefield was induced, from the appearance of the church, to ſuppoſe it was erected ſo early as the reign of Henry I. It ſtands at a diſtance from the town, near the ſcite of the old manorial houſe; and was evidently ſo placed to accommodate the tenants of the ſeveral hamlets belonging to the manor. On the 25th of April 1673, a dreadful fire happened in the town, when above ſixty houſes were burnt down, beſides outhouſes, &c. to the damage of 7450*l*., and goods to the further value of 2660*l*.: for which a brief was granted to collect throughout England for two years.—Blomefield's Eſſay towards a Topographical Hiſtory of Norfolk, vol. 2. 8vo. 1805. Beauties of England and Wales, vol. xi. Norfolk. By Rev. J. Evans, and J. Britton, F.S.A.

WATTS, ISAAC, D.D. in *Biography*, a Nonconformiſt divine, eminently diſtinguiſhed for talents and piety, was born at Southampton in 1674, where, under the tuition of a clergyman of the eſtabliſhed church, he made rapid progreſs in the Latin and Greek languages, and acquired ſome knowledge even of Hebrew. When it was propoſed by ſome gentlemen who were apprized of his proficiency, to bear the charges of his education in one of the Engliſh univerſities, he declared his purpoſe of continuing among the Diſſenters, though his father, who was of that profeſſion, had often ſuffered perſecution; and at the age of ſixteen he was placed under the care of the Rev. Thomas Rowe, who kept an academy in London. Twenty-two Latin diſſertations on metaphyſical and theological ſubjects, found among his papers, afford ample evidence of his zealous application during his connection with this inſtitution. Of his poetical talents at the early age of fifteen years ſeveral ſpecimens have been preſerved, and more particularly a Pindaric ode, addreſſed to his preceptor Mr. Pinhorne. At the age of twenty he finiſhed his academical ſtudies, and reſided with his father for two years with a view to farther improvement. At this time he was invited to become private tutor to the ſon of ſir John Hartopp, bart. at Stoke-Newington near London, and in this ſituation he continued for five years, gaining univerſal eſteem, cultivating a friendſhip with his pupil which laſted through life, and connecting with the diſcharge of his office the ſtudy of the ſcriptures in the original languages. Although he was well qualified for the public exerciſe of his miniſtry, ſuch was his diffidence that he would not venture to aſcend the pulpit till he had completed his twenty-fourth year, at which time he was choſen aſſiſtant to Dr. Iſaac Chauncy, whom he ſucceeded as paſtor in the year 1702. His conſtitution was ſo delicate that he could not undertake the whole ſervice, and the attack of a fever in 1712 diſqualified him for his public duties for four years. In this ſtate of debility he was kindly received in the houſe of ſir Thomas Abney, where the indulgent treatment of this gentleman and his lady contributed to reſtore his health and ſpirits. In this hoſpitable manſion he not only found a temporary aſylum, but a permanent abode for the remaining thirty-ſix years of his life. Here he enjoyed every comfort which friendſhip and liberality could beſtow, and which, by repairing his enfeebled frame, enabled him to reſume his ſervices in public and to proſecute his private ſtudies, no leſs to the improvement and ſatisfaction of thoſe with whom he was immediately connected, than to the benefit of the world; inſomuch that few perſons have acquired a more extenſive and a more permanent popularity, as it reſpects the intereſts both of literature and of religion. His reputation attracted the notice of both the univerſities of Edinburgh and Aberdeen, and they ſeemed to vie with each other which ſhould firſt confer upon him the honour of the degree of doctor in divinity, and he received it from theſe two univerſities in the year 1728. His conſtitution, though in ſome degree renovated by the attention and kindneſs which he experienced, was ſtill ſo delicate and feeble, that he found it neceſſary to remit, and at length to reſign his miniſterial duties; but his congregation teſtified their reſpect for him by declining to accept his offer of the renunciation of his uſual ſalary: However, he gradually declined, and calmly expired at Stoke Newington, November the 25th, 1748, in the 75th year of his age.

Dr. Watts was a man of lively fancy, warm feelings, and a comprehenſive underſtanding, and diſtinguiſhed by that verſatility of talents and purſuits, which enabled him to acquire a conſiderable degree of reputation in various departments of literature, but which prevented his arriving at a ſupereminent rank in any. The characteriſtic quality of his mind, manifeſted in his numerous productions, was a devotional ſpirit. Of his "Horæ Lyricæ," the greateſt number belongs to the devotional claſs, and in theſe his ardent feelings and imagination have ſometimes tranſported him beyond the bounds which a correct taſte and ſound judgment would have preſcribed. The ſame obſervation may be alſo applied to his "Pſalms and Hymns," and more eſpecially to the latter, which were juvenile compoſitions, and in which a ſober reader will be diſguſted with the contraſt that is exhibited between the wrath of the Supreme Being and the benignity of the Son of God; as if the Deity were inclined to puniſh his offending creatures with everlaſting puniſhment, and the Son were diſpoſed to reſcue and ſave them. Many of the pſalms and hymns, however, are admirably adapted to Chriſtian worſhip, and a ſelect collection of them, which has been lately made by ſome miniſters in London, and which they have enriched by extracts from other ſources, is leſs exceptionable in a variety of reſpects than either the pſalms or hymns even of Dr. Watts in their original ſtate; and in theſe devotion and poetry are more happily combined for the worſhip of Diſſenters and even of Churchmen than in the pſalmody of the eſtabliſhment. Many of Watts's lyric productions poſſeſs conſiderable poetical merit, and diſplay a fertility and elegance of fancy. His "Divine Songs for Children" have been widely circulated, and are well calculated to intereſt and impreſs youthful minds; and they are, generally ſpeaking, unexceptionable, though not incapable of caſtigation and improvement.

The doctor's philoſophical publications are numerous, and moſt of them are well known. Among theſe we may reckon his "Logic," and the ſupplement to it, entitled the "Improvement of the Mind;" "A Diſcourſe on Education;" "An Elementary Treatiſe on Aſtronomy and Geography;" "Philoſo-

"Philofophical Effays on various Subjects, with Remarks on Locke's Effay on the Human Underftanding;" and "A brief Scheme of Ontology." His other works are chiefly theological, confifting of Sermons, Difcourfes, Effays, and Controverfial Tracts, &c. His fcheme of theology was undoubtedly that which is ufually called orthodoxy, and, to fay the leaft of it, approaching to Calvinifm. His temper, however, was kind and gentle, and his moderation was increafing as he advanced in years, and the maturity of his judgment reftrained and controlled the fervour of his feelings and paffions. Some have faid that towards the clofe of life his fentiments, with regard to the doctrine of the Trinity, were materially altered. This, however, is a queftion *fub judice.* Whilft it is needlefs in this place to enter into the difpute, and to examine the allegations *pro* and *con*, we incline to think, as far as we have had an opportunity of examining the evidence, that the fuppofition of fome degree of change is not improbable. The printed Works of Dr. Watts, together with thofe which were left in M.S. for the revifion of Dr. Jennings and Dr. Doddridge, were publifhed collectively by Dr. Gibbons, in 6 vols. 4to. 1754. We fhall conclude this article with the words of one of his biographers. "To whatever clafs Dr. Watts belongs," ranked by this biographer among the decided advocates for orthodoxy, "he muft always be regarded as one of thofe whofe whole heart was devoted to the promotion of the beft interefts of mankind, and whofe life would have done honour to any fyftem of opinions." Gibbons's Memoirs of Watts. Johnfon's Lives of the Poets. Gen. Biog.

WATTS, in *Geography*, a town of Virginia; 30 miles N.W. of Alexandria.—Alfo, a town of the ftate of Georgia. N. lat. 34° 22′. W. long. 86° 25′.

WATTS *Ifland*, a fmall ifland in the Chefapeak. N. lat. 37° 54′. W. long. 76° 3′.

WATTUSKIFLET, a channel of the Baltic, between the ifland of Aland and the coaft of Finland, abounding with fmall iflands.

WATWEILER, or WATTERWEILER, a town of France, in the dapartment of the Upper Rhine. Near it is a medicinal fpring; 16 miles S. of Colmar.

WAU, a town of Hindooftan, in the circar of Werrear; 24 miles N. of Radunpour.

WAU-CA-HATCHO, or COW-TAIL *River*, a river of Louifiana, which is the laft ftream of any confequence that enters the Sabine.

WAVE, UNDA, in *Phyfics*, a cavity in the furface of the water, or other fluid, with an elevation on its fides. Or, it is a volume of water elevated by the action of the wind upon its furface, into a ftate of fluctuation.

The origin of waves may be thus conceived. The furface of a ftanding water being naturally plain, and parallel to the horizon, (allowing for that fmall degree of curvature which refults from its gravitation to the centre,) if by any means it be rendered hollow, as at A, (*Plate* XV. *Hydraulics*, *fig.* 11.) its cavity will be furrounded with an elevation B B; for if a certain quantity of water be depreffed below the ufual level, an equal quantity muft rife in fome other place above that level, and the water which ftands clofeft to the place of the original impreffion will of courfe be moved. The raifed water will defcend by its gravity, and, with the celerity acquired in defcending, will form a new cavity; by which motions, the water will afcend at the fides of this cavity, and fill the cavity A, while there is a new elevation towards C; and, when this laft is depreffed, the water rifes anew towards the fame part. Thus arifes a fucceffive motion in the furface of the water; and a cavity, which carries an elevation before it, is moved along from A, towards C. Thus the alternate rifing and falling of the water in ridges will extend all round the original fource of motion; but as they recede from that place, fo the ridges, as well as the adjoining hollows, become fmaller and fmaller, until they vanifh. This diminution of fize is produced by three caufes; *viz.* by the want of perfect freedom of motion amongft the particles of water, by the refiftance of the air, and by the further ridges being larger in diameter than thofe which are nearer. It is likewife on account of the friction, or adhefion, among the particles of water, and of the refiftance of the air, that, in the fame place, the alternate elevations and depreffions diminifh gradually, until the water reaffumes its original tranquillity, unlefs the external impreffion be renewed or continued. This cavity, with the elevation next it, is called a *wave;* and the fpace taken up by the wave on the furface of the water, and meafured according to the direction of the wave's motion, is called the *breadth of the wave;* which is evidently equal to the diftance between the tops of contiguous ridges, or between the loweft parts of two contiguous hollows; and a wave is faid to *have run its breadth*, when its elevated part is arrived at the place where the elevated part of the next wave ftood before, or (the fituations of two contiguous waves being given) when one of them is arrived at the place of the other; and the time which is employed in this tranfition is called *the time of a wave's motion.*

WAVES, *the Motion of*, forms an article in the new philofophy; and its laws being now pretty well determined, we fhall give the reader the fubftance of what is taught on this fubject.

1. The cavity, as A, is encompaffed every way with an elevation; and the motion above-mentioned expands itfelf every way: therefore the waves are moved circularly.

2. Suppofe, now, A B (*fig.* 12.) an obftacle, againft which the wave, whofe beginning is at C, ftrikes; and we are to examine what change the wave fuffers in any point, as E, when it is come to the obftacle in that point. In all places through which the wave paffes in its whole breadth, the wave is raifed; then a cavity is formed, which is again filled up; which change while the furface of the water undergoes, its particles go and return through a fmall fpace: the direction of this motion is along C E, and the celerity may be reprefented by that line. Let this motion be contrived to be refolved into two other motions, along G E and D E, whofe celerities are refpectively reprefented by thofe lines. By the motion along D E, the particles do not act againft the obftacle; but, after the ftroke, continue their motion in that direction with the fame celerity; and this motion is here reprefented by E F, fuppofing E F and E D to be equal to one another; but by the motion along G E, the particles ftrike directly againft the obftacle, and this motion is deftroyed: for though the particles are elaftic, yet, as in the motion of the waves they run through but a fmall fpace, going backward and forward, they proceed fo flowly, that the figure of the particles cannot be changed by the blow; and fo are fubject to the laws of percuffion of bodies perfectly hard. See PERCUSSION.

But there is a reflection of the particles from another caufe: the water which cannot go forward beyond the obftacle, and is pufhed on by that which follows it, gives way where there is the leaft refiftance; that is, it afcends; and this elevation, which is greater in fome than other places, is caufed by the motion along G E; becaufe it is by that motion alone that the particles impinge againft the obftacle. The water, by its defcent, acquires the fame velocity with which it was raifed; and the particles of water are repelled from the obftacle with the fame force in the direction E G,

 as

as that with which they ftruck againft the obftacle. From this motion, and the motion above-mentioned along E F, arifes a motion along E H, whofe celerity is expreffed by the line E H, which is equal to the line C E; and by the reflection, the celerity of the wave is not changed, but it returns along E H, in the fame manner as if, taking away the obftacle, it had moved along E *h*.

If from the point C, C D be drawn perpendicular to the obftacle, and then produced, fo that D *c* fhall be equal to C D, the line H E continued will go through *c*; and as this demonftration holds good in all points of the obftacle, it follows, that the reflected wave has the fame figure on that fide of the obftacle, as it would have had beyond the line A B, if it had not ftruck againft the obftacle. If the obftacle be inclined to the horizon, the water rifes and defcends upon it, and fuffers a friction, by which the reflection of the wave is difturbed, and often wholly deftroyed; and this is the reafon why very often the banks of rivers do not reflect the waves.

If there be a hole, as I, in the obftacle B L, the part of the wave which goes through the hole, continues its motion directly, and expands itfelf towards Q Q; and there is a new wave formed, which moves in a femicircle, whofe centre is the hole. For the raifed part of the wave, which firft goes through the hole, immediately flows down a little at the fides; and, by defcending, makes a cavity which is furrounded with an elevation on every part beyond the hole, which moves every way in the fame manner as was laid down in the generation of the firft wave.

In the fame manner, a wave to which an obftacle, as A O, is oppofed, continues to move between O and N, but expands itfelf towards R, in a part of a circle, whofe centre is not very far from O. Hence, we may eafily deduce what muft be the motion of a wave behind an obftacle, as M N.

Waves are often produced by the motion of a tremulous body, which alfo expand themfelves circularly, though the body goes and returns in a right line; for the water which is raifed by the agitation, defcending, forms a cavity, which is every where furrounded with a rifing.

Different waves do not difturb one another, when they move according to different directions. The reafon is, that whatever figure the furface of the water has acquired by the motion of the waves, there may in that be an elevation and depreffion; as alfo fuch a motion as is required in the motion of a wave.

To determine the celerity of the waves, another motion, analogous to their's, muft be examined. Suppofe a fluid in the bent cylindric tube E H (*fig.* 13.); and let the fluid in the leg E F be higher than in the other leg by the diftance *l* E; which diftance is to be divided into two equal parts at *i*. The fluid, by its gravity, defcends in the leg E F, while it afcends equally in the leg G H; fo that when the furface of the fluid is arrived at *i*, it is at the fame height in both legs; which is the only pofition in which the liquid can be at reft: but by the celerity acquired in defcending, it continues its motion, and afcends higher in the tube G H; and in E F is depreffed quite to *l*, except fo much as it is hindered by the friction againft the fides of the tube. The fluid in the tube G H, which is higher, alfo defcends by its gravity, and fo the fluid in the tube rifes and falls, till it has loft all its motion by the friction.

The quantity of matter to be moved is the whole fluid in the tube; the moving force is the weight of the column *l* E, whofe height is always double the diftance E *i*; which diftance, therefore, increafes and diminifhes in the fame ratio with the moving force. But the diftance E *i* is the fpace to be run through by the fluid, in order to its moving from the pofition E H, to the pofition of reft; which fpace, therefore, is always as the force continually acting upon the fluid: but it is demonftrated, that it is on this account that all the vibrations of a pendulum, ofcillating in a cycloid, are ifochronal; and, therefore, here alfo, whatever be the inequality of the agitations, the fluid always goes and returns in the fame time. The time in which a fluid thus agitated afcends, or defcends, is the time in which a pendulum vibrates, whofe length is equal to half the length of the fluid in the tube, or to half the fum of the lines E F, F G, E H. This length is to be meafured in the axis of the tube. See PENDULUM.

From thefe principles, to determine the celerity of the waves, we muft confider feveral equal waves following one another immediately; as A, B, C, D, E, F, (*fig.* 14.) which move from A towards F: the wave A has run its breadth, when the cavity A is come to C; which cannot be, unlefs the water at C afcends to the height of the top of the wave, and again defcends to the depth C; in which motion, the water is not agitated fenfibly below the line *b i*: therefore, this motion agrees with the motion in the tube above-mentioned; and the water afcends and defcends, that is, the wave goes through its breadth, while a pendulum of the length of half B C performs two ofcillations, or while a pendulum of the length B C D, that is, four times as long as the firft, performs one vibration; fince the times in which pendulums of different lengths perform their vibrations are as the fquares of their lengths. (See VIBRATION.) Therefore, the celerity of the wave depends upon the length of the line B C D; which is greater, as the breadth of the wave is greater, and as the water defcends deeper in the motion of the waves. In the broadeft waves, which do not rife high, fuch a line as B C D does not much differ from the breadth of the wave; and in that cafe a wave moves its breadth, while a pendulum, equal to that wave, ofcillates once. Hence, if the breadth of a wave be 39.1196 inches, (this being the length of a pendulum which vibrates feconds,) then that wave will move on at the rate of 39.1196 inches *per* fecond of time; that is, at the rate of 195 feet *per* minute, nearly.

In every equable motion, the fpace gone through increafes with the time and the celerity; wherefore, multiplying the time by the celerity, you have the fpace gone through; whence it follows, that the celerities of the waves are as the fquare roots of their breadths: for as the times in which they go through their breadths are in that ratio, the fame ratio is required in their celerities, that the products of the times, by their celerities, may be as the breadths of the waves, which are the fpaces gone through.

Dr. Young is of opinion, that fir Ifaac Newton's analogy, refulting from a comparifon of a wave with the ofcillation of a fluid in a bent tube, is too diftant to admit our founding any demonftration upon it. Legrange, he fays, has inveftigated the motions of waves in a new and improved manner; and Dr. Young has alfo demonftrated a theorem fimilar to his, but, as he apprehends, more general and explicit. From thefe premifes it appears, that, fuppofing the fluids concerned to be infinitely elaftic, that is, abfolutely incompreffible, and free from friction of all kinds, any fmall impulfe communicated to a fluid would be tranfmitted every way along its furface, with a velocity equal to that which a heavy body would acquire in falling through half the depth of the fluid; and he concludes, from obfervation and experiment, that where the elevation or depreffion of the furface is confiderably extenfive in proportion to the depth, the velocity approaches nearly to that which is thus deter-

mined,

mined, being frequently deficient one-eighth or one-tenth only of the whole. In other cafes, where a number of fmall waves follow each other at intervals confiderably lefs than the depth, he has endeavoured to calculate the retardation which muft be occafioned by the imperfect elafticity or compreffibility of the fluid; but it feems probable that the motion of fmall waves is ftill much flower than this calculation appears to indicate. Many of the phenomena of waves, fays this ingenious author, may be very conveniently exhibited by means of a wide and fhallow veffel, with a bottom of glafs, terminated by fides inclined to the horizon; in order to avoid the confufion which would arife from the continual reflections produced by perpendicular furfaces. The waves may be excited by the vibrations of an elaftic rod or wire, loaded with a weight, by means of which its motions may be made more or lefs rapid at pleafure; and the form and progrefs of the waves may be eafily obferved, by placing a light under the veffel, fo that their fhadows may fall on a white furface, extended in an inclined pofition. In this manner, the manifeft inflection of the furface of the water may be made perfectly confpicuous.

This motion of the fea-water depends greatly on the winds, and on the fituation of mountains, in regard to the fea; for the winds are driven back from thefe with great impetuofity; and in fome places this occafions a great and very irregular undulation, befide that which is produced by the immediate action of the winds on the furface of the water in their own direct courfe.

Waves are to be confidered as of two kinds, and thefe may be diftinguifhed from one another by the names of *natural* and *accidental* waves.

The *natural* waves are thofe which are regularly proportioned in fize to the ftrength of the wind, whofe blowing gives origin to them. The *accidental* waves are thofe occafioned by the wind's reacting upon itfelf by repercuffion from hills and mountains, or high fhores, and by the wafhing of the waves themfelves, otherwife of the natural kind, againft rocks and fhoals: all thefe caufes give the waves an elevation, which they can never have in their natural ftate.

It feems to be pretty well determined, from a variety of experiments and obfervations, that the moft violent wind never penetrates a great way into the water; and that in great ftorms the water of the fea is flightly agitated at the depth of 20 feet below the ufual level, and probably not moved at all at the depth of 30 feet, or 5 fathoms; confequently the natural difplacing of the waters by the wind cannot be fuppofed to reach nearly fo low: and hence it fhould feem, that the greateft waves could not be fo very high as they are reprefented by accurate and creditable navigators. Mr. Boyle found, upon inquiry, that when the wind was high, fo that the waves were manifeftly fix or feven feet high above the furface of the water, no fign of agitation was perceived at the depth of 15 fathoms; but if the blaft continued long, then the mud at the bottom was ftirred, and the water became thick and dark. Perfons who have remained for fome time at a confiderable depth have been furprifed to find a ftorm, when they have returned to the upper parts of the water. At the depth of 12 or 15 feet, the agitation of the water has been accordingly diminifhed; and at a confiderable diftance from the fhore, and in deeper water, the fea has been found proportionably calm and tranquil. It has alfo been found, that in a part of the fea often tempeftuous, the ftorm did not reach with any efficacy four fathoms beneath the furface of the water. Boyle's Works, vol. iv. p. 354, 4to. Relations about the Bottom of the Sea, § 3.

Count Marfigli meafured carefully the elevations of the waves near Provence, and found that, in a very violent tempeft, they arofe only to feven feet above the natural level of the fea; and this additional foot in height, above the refult of Mr. Boyle's deductions, he eafily refolved into the accidental fhocks of the water againft the bottom, which was, in the place he meafured them in, not fo deep as to be out of the way of affecting the waves; and he allows that the addition of one-fixth of the height of a wave, from fuch a difturbance from the bottom, is a very moderate alteration from what would have been its height in a deep fea; and concludes, that Mr. Boyle's calculation holds perfectly right in deep feas, where the waves are purely natural, and have no accidental caufes to render them larger than their juft proportion.

In deep water, under the high fhores of the fame part of France, this author found the natural elevation of the waves to be only five feet; but he found alfo that their breaking againft rocks, and other accidents to which they were liable in this place, often raifed them to eight feet high.

We are not to fuppofe, from this calculation, that no wave of the fea can rife more than fix feet above its natural level in open and deep water; for waves immenfely higher than thefe are formed in violent tempefts in the great feas. Thefe, however, are not to be accounted waves in their natural ftate, but they are fingle waves formed of many others; for in thefe wide plains of water, when one wave is raifed by the wind, and would elevate itfelf up to the exact height of fix feet, and no more, the motion of the water is fo great, and the fucceffion of waves fo quick, that, during the time this is rifing, it receives into it feveral other waves, each of which would have been at the fame height with itfelf: thefe run into the firft wave one after the another, as it is rifing; and by this means its rife is continued much longer than it naturally would have been, and it becomes accumulated to an enormous fize. A number of thefe complicated waves arifing together, and being continued in a long fucceffion by the continuation of the ftorm, makes the waves fo dangerous to fhips, which the failors in their phrafe call mountains high. Marfigli, Hift. Phyf. de la Mer.

When it blows frefh, the waves not moving with fufficient rapidity, their tops, which are thinner and lighter, are impelled forward, broken, and changed into a white foam, particles of which, called the "fpray," are carried a great way. Waves, with regard to their form, are circular or ftraight, or otherwife bent, according as the original impreffion is made in a narrow fpace nearly circular, or in a ftraight line, or in other configurations. In open feas the waves generally are in the fhape of ftraight furrows, becaufe the wind blows upon the water in a parallel manner, or at leaft for a long apparent tract. The fame caufes which raife water into waves muft evidently produce the like effect on other fluids, but in various degrees, as the fluid is more or lefs heavy, as its particles adhere more or lefs forcibly to each other, and probably likewife as there is a greater or lefs degree of attraction between the fluid and the other body which gives it the impulfe. If it be attempted to raife waves upon oil by the force of wind, it will be found very difficult to fucceed in a fimilar degree. This difficulty is probably owing to the natural attraction of the particles of oil; and befides, there may be lefs attraction between oil and air than between the latter and water, for water always contains a certain quantity of air; and if it be deprived of that air by boiling, or otherwife, a fhort expofure to the atmofphere will enable the water to reimbibe it. It is likewife probable, that the furface of water, even when ftag-

nant,

nant, may not be fo fmooth as the furface of oil, fo that the wind may more eafily catch into the inequalities of the former than the latter. Hence it is that the effect of the wind upon waves may in a great degree be prevented or moderated, by fpreading a thin film of oil on the furface of the water. For an account of this operation and its effects, fee OIL.

WAVE-*Offering*, among the *Jews*, a facrifice offered by agitation or waving towards the four cardinal points.

To WAVE, is ufed, in the *Sea-Language*, for the making figns for a veffel to come near, or keep off.

WAVED, or WAVY, a term in *Heraldry*, when a bordure, or any ordinary or charge in a coat of arms, has its outlines indented, in manner of the rifing and falling of waves. This is alfo called *undy*, *undé*, or *ondé*, and denotes that the firft of the family in whofe arms it ftands, acquired his honours for fea fervices, and has this peculiar commemoration of it ordered in his arms.

WAVED *Hair-Grafs*, in *Agriculture*, a fort of grafs which is found to be pretty productive on mountain heathy lands, and which abounds pretty much in nutritive matter, but which lofes confiderably in its weight in drying, according to the trials which have lately been made on graffes at Woburn. See AIRA *Flexuofa*.

WAVELLITE, in *Mineralogy*, a mineral firft difcovered at Barnftaple, in Devonfhire, by Dr. Wavell, and fince found in various other fituations. From its appearance, it has been claffed by Mr. Jamefon as a member of the zeolite family. See ZEOLITE.

Wavellite occurs in a botryoidal, ftalactical, and globular form; alfo cryftallized in very oblique four-fided prifms, flatly bevelled on the extremities: the bevelling planes are fet on the obtufe lateral edges. The prifms are fometimes deeply truncated on the obtufe lateral edges. Wavellite occurs alfo in fibres, or acicular prifms, diverging from a common centre, and either feparated or adhering laterally to each other, compofing hemifpherical concretions of various fizes, to the magnitude of a bullet. The luftre of wavellite is pearly, more or lefs fhining. The colour is yellowifh-white, greyifh-white, and greenifh-white; it is tranflucent. This mineral is brittle, and, according to profeffor Jamefon, it is fufficiently hard to fcratch quartz: others afcribe to it a lower degree of hardnefs. Before the blow-pipe it becomes foft and opaque, but neither decrepitates nor fufes. It is foluble by the affiftance of heat in the mineral acids, in which it effervefces and leaves very little refidue. The fpecific gravity of wavellite varies from 2.22 to 2.70.

The moft remarkable peculiarity of this mineral is its compofition; wavellite being nearly a pure hydrat of alumine; but fome fpecimens contain a trace of fluoric acid. When fragments of the Englifh or Irifh wavellite are laid upon a glafs plate, and a drop of fulphuric acid is added, the glafs is flightly corroded on the application of heat, indicating the prefence of the above-mentioned acid.

The conftituent parts of wavellite are given as under:

	Wavellite from Barnftaple.	
Alumine -	71.50	70
Oxyd of iron	.50	
Lime - -		1.4
Water -	28.	26.2
	100 Klaproth.	97.6 Davy.

	Cornifh Wavellite.	South American Wavellite.
Alumine -	58.70	68.
Oxyd of iron	0.19	1.
Lime -	0.37	
Silex -	6.12	4.50
Water -	30.75	
Lofs -	3.87	26.50
	100 Gregor.	100 Klaproth.

Wavellite occurs in veins in the granite of Cornwall, with fluor-fpar, quartz, tin-ftone, and copper pyrites. At Barnftaple, in Devonfhire, it occurs in foft flate. Several mineralogifts confider wavellite as a variety of the fame mineral, which Hauy has called diafpore.

WAVENEY, in *Geography*, a river of England, in the county of Suffolk, which joins the Yare, at its mouth.

WAVEREN, a town of France, in the department of the Scheld, on the Dyle. By war and accidental fires much decayed; 12 miles S. of Louvain.

WAVERS, in *Rural Economy*, a term ufed to fignify the young timber-trees, or timberlings as they are moftly called, that are left ftanding for further growth, in felling or cutting over woods of different kinds. See TIMBER.

WAVESON, in the *Admiralty-Law*, a term ufed for fuch goods, as, after fhipwreck, appear fwimming on the waves.

WAVIGNIES, in *Geography*, a town of France, in the department of the Oife; 10 miles N. of Clermont.

WAUKEAGUE, a town of the diftrict of Maine, near the coaft; 5 miles W. of New Briftol.

WAUNGLY, a town of Hindooftan, in Vifiapour; 10 miles S.E. of Currer.

WAVY, in *Botany*, is fynonymous with *repandum* and *undulatum*; in the firft inftance, it expreffes an undulating outline, with an even furface; in the fecond, an undulating furface, caufed by the marginal region of a leaf, or petal, being more ample or luxuriant than the central part, or bafe. The latter is often the cafe with cultivated plants, as *Malva crifpa*, and the different curled varieties of cabbage, brocoli, parfley, mint, &c.

WAVY, in *Heraldry*. See WAVED.

WAWAY, in *Geography*, a fmall ifland in the Eaft Indian fea, near the E. coaft of the ifland of Celebes, about 40 miles in circumference. S. lat. 4° 8′. E. long. 123° 30′.

WAWARSING, a large townfhip of New York, in the fouth-weft angle of Ulfter county, 25 miles S.W. of Kingfton, erected in 1806, from the S.W. part of Rochefter, and lying on the W. of the Shawangunk mountain. Plumbago, of a good quality, is found in this townfhip, and here are many indications of iron-ore. Here are feveral fmall fettlements, as at Warwafing, Napenagh, and Lurenkill; but much of the land is uncultivated. Here are one Dutch reformed church, and eight or ten fchool-houfes. In 1812, the whole population confifted of 1335 perfons, and the number of electors was 117; and here were 74 looms in families, which produced 18,047 yards of cloth.

WAWIACHTANOS, Indians of America, inhabiting chiefly between the rivers Wabafh and Sciota.

WAWRA, a fmall negro town of Africa, properly belonging to Kaarta, but when Park vifited it, tributary to Maafong, king of Bambarra. It is furrounded with walls, and inhabited by a mixture of Mandingoes and Foulahs. The inhabitants are chiefly employed in cultivating corn, which they

they exchange with the Moors for ſalt; 60 miles E.S.E. of Benowm.

WAX, a term which comprehends two or three ſubſtances, differing in their nature and origin, and yet poſſeſſing ſeveral common properties. The common properties of the animal and vegetable productions, of which we ſhall give a brief account in the ſequel of this article, are fuſibility at a moderate heat; when kindled, burning with much flame; inſolubility in water; ſolubility in alkalies, and alſo in alcohol and ether; in which two latter properties all the ſpecies of wax differ from the concrete oils, to which in other reſpects they bear a very ſtrong reſemblance. The moſt important, and moſt generally known and uſed of theſe ſubſtances, is

Bees'-wax, excreted from the body of the bee, and employed by theſe inſects in the conſtruction of their cells, both for the accommodation of their young and the depoſition of their honey. Of this ſubſtance, a young hive will yield at the end of the ſeaſon about a pound of wax; and an old hive about twice as much. The fineſt wax is that which is made in dry, heathy, or hilly countries; but in parts abounding with vineyards it is decidedly inferior. Although the commonly received notion, which aſcribes this ſubſtance to the elaboration of the pollen of flowers, which the bees viſibly collect on their thighs, had received the ſanction of obſervers not leſs diſtinguiſhed than Bonnet and Reaumur (ſee PAIN *D'Abeilles*), yet the Luſatian Society, as long ago as the year 1768, was not unacquainted with the fact, that the wax, inſtead of being diſcharged from the mouth, is ſecreted in the form of thin ſcales among the abdominal rings or ſegments. In 1792, the celebrated Mr. John Hunter detected the genuine reſervoir of the wax under the belly of the bees, and gave an account of his obſervations in the Philoſophical Tranſactions, (vol. lxxxii. part 1.). On elevating the lower ſegments, he obſerved plates of a fuſible ſubſtance, which he aſcertained to be wax; and he was convinced, that an eſſential difference ſubſiſts between the pollen, which theſe little creatures collect with ſo much care and induſtry in the form of pellets on their thighs, and the matter of which the combs are conſtructed. This curious ſubject has been further inveſtigated by Meſſrs. Huber, father and ſon; and they have demonſtrated the organs in which the wax is ſecreted, though they had eluded the perſpicuity of Swammerdam, Hunter, and other acute anatomiſts. Theſe facklets, or ſmall compartments, now minutely explained and illuſtrated by engravings, are peculiar to the working bees, which alone produce wax; and each individual is furniſhed with eight of them. The waxy matter, as it occurs in a tranſuded ſtate in the ſecretory organs, differs from the freſh wax of the combs only in being of a leſs compounded nature, which has been aſcertained by trials with ſpirit of turpentine and ſulphuric ether. Proſecuting theſe reflections, our ingenious authors concluded that the common opinion was probably erroneous; becauſe, like Hunter, they had obſerved ſwarms, newly placed in the empty hives, conſtruct their combs without fetching home any pollen; while the bees of old hives, where no freſh cells were required, nevertheleſs provided an ample ſtock of this powder. In order, however, to determine the point more directly, they confined a recent ſwarm within an empty ſtraw-hive, leaving at their diſpoſal only a ſufficiency of honey and water for their conſumption, and preventing them from going beyond the precincts of a well-cloſed room; when, in the ſhort ſpace of five days, they had conſtructed five cakes of a beautiful white though very fragile wax. This experiment was repeated, and was uniformly accompanied by ſimilar reſults; and therefore they no longer heſitated in admitting the fact, that honey, through the organic intervention of bees, may be converted into wax. In order to determine whether vegetable pollen, alſo, was ſuſceptible of this converſion, the honey was wholly removed, and the confined bees were fed on fruits and pollen, of which laſt a large ſtore was left at their diſpoſal; but, though they continued in this ſituation during eight days, they neither made any wax, nor exhibited any plates under their abdominal rings. Having ſuſpected that the ſecretion of wax originated in the coheſive principle contained in honey, our authors recurred to various experiments, which conſtantly proved that ſugar alone was an excellent ſubſtitute for honey, and, on ſome occaſions, afforded a ſuperior wax. They afterwards found, that bees, when left at perfect liberty to roam abroad, act preciſely on the ſame principle in the conſtruction of their combs; and they alſo diſcovered, that labourers of two deſcriptions exiſt in each hive. The firſt, ſuſceptible of acquiring conſiderable dimenſions, when they have received all the honey which their ſtomachs can contain, are principally deſtined to the elaboration of the wax; while the ſecond, whoſe abdomen undergoes no ſenſible change of bulk, neither gather nor retain more honey than is neceſſary for immediate ſubſiſtence, and readily ſhare that which they collect with their companions; who take no charge of ſtoring the hive with proviſions, their appropriate office being to attend the young. Theſe they call nurſing or ſmall bees, in contradiſtinction to thoſe with dilated bellies, and which, as they ſay, are entitled to the appellation of "wax-workers." The exiſtence and ſeparate offices of theſe two ſorts of bees were ſufficiently aſcertained. When the hives are filled with combs, the wax-working bees diſgorge their honey into the uſual magazines, and produce no more wax; but, if they have no receptacle in which they can depoſit it, and if the queen finds no cells formed ready for the reception of her ova, they retain in their ſtomachs the honey which they had amaſſed; and, at the end of 24 hours, the wax oozes out between the rings, when the fabrication of the combs commences. The nurſing bees alſo produce wax, but in a much ſmaller quantity than the others.

As for the uſe of the pollen, our authors have aſcertained, that it is collected for the purpoſe of feeding the young; and they have alſo found, that bees, fed too long on the ſyrup of ſugar alone, are incapable of rearing their offspring, and at length deſert the hive. The waxy matter, when newly ſecreted and moulded in its appropriate organs, differs from real wax in being tranſparent like ſcales of talc, white, and quite friable, or brittle; whereas that of which the cells are compoſed is of a yellowiſh-white, opaque, and flexible. Our limits will not allow our deſcribing the proceſs obſerved by our authors with the aid of a glaſs apparatus, by which theſe inſects commence and conduct the conſtruction of their combs. The difference of aſpect and conſiſtency between cells juſt formed, and thoſe which are of older ſtanding, cannot fail to attract the attention of every obſervant apiarian. The former are, in fact, of a dull white colour, ſemi-tranſparent, ſoft, and even, without being ſmooth; but, in the courſe of a few days, the whole of their internal ſurface aſſumes a yellow tint of greater or leſs intenſity: their ſharp edges become thicker and leſs regular; and thoſe tubes, which at firſt could not reſiſt the ſlighteſt preſſure, become flexible, ſomewhat more heavy, and more difficult of ſolution in hot water. The contour of the orifice of mature cells is bound with a rim of a reddiſh and odorous reſin, which is alſo employed to cement the angles of other parts of the cell. This ſolder or varniſh is found, on chemical trial, to be identical with the propolis,

and

and quite diftinct from the wax. Meffrs. Huber have not only eftablifhed this important fact, but detected the origin of the propolis itfelf. Having obtained branches of the wild poplar, cut in fpring before the developement of their leaves, with very large buds filled with vifcous, reddifh, and odorous juice, they placed thefe in the way of the bees to the fields, fo that they muft fee them: foon after this arrangement, a bee alighted on one of the branches, and approached one of the largeft buds; fhe then feparated its folds with her teeth, attacked the parts which fhe had half-opened, pulled off filaments of the vifcid matter with which they were filled, and then feized, with one of the legs of the fecond pair, the fubftance held between her jaws, brought forwards one of her hind-legs, and finally placed in the bafket of that leg the little ball of propolis which fhe had juft collected. Having accomplifhed this object, fhe again opened the bud in another place, carried off new threads of the fame matter with her teeth, laid hold of them with the legs of the fecond pair, and placed them nicely on the other bafket. She then took her departure, and rejoined her hive. In a few minutes afterwards, a fecond bee alighted on the fame branches, and loaded herfelf with propolis in the fame manner. This propolis was found to be different from the matter which imparts the yellow colour to the wax, which is probably fecreted in the cavity of the teeth, and depofited on the wax. We obferve, however, that bees are not contented with merely painting and varnifhing their cells, but they alfo impart additional folidity to their aggregate amount by the ufe of a mortar, compofed of wax and propolis; and which the ancients, who had not overlooked this department of their economy, termed *metis*, or *piffocerum*. (See PROPOLIS.) With the neceffary documents before us, we cannot forbear introducing fome further obfervations on the economy of thefe infects, though they are not immediately connected with the fubject of this article. As the clofenefs of a hive, and the multitude of living creatures which inhabit it, (amounting fometimes to twenty-five or thirty thoufand,) are circumftances which feem to preclude a free ventilation and renewal of air, we might be induced to fuppofe that bees are not endowed with any particular fyftem of refpiratory organs, and that they are capable of exifting in any atmofphere, however vitiated. As a teft of this fuppofition, our ingenious and perfevering authors recurred to various experiments; which inconteftibly prove, that thefe infects cannot long exift either in *vacuo*, or in air that is contaminated by noxious gafes; that, in fhort, they breathe like other animals of their clafs; and that they are fpeedily deprived of life if the procefs of refpiration be arrefted. Yet it refults, from eudiometrical trials, that the air of a well-ftocked hive is equally pure with that of the atmofphere. It has been afcertained, too, that neither wax nor pollen favours the production of oxygen gas, and that the bees themfelves have no internal faculty of generating vital air; fince, if that of the atmofphere be entirely excluded, they are obferved to perifh in the courfe of a few hours. Our authors, therefore, took an opportunity of examining, whether the induftry of thefe infects prefented no particular caufe of this phenomenon; and at length they were ftruck by the connection which might fubfift between the circulation of the air and that beating of the wings which they had recently obferved, and which occafioned a continual humming in the interior of their habitation. They fufpected that the play of thefe membranes, which imprefs the air with fufficient force to elicit from it a very diftinct found, might be deftined to replace that which had been vitiated by refpiration. Although this may feem to be a trivial caufe for counteracting the pernicious effect above ftated, yet by putting the hand near to a fanning-bee, we fhall perceive that fhe agitates the air in a manner that is very fenfible, and moves her wings with fuch rapidity as that they are fcarcely diftinguifhable.

United at their edge by means of fmall hooks, the two wings of each fide prefent a larger furface to the air, on which they have to ftrike; they form, befides, a flight concavity, which fhould fomewhat contribute to increafe their energy; and we may be fatisfied that they defcribe an arc of 90°, becaufe we fee them, fimultaneoufly, on the two extremes of their vibrations. When engaged in this exercife, the bees cling faft to the ftand with their legs, the firft pair being projected forwards, the fecond feparated and fixed to the right and left of the body, while the third, clofely approximated, and in a direction perpendicular to the abdomen, contributes to fupport the hinder parts in an elevated pofition. During the fine feafon, we may always obferve a certain number of bees agitating their wings in front of the entrance to their hive; but we may alfo be convinced, by infpection, that ftill more of them are employed in fanning within their dwelling. The ordinary ftation of the ventilating bees is on the lower floor of the hive. All thofe which are occupied in this way, on the outfide, have their heads turned towards the entrance, but thofe within prefent their backs to it. Thefe bees feem to arrange themfelves methodically, fo that they may manage the ventilating procefs with the greateft eafe; being diftributed into files, which terminate at the entrance of the hive, and are fometimes difpofed like fo many diverging rays; but this order is not uniform: and it is probably owing to the neceffity to which the fanning bees are fubjected of leaving room for fuch as go and come, whofe rapid courfe conftrains them to form in file, that they may avoid being joftled and overturned at every inftant. More than 20 bees may fometimes be feen ventilating in the lower part of the hive; but their number at other times is fmaller; and each of them vibrates her wings for a longer or fhorter period. They have been obferved to continue the exertion during 25 minutes, without refting; although they feemed occafionally to take breath by fufpending the vibration of their wings for an almoft imperceptible inftant; but, as foon as they ceafe from fanning, others take their place, fo that the humming noife in a well-filled hive never fuffers interruption.

But to return from this digreffion to the principal fubject of the article.

Bees'-wax makes a very confiderable article in commerce; the confumption of it throughout the feveral parts of Europe being incredible. There are two kinds, *white* and *yellow*; the yellow is the native wax, juft as it comes out of the hive, after expreffing the honey, &c. This colour, fays Thorley, is owing to the age of the combs, and breath of the bees; wax, he fays, both as it is gathered, and wrought into combs, being always white: the white is the fame wax, only purified, wafhed, and expofed to the air. The preparation of each follows.

WAX, *Yellow*. To procure the wax from the combs for ufe; after feparating the honey from them as much as poffible by the prefs, they are either foaked for fome days in clear water, in order to extract all the honey, or they are broken into pieces, and fpread on a fheet near the hives, fo that the bees in time fuck out all the honey that is left, and reduce the wax into fmall fragments like bran. Then the whole of the wax is put into a large kettle, with a fufficient quantity of water; and with a moderate fire, it is melted, and then ftrained through a linen cloth, by a prefs, and thus freed from all remaining impurity. Before it is cold, they fcum it with a tile, or a piece of wet wood, and caft it, while

while yet warm, in wooden, earthen, or metalline moulds; having firft anointed them with honey, oil, or water, to prevent the wax from fticking. Some, to purify it, make ufe of Roman vitriol, or copperas; but the true fecret is to melt, fcum it, &c. properly, without any ingredients at all.

The beft is that of a high colour, an agreeable fmell, fomewhat refembling that of honey, foft, fomewhat unctuous to the touch, but not fticking to the fingers, nor to the teeth when chewed. When new, it is of a lively yellow colour; it is fomewhat tough, yet eafy to break; by age, it lofes its fine colour, and becomes harder and more brittle. In winter it becomes confiderably hard and tough. It is deprived of its yellow colour and fmell by expofing it in thin laminæ to the action of the light and air, in the procefs of bleaching; by which it becomes perfectly white, fcentlefs, fomewhat harder, and lefs greafy to the touch. However, wax is often fophifticated with refin, or pitch, coloured rocou, or turmeric.

The prefence of refin may be fufpected when the fracture appears fmooth and fhining, inftead of being granulated: and it may be faturated by putting fmall pieces of the wax into cold alcohol, which will readily diffolve the refinous part, without affecting the wax in any confiderable degree.

Its adulteration with earth or peas meal may be fufpected when the cake is very brittle, and the colour inclining more to grey than bright pale yellow; and they may be feparated by fmelting and ftraining the wax. White wax is fometimes adulterated with white oxyd of lead, in order to increafe its weight. This may be known by melting the wax in water, when the oxyd falls to the bottom of the veffel.

It is alfo adulterated by tallow, fuet, or any kind of animal fat. It then becomes more fufible, and when rebleached and expofed to a hot fun, it is very apt to cake. It likewife lofes its femi-tranfparency, the diftinguifhing property of pure bleached wax. This adulteration may be detected by boiling alcohol, which will diffolve wax, but not tallow.

Wax, *White*. The whitening, blanching, or bleaching of wax, is performed by reducing the yellow fort, firft, into little bits or grains, and melting it in a copper cauldron, with water juft fufficient to prevent the wax from burning. The cauldron in which the wax is melted is fo difpofed, that it may flow gradually through a pipe at the bottom into a large tub filled with water, and covered with a thick cloth, to preferve the heat till the water and impurities are fettled. From this tub the clear melted wax flows into a veffel, the bottom of which is full of fmall holes, about the fize of a grain of wheat, and hence it falls in fmall ftreams upon a cylinder, conftantly revolving over water, into which it occafionally dips, fo that the wax is cooled, and at the fame time drawn out into thin fhreds or ribbands. The continual rotation of the cylinder carries off thefe ribbands as faft as they are formed, and diftributes them through the tub. The wax, thus granulated or flatted, is expofed to the air on linen cloths, ftretched on large frames, about a foot or two above the ground, in which fituation it remains night and day for feveral days, expofed to the air and fun; and thus the yellow colour nearly difappears. In this half-bleached ftate, it is heaped up in a folid mafs, and allowed to remain for a month or fix weeks; after which, to complete the procefs for whitening it, it is re-melted, and ribbanded, and bleached as before, (in fome cafes feveral times) till it wholly lofes its colour and fmell. Some manufacturers, in re-melting it, add alum or cream of tartar, which are fuppofed to increafe the whitenefs and folidity of the wax. Some alfo, inftead of fpreading the ribbands of wax on cloths, lay evenly a broad courfe of bricks, which are frequently watered, fo that the wax is kept from melting by the fun's heat abforbed by the bricks.

When the fun and air have at length perfectly blanched the wax, fome melt it for the laft time in a large kettle; out of which they caft it, with a ladle, upon a table, covered over with little round dents or cavities, of the form of the cakes of white wax, as fold by the apothecaries, &c. having firft wetted thofe moulds with cold water, that the wax may be the more eafily got out. Laftly, they lay out thefe cakes to the air for two days and two nights, to render it more tranfparent and dry.

As the volatile fulphureous acid has the property of deftroying more quickly almoft all the colours of vegetables, it has been fuggefted by Macquer, the author of the Chemical Dictionary, that this bleaching might perhaps be fhortened, by expofing ribbands of yellow wax to the vapour of fulphur, as is practifed for wool and filk; but this procefs has not been found to fucceed.

However, the operation of bleaching wax above defcribed can be performed well only in fine weather, as it depends chiefly on the action of the fun. This circumftance being attended with much inconvenience to the manufacturers, the difcovery of a method of whitening wax independently of the feafons would be very ufeful, and has been recommended to the attention of chemifts by fome economical focieties.

With a view to difcover fuch a method, Mr. Beckman has made experiments, an account of which is publifhed in the fifth volume of the "Novi Commentarii Societatis Regiæ Scientiarum Gottingenfis." According to thefe experiments, thin pieces of yellow wax were whitened and hardened, by being digefted and boiled in diluted and undiluted nitrous acid, in a few hours. But the wax thus whitened, being melted by means of boiling water, was obferved to acquire a yellow colour, lefs intenfe, however, than it was before it had been treated with the mineral acids. The marine and vitriolic acids were lefs effectual than the nitric or nitro-muriatic. He expofed wax to the flames of burning fulphur, but without fuccefs. Yellow wax being melted in vinegar, was rendered of a grey colour. The oil of tartar whitened wax, but lefs effectually than acids had done; and this wax being wafhed in water, and afterwards digefted in nitrous acid, was rendered ftill more white; but upon melting it in water, a yellowifh tinge returned. He liquefied wax in folutions of nitre and alum, but without any good effect. Spirit of wine, which is recommended by Mr. Boyle for this purpofe, did indeed whiten the wax, but changed it to a butyraceous fubftance, fo frothy, that its bulk was increafed thirty times. Reflecting that tartar is purified from its oily particles by means of a calcareous earth, he tried the effects of a kind of fuller's earth, which he threw upon wax liquefied in water, and he agitated the mixture. This method rendered wax of a greyifh colour, and is, therefore, recommended by him as preparatory to bleaching; the time neceffary for which, he thinks, may be thus greatly fhortened.

M. Sennebier made fome remarks on the effect of light, and other fuppofed difcolouring agents. Some yellow wax was melted, and thinly fpread upon a plate of glafs; and a fimilar plate was laid upon it when hot; and the edges of the plates were clofed with fealing-wax. Thus the bees'-wax was deprived of the accefs of air, and it was placed in the fun, to the light of which it was expofed for four or five hours daily. Another quantity of wax was inclofed between plates in a like manner, but kept in the dark. In two days the wax expofed to the fun began to bleach, and in in a month's time the whole, when it did not exceed one-fixth of an inch in thicknefs, was quite white; whilft no change at all took place in that which was kept in darknefs.

Alcohol has no fenfible action on wax when cold, but if the fluid be boiled, it will diffolve rather lefs than one-twentieth of its weight of wax; and the greater part of it feparates, when cold, in the form of white bulky flocculi, while the fmall quantity that remains is wholly precipitated by water. Such is the refult of Pearfon's and Boftock's experiments; whereas Fourcroy, Chaptal, and Nicholfon affert, that it is infoluble in this fluid. Sulphuric ether diffolves wax when heated, and much more copioufly than alcohol diffolves it, but the greater part, like that of the former, is feparated by cooling, and the remainder by water. Wax boiled in cauftic potafh makes the fluid turbid, and in procefs of time rifes to the furface in a flocculent form. The portion of the wax, held in folution by the clear alkaline liquor, may be feparated by an acid, and the refidue floating on the furface is fo far converted into a faponaceous ftate as to have loft its inflammability, and to be no lefs foluble in pure water than white foap, and again precipitable by acids nearly in its original form, with a reftoration of its inflammability. Pure ammonia nearly refembles the fixed alkalies in its action; but the refulting faponaceous form is lefs foluble in water.

When yellow wax has been long fwimming in a folution of carbonate of potafh, it becomes grey; and this colour is entirely changed into a milk white by fubfequent digeftion in nitric acid, and the wax refumes its whitenefs.

If wax be diftilled with a heat greater than that of boiling water, it may be decompofed. By this diftillation, a fmall quantity of water is firft feparated from the wax, and then fome very volatile and penetrating acid, (probably a modification of the acetous,) accompanied with a fmall quantity of a very fluid and very odoriferous oil. As the diftillation advances, the acid becomes more and more ftrong, and the oil more and more thick, till its confiftence be fuch, that it becomes folid in the receiver, and is then called *butter of wax*. When the diftillation is finifhed, nothing remains but a fmall quantity of coal, which is almoft incombuftible, from the want of fome faline matter. Wax cannot be kindled, unlefs it be previoufly heated, and reduced into vapours; in which refpect it refembles fat oils. The oil and butter of wax may, by repeated diftillations, be attenuated, and rendered more and more fluid, becaufe fome portion of acid is thereby feparated from thefe fubftances; which effect is fimilar to what happens in the diftillation of other oils and oily concretes; but this remarkable effect attends the repeated diftillation of oil and butter of wax, that they become more and more foluble in fpirit of wine; and that they never acquire greater confiftence by the evaporation of their more fluid parts. Boerhaave kept butter of wax in a glafs veffel open, or carelefsly clofed, during twenty years, without acquiring a more folid confiftence. Wax, its butter, and its oil, differ entirely from effential oils and refins, in all the above-mentioned properties; and in all thefe perfectly refemble fweet oils. Hence Macquer concludes, that wax only refembles refins in being an oil rendered concrete by an acid; but that it differs effentially from thefe in the kind of oil, which in refins is of the nature of effential oils; while in wax and other analogous oily concretions, it is of the nature of fweet, unctuous oils, that are not aromatic, and not volatile, and are not obtained from vegetables by expreffion.

Although wax is not diffoluble at all in watery liquors, yet the gelatinous folution obtained by boiling it in fpirit of wine, by mixture with a thick mucilage of gum arabic, becomes foluble in water, fo as to form therewith an emulfion or milky liquor: the wax itfelf is made in like manner foluble, without the intervention of fpirit, by thoroughly mixing it with the gum in fine powder; but when thus diffolved, it proves ftill infipid, and perfectly void of acrimony.

Wax is foluble abundantly in the fixed oils, and melted with them, produces an uniform mafs, the confiftence of which, whatever be the proportion of each, is intermediate between the two. It is diffolved but fparingly in effential oils.

Bleached wax burns with a very pure white light, without any offenfive fmell, and with much lefs fmoke than tallow; and as it is lefs fufible than tallow, it requires a fmaller wick. (See CANDLES.) Bleached wax melts at about 155° of Fahrenheit; and the unbleached at 142°, according to Pearfon and Nicholfon, and alfo Dr. Boftock, but at 117° according to Fourcroy; whilft tallow melts at 92°, fpermaceti at 133°, adipocire at 127°, and the pela of the Chinefe at 145°. (See Nicholfon's Journal, vol. i. p. 70, 4to.) The fpecific gravity is lefs than that of water, being about .96.

The *yellow* wax is brought to market in round cakes about two inches thick; and large quantities of it are imported from the Baltic, the Levant, and the Barbary coaft.

The *white* wax is ufed in the manufacture of candles, torches, tapers, figures, and a variety of other wax-works. See CANDLES, &c.

It is alfo an article of the *Materia Medica*, and ufed as an ingredient, partly for giving the requifite confiftence to other ingredients, and partly on account of its own emollient quality, in plafters, cerates, and divers pomatums and unguents for the complexion.

The yellow fort, diffolved into an emulfion, or mixed with fpermaceti, oil of almonds, conferve of rofes, &c. into the form of an electuary; or divided, by ftirring into it, when melted over a gentle fire, as much as it will take up of powdery matter, as the compound crab's-claw powder, has been given alfo internally, and, as fome have pretended, often with great fuccefs, in diarrhœas and dyfenteries, for obtunding the acrimony of the humours, fupplying the natural mucus of the inteftines, and healing their excoriations or erofions.

The empyreumatic oil, into which wax is refolved by diftillation with a ftrong heat, is greatly recommended by Boerhaave and others, for healing chaps and roughnefs of the fkin, for difcuffing chilblains, and with proper fomentations and exercife, againft ftiffnefs of the joints, and contractions of the tendons. It is, without doubt, fays Dr. Lewis, highly emollient; but does not appear to have any other quality by which it can act in external applications; it has nothing of the acrimony or pungency which prevail in all the other known diftilled vegetable oils; though in fmell it is not a little difagreeable and empyreumatic; a circumftance which occafions it to be at prefent more rarely ufed than formerly. As the wax fwells up greatly in the diftillation, it is convenient to divide it, by melting it with twice its weight of fand; or putting the fand above it in the retort, that it may mingle with the wax when brought into fufion. The oil, which is preceded by a fmall quantity of acid liquor, congeals in the neck of the retort, from whence it may be melted down, by applying a live coal, and made fluid by rediftilling it two or three times without addition. The fæces remaining, after expreffing the wax, have been ufed used both by surgeons and farriers, with success, against strains.

The officinal preparations are as follow: *cera flava purificata* of Dub. Ph.; *oxidum antimonii vitrificatum cera* of Edinb.; *emplastrum ceræ* of Lond. and Edinb.; *emplastrum cumini* of Lond.; *empl. picis compositum* of Lond.; *empl. oxidi ferri rubri* of Edinb.; *empl. assafœtidæ* of Edinb.; *empl. gummosum* of Edinb.; *empl. meloes vesicatorii* of Edinb. and Lond.; *empl. galbani* of Dub.; *empl. aromaticum* of Dub.; *ceratum* of Lond. and Dub.; *ceratum calaminæ* of Lond. and Dub.; *ceratum resinæ* of Lond. Edinb. and Dub.; *ceratum sabinæ* of Lond. and Dub.; *ceratum saponis* of Lond.; *unguentum picis aridæ* of Lond. and Edinb.; *ung. infusi meloes vesicatorii* of Edinb.; and *ung. cantharidis* of Dub. Ph. For the first, see *white-wax* below. The second, or vitrified oxyd of antimony with wax, formerly waxed glass of antimony, is formed by melting one part of yellow wax in an iron vessel, and throwing into it eight parts of oxyd of antimony vitrified with sulphur, reduced to powder, and roasting the mixture with a gentle fire for a quarter of an hour, stirring it assiduously with a spatula; then pouring out the latter, and when cold rubbing it into a powder. This preparation is diaphoretic and cathartic, occasionally exciting nausea and vomiting. It was formerly thought to possess efficacy in diarrhœa and dysentery; but is now scarcely ever prescribed. The dose may be from gr. ij. to gr. xv. given twice or three times a day. For the *empl. ceræ*, see *Wax* PLASTER. For the 4th, see EMPLASTRUM *é Cymino.* For the 5th, see *Compound Pitch* PLASTER. For the 6th, see PLASTER *of red Oxyd of Iron.* For the 7th, see *Assa Fœtida* PLASTER. For the 8th, see *Gum* PLASTER. For the 9th, 10th, and 11th, see PLASTER. For the others, comprehending *cerates* and *ointments.* See UNGUENTUM.

The *bleached* or *white wax* is generally melted and cast, in the manner already stated, into thin discs, about 5 inches in diameter, in which form it is found in the shops. For medical purposes, it is regarded as a demulcent; and has been sometimes administered in obstinate cases of diarrhœa and dysentery, with the view of sheathing the bowels; which effect is better produced by simple mucilages and solutions. It is generally exhibited diffused in mucilaginous fluids by means of soap, in the proportion of ⅓d part of the wax, with which it is first melted, and then rubbed in a mortar, with the fluid gradually added; but a preferable method is said to be that of Poerner, which is first to melt the wax with olive oil, and then mix the oily compound while hot with the mucilaginous fluid, by triturating with the yolk of an egg. The dose is a cupfull of the emulsion, containing about ℈j of wax, given every four or five hours. This wax, as well as the yellow sort, is much used in the composition of plasters and ointments. The officinal preparations are *ceratum cetacei* of Lond. Edinb. and Dub. pharmacopeias; *unguentum cetacei* of Lond. and Dub.; *ung. hydrargyri nitrico-oxydi* of Lond.; *linimentum simplex* of Edinb.; and *ung. simplex* of Edinb. See CERATUM, LINIMENT, and UNGUENT. Lewis's Mat. Med.

Yellow wax is made soft with turpentine, yet retains its natural colour. Red wax is only the white melted with turpentine, and reddened with vermilion or alkanet. Verdigrise makes it green; and burnt paper, or lamp-black, black. Some travellers tell us of a natural black wax; assuring us there are bees, both in the East and West Indies, that make an excellent honey, included in black cells. Of this wax, they say, it is, that the Indians make those little vases, in which they gather their balsam of Tolu.

WAX is also produced by the secretion of many plants, and forms the silvery powder or bloom, which covers their leaves and fruit. It is found very abundantly combined with resin, covering the trunk of the wax-palm (*Ceroxylon*) of South America, found in the Quinoliu mountains, 180 feet high, with leaves 20 feet long, the trunk of which is covered with the waxy secretion about two inches thick, and consisting of two-thirds of resin and one of wax; and very pure, encrusting the seeds of the *Myrica cerifera*, or wax-tree of Louisiana, and other parts of North America. The *Pe-la* of the Chinese is an animal wax, and the white lac of India appears to be a variety of wax; so that wax may be regarded, in the extended meaning of the term, both as an animal and a vegetable product. The croton sebiferum, the tomex sebifera, the poplar, the alder, the pine, as well as the Myrica, afford a concrete inflammable matter by decoction, that more or less resembles tallow or wax, that is, a fixed oil saturated with oxygen. But the Myrica cerifera supplies it in the greatest abundance. The grains of this tree, and the shining wax obtained by boiling them in water, have been long ago, *viz.* in 1722 and 1725, noticed in the History of the Academy of Sciences. The wax, it was observed, is drier and more friable than our's; and it was found, that the liquor in which the grain had been boiled, and from which the wax was procured, afforded, on evaporation, a kind of extract that checked the most obstinate dysenteries; and the inhabitants of Louisiana are said to have made candles of the wax. Several authors have mentioned different species of these trees; but the wax they afford has more lately been the subject of experimental investigation, particularly by M. Cadet and Dr. Bostock. The most fertile of these shrubs afford near seven pounds of berries, the gathering of which employ several families. These berries are thrown into a kettle, and covered with water. Whilst the water is boiling, the grains are stirred about against the sides of the vessel, so that the wax may more easily come off. In a little time it floats on the water like fat, and being collected, is strained through a coarse cloth, to free it from any impurities. This operation is repeated with fresh berries; and when a considerable quantity of wax has been obtained, it is laid upon a cloth to drain off the water; and it is then dried and melted a second time; and when thus purified, formed into masses. Four pounds of berries afford about one of wax: that which is first obtained is generally yellow; but in the latter boilings it assumes a green colour, from the pellicle with which the kernel of the berry is covered. M. Cadet made a variety of experiments on these berries, and found that the powder which was obtained from them afforded an astringent solution by alcohol, and that it contained gallic acid, but no tannin; and to this acid he attributes their effect in dysenteries. The wax, obtained either by the decoction of the grains, or the solution of the powder when precipitated from alcohol by water, when melted, is always of a greenish-yellow; of a firmer consistence than bees'-wax, dry, and sufficiently friable to be pulverized; and evidently more oxygenated than the wax prepared by bees. Candles made of this wax yielded a white flame, a good light, without smoke, and without guttering; and when quite fresh, they emit a balsamic odour, considered in Louisiana as very salubrious to persons in bad health. Distilled in a retort, this wax, for the most part, passes over in the form of butter. This portion is much whiter, and has no more consistence than tallow. Another portion that was decomposed afforded a little water, with some empyreumatic oil and sebacic acid. Much carbonated hydrogen gas and carbonic acid gas were disengaged; and there remained in the retort a black and coaly bitumen. Ether was found to dissolve

 this

this wax better than alcohol. Oxygenated muriatic acid rendered this, as well as bees'-wax, perfectly white; but the vegetable wax was bleached with the greateſt difficulty. The ſolution in ammonia is of a brown colour, and a portion of the wax is rendered ſoapy; and it forms ſoap with fixed alkali. When the ſoap of Myrica is decompoſed, a very white wax is obtained, but in a ſtate unfit for our uſes. Litharge diſſolves very well in this melted wax, and forms a hard plaſter, the conſiſtence of which may be diminiſhed at pleaſure by the addition of a little oil. For bleaching this wax, M. Cadet obſerves, that two re-agents preſent themſelves to manufacturers, the ſulphuric acid and the oxygenated muriatic acid. He propoſes the following method as the moſt ſpeedy in its effect:—Let the wax be reduced to a very divided ſtate, and ſtratified in a caſk with ſuper-oxygenated muriate of lime, and let them remain for ſome time in contact without water. Let the ſalt be afterwards decompoſed with water, acidulated by the ſulphuric acid; taking care to pour the water a little at a time at different intervals, until there ſhall be no longer any perceptible diſengagement of muriatic gas; at which period a large quantity of water is to be added, and the mixture agitated with a ſtaff. The inſoluble ſulphate of lime falls down by repoſe, while the bleached wax riſes and ſwims at the ſurface. This is to be waſhed and melted on the water bath. Our author cloſes his memoir with recommending the culture of the plant that yields this wax, and with a brief detail of methods for effecting this purpoſe. Dr. Boſtock has alſo proſecuted an inquiry into the nature and uſes of myrtle wax. He finds that in its more important properties it reſembles bees'-wax, but that in ſome reſpects they differ from one another. The myrtle wax is moderately hard and conſiſtent, poſſeſſing in part the tenacity of bees'-wax, without its unctuoſity, and alſo, in ſome degree, the brittleneſs of reſin. The prevalent colour is pale green, tending in moſt of the pieces to a dirty grey; in others it is lighter, more tranſparent, and of a yellowiſh tinge. Its ſpecific gravity is about 1.0150, water being 1.000, ſo that it ſinks in it, and the white bees'-wax being .9600. Water has no action upon it, either when cold or at the boiling heat. Alcohol, when cold, does not affect it; but 100 parts, by weight, of this fluid, when boiling, diſſolve about five parts of the wax. Nearly four-fifths are depoſited by the cooling of the alcohol; one-fifth remains ſuſpended, but in the courſe of a few days is ſlowly depoſited, or may be precipitated by the addition of water. Sulphuric ether, when at the common temperature of the atmoſphere, diſſolves only a ſmall quantity of this wax, but acts upon it rapidly when boiling. It takes up ſomewhat more than one-fourth of its own weight. As the ether cools, it is moſtly ſeparated, and the ſmall reſidue may be precipitated by water. After ſolution, the wax is nearly colourleſs, and the fluid aſſumes a beautiful green hue. The depoſit by evaporation ſomewhat reſembles ſpermaceti. Rectified oil of turpentine, at the temperature of the atmoſphere, ſoftens the wax, but does not diſſolve it: aided by a moderate heat, 100 grains of the turpentine diſſolves ſix grains of the wax. The turpentine acquires a light green tinge, part of the wax is ſeparated as the fluid cools, and part remains permanently diſſolved in it. Pure potaſh renders it colourleſs by boiling, and forms a ſoap with a ſmall part, which being decompoſed by acid, affords the wax nearly unchanged. Pure ammonia acts nearly as potaſh, but more feebly. The three principal mineral acids act upon the myrtle wax, but with no great force. The ſulphuric acid, with a moderate heat, diſſolves about one-twelfth of its weight, and converts it into a thick, dark-brown maſs, which on cooling becomes nearly concrete, but without any ſeparation of the wax. The nitric and muriatic acids, even when heated, ſeem to poſſeſs little attraction for the wax. From ſuch experiments, Dr. Boſtock aſſigns to myrtle wax, with a conſiderable degree of probability, the place which it ſhould occupy among chemical ſubſtances. Its inflammability, fuſibility, inſolubility in water, and the action which takes place between it and the alkalies, indicate its affinity to the fixed oils; while its texture and conſiſtence, and more particularly its habitudes with alcohol and ether, manifeſt a reſemblance to the reſins. Upon the whole, we may conſider the myrtle wax as a fixed vegetable oil, rendered concrete by the addition of a quantity of oxygen; and ſeeming to hold the ſame relation to the fixed, which reſins do to the eſſential oils of vegetables. Dr. Boſtock has inſtituted a compariſon between myrtle wax and other ſubſtances which it reſembles, ſuch as bees'-wax, ſpermaceti, adipocire, and the cryſtalline matter of biliary calculi; and, upon the whole, deduces this concluſion, that though theſe five ſubſtances poſſeſs certain properties in common, and have a degree of ſimilarity in their external appearance, yet that they differ materially in their chemical nature. There is indeed, he ſays, reaſon to conjecture, that they are all compoſed of the ſame elements, combined together in different proportions, and with different degrees of attraction. Nicholſon's Journal, vol. iv. 8vo.

Wax, *Chafe*. See Chafe.

Wax, *Crude* or *Rough*, called by the French *cire brute*, in *Natural Hiſtory*, a name given to a ſubſtance called by the ancients *erithace*, *ſandarac*, and *ambroſia*.

We ſeem to have no name for it in Engliſh, but may call it after the name of the French, *rough wax*.

The Dutch call it the food of the bees, and that, perhaps, very properly, there appearing many reaſons to think that the bees eat it.

This is the yellow ſubſtance found on the hinder legs of bees in ſmall lumps, of which, as Reaumur and ſome others erroneouſly thought, wax is made by this inſect. See Pain *d'Abeilles*.

Wax, *Myrtle*. See Myrica, and Wax, *ſupra*.

Wax, *Virgin*, *Propolis*, is a ſort of reddiſh wax, uſed by the bees to ſtop up the clefts or holes of the hive. It is applied juſt as taken out of the hive, without any art, or preparation of boiling, &c. It is the moſt tenacious of any, and is held good for the nerves. See Propolis.

Wax, *Sealing*, or *Spaniſh Wax*, is a compoſition of gum lacca, melted and prepared with reſins, and coloured with ſome ſuitable pigment.

There are two kinds of ſealing-wax in uſe: the one hard, intended for ſealing letters, and other ſuch purpoſes, where only a thin body can be allowed; the other ſoft, deſigned for receiving the impreſſions of ſeals of office to charters, patents, and ſuch written inſtruments.

The beſt hard red ſealing-wax is made by mixing two parts of ſhell-lac, well powdered, and reſin and vermilion, powdered, of each one part, and melting this combined powder over a gentle fire; and when the ingredients ſeem thoroughly incorporated, working the wax into ſticks. Seed-lac may be ſubſtituted for the ſhell-lac; and inſtead of reſin, boiled Venice turpentine may be uſed. A coarſer, hard, red ſealing-wax may be made, by mixing two parts of reſin, and of ſhell-lac, vermilion and red-lead, mixed in the proportion of one part of the vermilion to two of the red-lead, of each one part; and proceeding, as in the former preparation. For a cheaper kind, the vermilion may be omitted, and the ſhell-lac alſo, for very coarſe uſes. The hard black ſealing-wax may be prepared in the ſame manner; uſing ufing for the beft fort, inftead of the vermilion, the beft ivory black; and for the coarfer fort, inftead of the vermilion and red-lead, the common ivory black. For hard green fealing-wax, inftead of vermilion, ufe powdered verdigrife; and for a bright colour, diftilled, or cryftals of verdigrife. For hard blue fealing-wax, inftead of the vermilion, fubftitute well powdered fmalt, or for a light blue, verditer; or a mixture of both. For yellow hard fealing-wax, fubftitute mafticot, or, for a bright colour, turbith mineral, inftead of the vermilion. The hard purple wax is made like the red; changing half the quantity of the vermilion for an equal, or greater proportion of fmalt, as the purple is defired to be more blue or more red.

For uncoloured foft fealing-wax, take of bees'-wax, one pound; of turpentine, three ounces; and of olive oil, one ounce; place them in a proper veffel over the fire, and let them boil for fome time; and the wax will be then fit to be formed into rolls or cakes for ufe. For red, black, green, blue, yellow, and purple foft fealing-wax, add to the preceding compofition, while boiling, an ounce or more of any ingredients directed above for colouring the hard fealing-wax, and ftir the mafs, till the colouring ingredient be incorporated with the wax.

The hard fealing-wax is formed into fticks, by rolling the mafs on a copper-plate, or ftone, with a rolling-board, lined with copper, or block-tin, into rolls of any required fize. In order to give them the fire-polifh, or glofs, a furnace or ftove, like a pail, with bars at the bottom for fupporting the charcoal, and notches at the top of the fides for putting the fticks of wax over the fire, is ufually provided. By means of this ftove the fticks of wax may be conveniently expofed to the fire, and turned about, till the wax is fo melted on the furface as to become fmooth and fhining. Hard fealing-wax may be formed into balls, by putting a proper quantity on the plate or ftone, and having fafhioned it into a round form, rolling it with the board till it be fmooth.

The foft wax is eafily formed into rolls or cakes, by pouring the melted mafs of the ingredients, as foon as they are duly prepared, into cold water, and working it with the hands into any defired figure. Some perfume both thefe kinds of wax, by ufing, for a pound of the wax, half an ounce of benjamin, one fcruple of oil of Rhodium, ten grains of mufk, and of civet and ambergrife, each five grains; rubbing the oil with the other ingredients powdered; and when the wax is ready to be wrought into fticks, fprinkling in and well ftirring the mixture; or by ufing one ounce of benjamin, one fcruple and a half of oil of Rhodium, and five grains of ambergrife, in the fame manner. Lewis's Com. of Arts, p. 370. Handmaid to the Arts, vol. ii. p. 34, &c.

WAX-*Candles*. See CANDLE.

WAX, *To imitate Fruit, &c. in.* Take the fruit, and bury it half-way in clay; oil its edges, and the extant half of the fruit; then nimbly throw on it tempered alabafter, or plafter of Paris, to a confiderable thicknefs. When this is concreted, it makes the half mould, the fecond half of which may be obtained in the fame way. The two parts of the mould being joined together, a little coloured wax, melted, and brought to a due heat, being poured through a hole made in any convenient part of the mould, and prefently fhook every way therein, will reprefent the original fruit. Boyle's Works abr. vol. i. p. 136.

Here we muft not forget that pretty invention of M. Benoift, a man famous at Paris for his figures of wax. Being by profeffion a painter, he found the fecret of forming moulds on the faces of living perfons, even the faireft and moft delicate, without any danger either to their health or complexion: in which moulds he caft mafks of wax; to which, by his colours, and glafs eyes imitated from nature, he gave a fort of life: infomuch as, when clothed in proper habits, they bore fuch a refemblance, that it was difficult diftinguifhing between the copy and the original.

WAX, *Gilding*. See GILDING.

WAX, *Grafting*, is a compofition ferving to bind or fix the bud, or graft, in the cleft of the ftock.

Inftead of grafting wax, the country gardeners, &c. only ufe clay, over which they lay a piece of linen cloth, and fo keep it moift; and to prevent its cracking with the heat of the fun, they tie mofs over it. But the wax ordinarily ufed is a compoft of one pound and a half of pitch, a quarter of a pound of wax, and an ounce of oil of almonds, melted and mixed together: with the addition, in fpring or autumn, of a moderate quantity of turpentine.

For cleft-grafting, whip-grafting, and grafting by approach, Mr. Mortimer recommends tempered clay, or foft wax; but for rind-grafting, clay and horfe-dung.

WAX, *Green*. See GREEN *Wax*.

WAX, *thorough*, in *Botany*. See BUPLEURUM.

WAX, *Painting in*. See ENCAUSTIC *Painting*.

WAX-*Bill*. See LOXIA *Aftrild*.

WAX-*Scot*, or *Wax-fhot*, *Ceragium*, in our *Ancient Cuftoms*, money paid twice a year towards the charge of maintaining lights, or candles, in the church.

WAXENBURG, in *Geography*, a town of Auftria; 10 miles W. of Freyftadt.

WAXHOLM, a fortrefs on the coaft of Sweden, in the Baltic; fituated on a fmall ifland at the entrance of the channel of the Malar Lake, and built in the year 1649. It has fince been greatly improved and enlarged, fo that it has the appearance of a little town. Here all homeward-bound fhips are fearched. On this ifland, which is called *Waxon*, befides this fort, are a church, a fchool, and a cuftom-houfe. The chief occupation of the inhabitants is fifhing; 16 miles E. of Stockholm. N. lat. 59° 21′. E. long. 18° 16′.

WAXING, CERATIO, in *Chemiftry*, the preparation of any matter to render it fit and difpofed to liquefy, or melt, which of itfelf it was not.

This is frequently done, to enable things to penetrate into metals, or other folid bodies.

WAXING, in the *Manufacture of Calico*, &c., a procefs by which the operation of certain colours is refifted by ftopping out with wax; but it is too expenfive to be often adopted among calico-printers, who are anxious to finifh their prints with the leaft poffible charge. Formerly this mode was very generally practifed, and great quantities of wax were confumed in the procefs. In the Eaft Indies wax is ftill ufed for preferving the whites in calico-printing. In printing the filk handkerchiefs called bandanas, a procefs called *waxing* is ftill followed. It confifts in making a preparation of tallow and rofin very liquid by heat, and in printing it in that ftate with a block upon the filk. When fuch goods are paffed through the blue vat, thofe parts which are covered with the tallow and rofin are preferved from the action of the indigo, and remain white, while the whole remainder is dyed a faft blue. The method afterwards taken to difcharge a part of this blue, and produce yellow, orange, &c. is as follows:—The agent employed for this purpofe is the nitrous, and fometimes the nitro-muriatic acid. This was ufed for the purpofe of putting yellow figures upon blue filk handkerchiefs. With this view aqua fortis, or nitro-muriatic acid, of a ftrength fuitable to the kind of blue that is to be difcharged, is mixed either with gum-tragacanth, or with flour pafte, to a proper confiftence, and in this form it is printed on the filk, by means of a common block, on which the

the intended pattern is cut. The confequence of this is, that wherever the acid attaches, there the original colour is difcharged, and a yellow dye is produced in its place. The pieces are then fteamed, by paffing them over a veffel containing boiling water, which gives brilliancy to the colour, and finifhes the operation. Parkes's Eff. vol. ii. p. 149. 170. See *Difcharge* WORK, and DISCHARGING *of Colours*.

WAXWAY, in *Geography*, an ifland in the Eaft Indian fea, near the E. coaft of the ifland of Celebes, about thirty miles in circumference. S. lat. 3° 35′. E. long. 123° 15′.

WAY. See PULO *Way*.

WAY, *Via*. See HIGHWAY, ROAD, TURNPIKE, and VIA.

Roman ways are divided into *confular*, *prætorian*, *military*, and *public*. See VIA.

We have four notable ones of thefe in England; anciently called *chimini quatuor*, and intitled to the privileges of pax regis. The firft is *Watling-ftreet*, or *Watheling-ftreet*, leading from Dover to London, Dunftable, Towcefter, Atterfton, and the Severn, near the Wrekin in Shropfhire, extending as far as Anglefea in Wales. The fecond, called *Hekineld*, or *Ikenild-ftreet*, reaches from Southampton, over the river Ifis at Newbridge, thence by Camden and Litchfield, then paffes the Derwent near Derby, fo to Bolfover-caftle, and ends at Tinmouth. The third, called *Foffe-way*, becaufe in fome places it was never perfected, but lies as a large ditch, leads from Cornwall through Devonfhire, by Tetbury near Stow in the Wolds; and befide Coventry to Leicefter, Newark, and fo to Lincoln. The fourth, called *Erming*, or *Erminage-ftreet*, ftretches from St. David's in Weft Wales, to Southampton.

WAY. See WEIGH.

WAY, *Milky*. The opinion, long maintained among aftronomers, but lately controverted, that the milky way contains a great number of ftars, has been confirmed by the obfervations of the ingenious and indefatigable Dr. Herfchel. On applying his telefcope of the Newtonian form, with an object-fpeculum of twenty feet focal length and an aperture of $18\frac{7}{10}$ inches, to a part of this fpace, he found that it completely refolved the whole whitifh appearance into fmall ftars; which his former telefcopes had not light enough to effect In the tract immediately about the hand and club of Orion, to which his obfervations were particularly directed, the multitude of ftars of all poffible fizes that prefented themfelves to view was aftonifhing: and in order to form fome juft idea of their number, Dr. Herfchel counted many fields, and computed from a mean of them, what a given portion of the milky way might contain. Among many trials of this fort, he found that fix fields, promifcuoufly taken, contained 110, 60, 70, 90, 70, and 74 ftars each. A mean of thefe gives 79 ftars for each field. Hence, by allowing fifteen minutes of a great circle for the diameter of the field of view, it is inferred, that a belt of fifteen degrees in length and two in breadth, which is the quantity often obferved by this excellent aftronomer to pafs through the field of his telefcope in one hour's time, could not well contain lefs than fifty thoufand ftars, that were large enough to be diftinctly numbered. But, befides thefe, Dr. Herfchel fufpected at leaft twice as many more, which, for want of light, he could only fee now and then by faint glittering and interrupted glimpfes. See GALAXY and NEBULA.

WAY *of a Ship* is fometimes ufed for the fame with the rake. But the term is more commonly underftood of the courfe or progrefs which fhe makes on the water under fail: thus, when fhe begins her motion, fhe is faid to be *under way*; when that motion increafes, fhe is faid to have *frefh way* through the water; when fhe goes apace, they fay *fhe has a good way*; and they call the account how faft fhe fails by the log, *keeping an account of her way*.

And becaufe moft fhips are apt to fail a little to the leeward of their true courfe; they always, in cafting up the log-board, allow fomething for her leeward-way. Hence alfo a fhip is faid to have *head-way* and *ftern-way*.

WAY *of the Rounds*, *Chemin des Rondes*, in *Fortification*, is a fpace left for the paffage of the rounds, between the rampart, and the wall of a fortified town.

This is not now much in ufe; becaufe the parapet not being above a foot thick, it is foon overthrown by the enemy's cannon.

WAY, *Covert*, *Fofs*, *Gang*, *Hatch*, *Spur*, and *Water*. See the feveral articles.

WAY-*Bread*, in *Agriculture*, a name given in fome places to the herb plantain, which is very ufeful in fome grafs lands, as increafing the quantity of feed very greatly. See PLANTAGO.

WAY-*Going Crop*, a term applied to that which is taken from the ground the year the tenant or occupant leaves a farm. Such crops are regulated in many different ways, according to the nature of the leafes. See LEASE.

WAY-*Leave*, a provincial term for the ground purchafed or hired to make a waggon-way upon, between coal-pits and the river.

WAY-*Pane*, in *Agriculture*, a term applied to the flips left for cartage in watered lands. It is that part of the ground which lies, in a properly watered meadow, on that fide of a main where no trenches are formed and taken out, but is floated all the length of the main over its banks, having a drain parallel to it. It ferves as a road for conveying the hay upon out of the ground, inftead of the teams having to crofs all the trenches.

WAY-*Thiftle*, a troublefome plant of the perennial weed kind, with ftrong roots that branch out in a horizontal manner. Some think it may be weakened or deftroyed wholly by frequent cutting over, the beft feafon for which is when it is coming into full bloom; as the wet then gets down its hollow ftalk, and aids the rotting of it. In tillage-land it is fometimes got quit of by deep repeated ploughing. See THISTLE and WEEDS.

WAY-*Warden*, in *Rural Economy*, a name fometimes given to the furveyor or overlooker of the roads of a diftrict or county.

WAYA, in *Geography*, a town on the E. coaft of the ifland of Celebes, in Tolo bay. S. lat. 1° 50′. E. long. 121° 52′.

WAYAM, a fmall ifland in the Pacific ocean, near the S.E. coaft of the ifland of Waygoo. S. lat. 0° 24′. E. long. 131° 30′.

WAYBARI, a river of Guiana, which runs into the Atlantic, N. lat. 6° 25′. W. long. 58° 6′.

WAYBORN HOPE, a creek and point of land, on the N. coaft of the county of Norfolk, which takes its name from a village, about five miles from Holt.

WAYED HORSE, in *Rural Economy*, a term applied to an animal of this kind which has been already backed and broken in for work, and which fhews a difpofition to be tractable and ufeful. See HORSE and TEAM.

The term is likewife fometimes applied to team-oxen and other animals.

WAYFARING-TREE. See VIBURNUM.

WAYGAT'S STRAIT, in *Geography*, a ftrait of Ruffia in Europe, feparating a fmall ifland, called *Waygat* ifland, from the continent or country of the Samoiedes. It is alfo called Vaigatfkoi and Vaiatch. N. lat. 68°. E. long. 60°. See VAIGATSKOI.

WAYGOO, an ifland in the Pacific Ocean, about 60 miles

miles in length, from E. to W., and 25 in breadth. N. lat. 0° 2′ to 0° 30′. E. long. 130° 31′ to 131° 40′.

WAYNE, a town of America, in the diftrict of Maine, and county of Kennebeck, containing 819 inhabitants.—Alfo, a townfhip of Pennfylvania, in Greene county, containing 588 inhabitants.—Alfo, a townfhip of Pennfylvania, in Crawford county, containing 502 inhabitants.—Alfo, a townfhip of Pennfylvania, in Mifflin county, containing 1501 inhabitants.—Alfo, a county of Pennfylvania, containing 4125 inhabitants.—Alfo, a townfhip of Ohio, in the county of Adams, containing 901 inhabitants.—Alfo, a townfhip of Ohio, in the county of Butler, containing 1135 inhabitants.—Alfo, a townfhip of Ohio, in the county of Columbiana, containing 377 inhabitants.—Alfo, a townfhip of Ohio, in Jefferfon county, containing 1161 inhabitants.—Alfo, a townfhip of Ohio, in Knox county, containing 478 inhabitants.—Alfo, a townfhip of Ohio, in Montgomery county, containing 431 inhabitants.—Alfo, a townfhip of Ohio, in Pickaway county, containing 742 inhabitants.—Alfo, a townfhip of Ohio, in Scioto county, containing 398 inhabitants.—Alfo, a townfhip of Ohio, in Tufcarawa county, containing 191 inhabitants.—Alfo, a townfhip of Ohio, in Warren county, containing 1862 inhabitants.—Alfo, a county of Kentucky, containing 5393 inhabitants, of whom 226 are flaves; the town Monticilio contains 37 perfons, including 4 flaves.—Alfo, a county of North Carolina, containing 8687 inhabitants, 2756 being flaves.—Alfo, a county of Georgia, containing 254 inhabitants.—Alfo, a county of the Miffiffippi territory, containing 1253 inhabitants, 262 being flaves.—Alfo, a large townfhip of New York, in the N.E. part of Steuben county, 15 miles E. of Bath, called Frederick's town till the year 1808: it has a poft-office called Rofcommon. The S. part is hilly, but the central and other parts are arable and productive. The timber is chiefly oak and walnut, and fome pine on the hills. Here are a congregation of Baptifts, and a competent number of fchool-houfes. The fettlement commenced about 1794, and the population is rapidly increafing. In 1810, the number of people was 1025, and that of fenatorial electors 57.

WAYNESBOROUGH, a town of Georgia, containing 111 inhabitants.

WAYS *and* MEANS, *Committee of*. See SUPPLIES.

WAYTE, in *Geography*, a rocky iflet in the ftraits of Macaffar, near the weft coaft of Celebes. S. lat. 0° 40′. E. long. 119° 18′.

WAYTO, a town on the S.E. coaft of the ifle of Timor. S. lat. 8° 39′. E. long. 126° 9′.

WAY-WISER, an inftrument for meafuring the road, or diftance gone; called alfo perambulator, and podometer, or pedometer.

Mr. Lovell Edgworth communicated to the Society of Arts, &c. an account of a way-wifer of his invention; for which he obtained a filver medal. This machine confifts of a nave, formed of two round flat pieces of wood, one inch thick and eight inches in diameter. In each of thefe pieces there are cut eleven grooves, five-eighths of an inch wide and three-eighths deep; and when the two pieces are fcrewed together, they enclofe eleven fpokes, forming a wheel of fpokes, without a rim: the circumference of the wheel is exactly one pole; and the inftrument may be eafily taken to pieces, and put up in a fmall compafs. On each of the fpokes there is driven a ferril, to prevent them from wearing out; and in the centre of the nave, there is a fquare hole to receive an axle. Into this hole there is inferted an iron or brafs rod, which has the thread of a very fine fcrew worked upon it from one end to the other; upon this fcrew hangs a nut which, as the rod turns round with the wheel, advances or recedes towards or from the nave of the wheel. The nut does this becaufe it is prevented from turning round with the axle, by having its centre of gravity placed at fome diftance below the rod, fo as always to hang perpendicularly like a plummet. Two fides of this fcrew are filed away flat, and have figures engraved upon them to fhew by the progreffive motion of the nut, how many circumvolutions the wheel and its axle have made: on one fide the divifions of miles, furlongs, and poles, are in a direct, and on the other fide the fame divifions are placed in a retrograde order.

If the perfon who ufes this machine places it at his right fide, holding the axle loofely in his hands, and walks forward, the wheel will revolve, and the nut advance from the extremity of the rod towards the nave of the wheel. When two miles have been meafured, the nut will have come clofe to the wheel. But to continue this meafurement, nothing more is neceffary than to place the wheel at the left hand of the operator; and the nut will, as he continues his courfe, recede from the axle-tree, till another fpace of two miles is meafured.

It appears from the conftruction of this machine, that it operates like circular compaffes; and does not, like the common-wheel way-wifer, meafure the furface of every ftone and mole-hill, &c. but paffes over moft of the obftacles it meets with, and meafures the chords only, inftead of the arcs of any curved furfaces upon which it rolls.

WAYWODE. See WAIWODE.

WEACHIN, in *Botany*, the name given by the Indians of America to the maize, or Indian corn, which they cultivated for bread before we knew them.

WEADINGSTEDE, in *Geography*, a town of the duchy of Holftein; 7 miles E. of Weflingburen.

WEAK, or EASY BRANCH, in the *Manege*. See BANQUET, and BANQUET-*Line*.

WEAK-*Land*, in *Agriculture*, that which is of a light, thin, open nature, and which is deficient in ftaple, or the quantity of proper mouldy material. It is directly contrary to that of the cold watery kind, which often changes the nature and quality of the produce, and retards vegetation in the early fpring, or during wet feafons, as it forwards the growth of the crops that are put upon it, but is frequently defective in the amount of produce which is afforded. It is to be improved by the ufe of proper earthy fubftances and manures, according as the quality of it may be, and by keeping the furface of it as much covered as poffible by fuitable green crops, to prevent the too great expofure of it to the action of the fun and winds. Such other means, of the fame kind, as the nature, circumftances, and fituation of the land will permit, may likewife be purfued. See SOIL.

WEAK-*Pulfe*. See PULSE.

WEAKY, in *Agriculture*, a term ufed to fignify juicy, in contradiftinction to that of dry or hufky, as applied to different kinds of food.

WEALD, or WEALD-*Land*, a name applied to a kind of wild woody tract of ground of a ftiff heavy quality in fome fouthern diftricts, as thofe of Kent, Suffex, &c.

It is moftly of a deep tenacious clayey, marly, and loamy nature, but occafionally intermixed with earths of a lighter and more open fort. The writer of the account of the agriculture of the former of the above counties, ftates, that the weald part of that diftrict was in ancient times an immenfe wood or foreft, inhabited only by herds of deer and hogs, and belonged wholly to the king. That by degrees it became peopled, and interfperfed with villages and towns; and by piece-meal, was, for the moft part, cleared of its wood, and converted into tillage and pafture. There are, however, ſome woodlands ſtill in their original ſtate; and by the author of that of the latter, it is remarked, that ſo predominant is the timber and wood of one ſort or another in the weald of that county, that when viewed from any eminence in the neighbourhood, it preſents to the eye hardly any other proſpect but a maſs of wood, which is, it is thought, to be aſcribed to the great extent and quantity of wood, preſerved by a cuſtom of a nature ſo extraordinary, that it is not a little ſurpriſing no ſteps have been taken to put an end to it.

When this county was firſt improved by clearing, as in the other diſtrict, it was, it is ſaid, a common practice to leave a *ſhaw* of wood ſeveral yards in width, to encompaſs each diſtinct incloſure, as a nurſery for the timber and other plants. The ſizes of theſe incloſures being ſmall, they muſt of neceſſity contribute to render the general appearance of the tract woody.

Anterior to the Conqueſt, the weald of this county was, it is ſaid, a continued foreſt, extending from the borders of the firſt diſtrict to the confines of Hampſhire, acroſs the whole of it; and the names of a variety of pariſhes ſituated in this line, and evidently derived from Saxon original, atteſt this fact to the preſent day. In ſhort, the foreſt now remaining occupies, it is ſaid, a conſiderable portion of the county.

The weald parts of both theſe counties were probably once one great foreſt.

It is noticed, that there is, perhaps, no object in the weald of the latter county, ſo worthy of attention and obſervation as the growth of timber; that there is no region of the earth where trees of all kinds thrive better, but eſpecially thoſe of the oak and aſh ſorts. The tract there diſtinguiſhed by the title of the Weald has formerly, it is ſtated, been covered with trees, and it was called the foreſt of Anderida; and that now, even if a field be neglected, it will become a wood, principally of oak and birch, intermixed with hazel, ſome kinds of willow, and dog wood.

This diſpoſition for the growth and raiſing of wood and timber ſhould, in all caſes of weald land where it cannot be converted to a better or more profitable purpoſe, be taken advantage of and promoted, by proper planting and encouraging the natural growth of the wood thrown up, as it may form one great feature in the improvement of ſuch land, and be productive of vaſt benefit in bringing every portion and ſort of it to the greateſt profit.

WEALREAF, in our *Old Writers*, ſignifies the robbing of a dead man in his grave.

The word comes from the Saxon *weal*, *ſtrages*, and *reaf*, *ſpoliatio*.

WEANEL, a country term for a young beaſt newly weaned, or taken from ſucking its dam.

WEANING, Ablactation. See Ablactation.

Weaning *Young Live-Stock*, in *Rural Economy*, the ſeparating them from the mothers in the different kinds, for different purpoſes, and in different intentions.

Foals, where they are deſigned for the ſaddle, ſhould, on being taken from the mothers, be put into ſome ſafe ſheds or other proper places at a diſtance, where they can be quiet and out of the hearing of the mares, being well ſupplied with the neceſſary ſorts of food and good water for a day or two; the buildings ſhould be connected with graſs-fields, into which they can be turned in the day-time, but be always brought up for the night, for ſome time, having proper kinds of dry food then given them in full quantities, ſo as to get them on well at firſt. Some intelligent breeders have their young horſe-ſtock fed, after weaning, with coarſely ground oats and one-third flour, divided into proper feeds, and given on the nights in the houſes. This, it is ſaid, puſhes them on early to a full growth, and that they never become ſtunted afterwards. In ſome inſtances, it may be uſeful and proper to put the colt and filly foals into ſeparate paſtures. Where a number are to be weaned at a time, it is of advantage to have the paſture-lands pretty large. See Breeding, Foal, and Horse.

In the weaning of the young of neat cattle, the buſineſs is accompliſhed at different times or ages of the animals, as the nature of the purpoſe for which they are deſigned may be; when for rearing as ſtock, it is often done immediately, or in a few days or weeks, and when for fattening, not at all. If for ſale, the time is uncertain, depending on the demand. Where good neat cattle-ſtock is the object, as ſoon as the natural food milk is laid aſide, a ſubſtitute of ſome good ſort of diet ſhould be had recourſe to, ſuch as oat or barley-meal, ſtirred in with the jelly of linſeed, that has been produced by being ſteeped in hot water, and mixed with flet milk; which ſhould be continued until they become capable of eating more firm and ſolid kinds of food, ſuch as either oats, ſplit beans, and chopped hay, or bran, and barley-flour mixed: in the early ſpring they ſhould be turned out into good graſs paſtures in warm ſituations. By theſe means they will be brought on well, and become good ſtrong ſtock. For the purpoſe of rearing, as well as that of the butcher, thoſe that are dropped early are to be preferred, as after the early ſpring months, they are not found capable of gaining ſufficient ſtrength and hardneſs before the ſucceeding winter comes on, or a proper ſize and growth by the enſuing ſpring.

In the buying of the young of neat cattle for weaning there are many ſyſtems of management among farmers: ſome prefer bull calves for caſtration, and which they keep, in ſome caſes, until they become reared, and are fat bullocks fit for the market; others buy cow-calves of the true ſhort-horned, or ſome other good milking-breed, which they ſell at two years, or two years and a half old, and upwards, to the cow-keepers as milking-ſtock. In this method, they are collected from the latter end of the ſummer through the autumn of the above true breed, as others will not do from Yorkſhire, and other places where they are to be met with of the right kind, as ſuch ſell better, and more readily to the cow-keepers for affording milk. In weaning, they are then firſt put to ſkim-milk, and tempted as ſoon as poſſible to eat ſome other good food, as bran, oats, oil-cake, the ſweeteſt hay, common turnips, and cole or rape; but nothing is found to do better for them than the Swediſh turnip cut ſmall. In keeping them, they ſhould have great attention to cleanlineſs, and the proper and regular feeding of them. In this way they are continued, being kept in ſheds in the night-time, and turned out by day, until the ſpring, when the ray-graſs becomes ready, and then they may go out gradually altogether, according as the weather may be: after ray-graſs to the beſt marſhes or paſtures; in the autumn to cole or rape that is feeding off for wheat, and after that to turnips: it is a rule with ſome to feed them through the whole period of keeping them as well as poſſible. This is expenſive, but it is conceived, that if they will not pay for good keeping, they will not for bad. Some, however, when they are turned out, make them the followers of the fattening ſtock.

In this ſyſtem there are thoſe, too, who buy both cow and bull-calves, diſpoſing of the former in the above manner, and keeping the latter raiſing a ſucceſſion of ſteers for the grazing or fattening farmers.

All theſe modes, though hazardous in ſome inſtances, are often

often very beneficial. A man is required for the purpofe, in autumn, winter, and fpring, when the bufinefs is carried on upon a large fcale. See CALF, BREEDING, and CATTLE. Alfo COW-KEEPING.

The weaning of lambs is a matter of fome trouble and difficulty in many cafes; it fhould be done towards the latter end of the fummer, according to circumftances, but never be delayed too long, as the ewes may thereby be greatly hurt in different ways. After the lambs are taken, or lifted as it is fometimes called, from the mothers, they fhould be allowed to pafs the night about the fold or place. In the following morning fome of them will begin to eat, and teach the others to do the fame. They fhould then be removed to fome convenient foft graffy pafture, difturbing them as little as poffible, care being taken that they do not wafte or exhauft themfelves by running. If there be any danger of their not refting quietly the firft night after they are removed, it is faid that it may be effectually prevented by pafturing them with their mothers the night immediately preceding their weaning, on their future pafture, and driving them to the fold or other place directly in that road or way by which the lambs are to be removed from it. In the courfe of ten or twelve days both the lambs and the ewes may be paftured together again without inconvenience. See LAMB and SHEEP.

Store fwine fhould conftantly be weaned at the end of a few weeks, as about fix or eight, otherwife they do much injury to the fow. The young pigs fhould be well fed for fome time afterwards, in order to pufh them on to their proper growth, and prevent their becoming dwarfifh. The want of attention to this often produces a poor ftunted fort of pigs, worth little or nothing. See SWINE.

WEANLING, a term applied in fome diftricts to the newly-weaned calf. See WEANING.

WEAPONS. See ARM and ARMOUR.

WEAPON-*Salve*, a kind of unguent, fuppofed to cure wounds fympathetically, by being applied, not to the wound, but to the weapon that made it. See SYMPATHETIC *Powder*, and TRANSPLANTATION.

WEAR, or WEER, a great ftank, or dam in a river; fitted for the taking of fifh, or for conveying the ftream to the mill. See FISHING, and WEIR.

WEAR, in *Geography*. See WERE.

WEARE, a townfhip of America, in New Hampfhire, in the county of Kellfborough, containing 2634 inhabitants; 18 miles S.W. of Concord.

WEARING, in *Sea Language*. See VEERING.

WEARY BAY, in *Geography*, a bay on the N.E. coaft of New Holland, S. of Endeavour river.

WEASEL, WEESEL, *Common*, in *Zoology*, a fpecies of the muftela. See MUSTELA *Vulgaris*.

The common weafel ufually refides in cavities under the roots of trees, as well as of banks near rivulets, &c. from which it occafionally fallies out in fearch of birds, and more efpecially of field-mice, great multitudes of which it deftroys.

In Norway, Sweden, Ruffia, and Siberia, the weafel always changes to white at the approach of winter. In Siberia it is called *lafmitfka;* and the fkins are fold to the Chinefe for three or four rubles *per* hundred.

We have authentic accounts of this animal's being fo completely tamed, as to exhibit every mark of attachment to its benefactors, and to be as familiar as a cat or lap-dog. A lady took one of thefe animals under her protection; and fed it from her hand with warm milk, and alfo with veal, beef, or mutton. When it is fatisfied it generally goes to fleep, and when it wakes, it amufes itfelf with various frolics, and beftows the moft affectionate careffes on its guardian. It diftinguifhes the voice of its benefactrefs amidft twenty people, and gives her a decided preference to all the reft. Among other curious particulars which this lady has recited, we cannot forbear mentioning the curiofity of this animal; it being impoffible, as fhe fays, to open a drawer or a box, or even to look at a paper, which this little creature will not alfo examine. Aldrovandus indeed confirms the account given by Buffon; exprefsly afferting, that weafels are eafily tamed, and that, when tame, they are remarkably playful; adding, at the fame time from Curdan, that if their teeth are rubbed with garlick, they will not afterwards prefume to bite. This writer alfo affirms, that the weafel fometimes carries her young in her mouth from place to place feveral times in a day, when fhe fufpects that they will be ftolen from her; refembling fome other animals in this refpect. For other fpecies of weafel we refer to MUSTELA and VIVERRA; and we fhall here add fome few fpecies, mentioned by Dr. Shaw, which have not been noticed under either of thofe articles. Such are the *Viverra Touan*, or ferruginous weafel, white beneath, with the tail naked towards the tip, the "Touan" of Buffon; a native of Cayenne, that lives in hollow trees, and feeds on worms and infects. The *V. Cuja*, or black weafel, with turned up fnout, the "Cuja" of Molina, refembling the ferret in fhape, manners, and teeth; a native of Chili, and preying upon mice. The *V. Maculata*, or dufky weafel, fpotted with white; the "Spotted Martin" of governor Phillips, in its form fomewhat refembling the foffane. There are alfo fome other fpecies, not yet fufficiently defcribed, as the grey-headed weafel, or "La Grande Marte de Guiane," of Buffon; the South American weafel, or "La Fouine de la Guiane," of Buffon; the woolly weafel, or "La petite Fouine de la Guiane," of Buffon; the mufky weafel of Pennant, a native of Bengal; and the flender-toed weafel with a bufhy tail, defcribed, as well as the other, by Mr. Pennant from a drawing; this latter being a native of Cochinchina.

WEASEL-*Coot*, in *Ornithology*, the red-headed fmew, or mergus minutus of Linnæus.

WEATHER, in *Agriculture*, as denoting the ftate or difpofition of the atmofphere, in regard to heat and cold, drought and moifture, fog, fair, or foul, wind, rain, hail, froft, fnow, and other changes, is a fort of knowledge which is of vaft utility and importance to the farmer, as the fecuring of his different produce in a perfect manner greatly depends upon it; and it is in and by means of the atmofphere, that plants are in fome meafure nourifhed, and that animals live and breathe: any alterations or changes in its heat, denfity, purity, or any other refpect, muft, of courfe, neceffarily be attended with proportionable changes in the ftate of thefe.

The great but regular alterations which a little change of weather makes in many parts and forts of inanimate matter, is fully and ftrikingly fhewn in the common inftances and cafes of barometers, thermometers, hygrometers, and other fuch inftruments; and it is owing partly to our inattention, and partly to other caufes and circumftances, that we, like other animals, do not feel as great and as regular ones in the weight, preffure, and affections, in the tubes, chords, and fibres of our own bodies.

In order, however, fully to form and eftablifh a proper and confiftent theory or doctrine of the weather, it would be neceffary to have accounts and regifters of it regularly and carefully kept, in divers parts of the globe, for a long ſeries of years, whence, it is poſſible, we might be enabled to aſcertain and determine the directions, breadths, and bounds of the winds, as well as other matters, and the nature of the weather they bring along with them; with the correſpondence there may be between the weather of different places, in divers parts of the earth, and the difference between one ſort and another at the ſame place; and thus, in time, learn to judge of, and foretell many great changes and emergencies; ſuch as extraordinary heats, droughts, rains, froſts, ſnows, and ſome others. But hitherto very few, and only partial accounts in relation to the weather, have been, for the moſt part, kept. The general concluſions that have been drawn from the experiments that have been made, and the experience had upon this ſubject, are, that barometers generally riſe and fall together, even at very diſtant places, and a conſequent conformity and ſimilarity of weather; and that this is the more uniformly ſo, as might be expected, as the places are the nearer together. That the variations of theſe inſtruments, too, are the greater, as the places are nearer to the pole; thus, for inſtance, the quickſilver in them at London, has a greater range by two or three lines than at Paris, and at that place a greater than at Zurich; and that at ſome places near the equator, there is ſcarcely any variation at all; that the rain in Switzerland and Italy is much greater in quantity, taking it for the whole year, than in the county of Eſſex, though the rains are yet more frequent, or there are more rainy days in that county, than in either of the other places; that cold contributes greatly to rain, and this apparently by condenſing the ſuſpended vapours, and thereby making them deſcend; thus, very cold months, or ſeaſons, are very commonly followed immediately by very rainy ones, and cold ſummers are always wet ones; that high ridges of country, or mountains, ſuch as the Alps and others, and the ſnows with which they are covered, not only affect the neighbouring places, but even diſtant countries, as theſe often partake of their effects; and the weather is moſtly rainy in the vicinities of them, both in this and other countries.

The prognoſtics of the weather that are formed from other circumſtances and obſervations are, that a thick dark ſky laſting for ſome time, without either ſun or rain, always becomes fair firſt and then foul; that is, it changes to a fair clear ſky before it turns to rain. The reaſon is thought to be obviouſly this: the atmoſphere is replete with vapours, which though ſufficient to reflect and intercept the ſun's rays from us, yet want denſity to deſcend, and while theſe vapours continue in the ſame ſtate, the weather will do ſo too: accordingly ſuch weather is commonly attended with moderate warmth, and with little or no wind to diſturb the vapours, but having a heavy atmoſphere to ſuſtain them; the barometer being commonly high: but when the cold approaches, and by condenſing the vapours, drives them into clouds, or drops, the way is made for the ſun-beams to diſplay themſelves; until the ſame vapour, by farther condenſation, be formed into rain, and fall down in drops. And that a change in the warmth of the weather is often followed by a change in the wind. Thus, the northerly and ſoutherly winds, though commonly accounted the *cauſes* of cold and warm weather, are in reality the *effects* of the cold or warmth of the atmoſphere; of which Dr. Derham aſſures us he has had ſo many confirmations, that he makes no doubt of the fact. Thus, it is common to obſerve a warm ſoutherly wind, ſuddenly changed to the north, by the fall of ſnow or hail; or to ſee the wind in a cold froſty morning north, when the ſun has well warmed the air, wheel towards the ſouth, and again turn northerly or eaſterly in the cold of the evening.

From the rules laid down by the ſhepherd of Banbury, many intereſting and uſeful deductions may be made in regard to the weather: it may be concluded, that when the ſun riſes red and fiery, there will be wind and rain; but that when it riſes cloudy, and the clouds ſoon diſappear or leſſen, there will certainly be fair weather; and that when the evening is red and the morning grey, a fine day may moſtly be predicted.

That when there are ſmall and round clouds, of a dapple grey colour, with a north wind, it may be determined, that there will be fair weather for two or three days; but that large clouds like rocks are a ſign of great ſhowers. And that when ſmall clouds increaſe, it is an indication that there will be much rain; but that if the large clouds are ſeen to leſſen, there will be fair weather. In ſummer or harveſt, it may alſo be conſidered, when the wind has been ſouth two or three days and it grows very hot, and clouds are ſeen to riſe with great white tops like towers, as if one were on the top of another, being joined together with black on the lower ſide, a ſign that there will be thunder and rain ſuddenly. And that when two ſuch clouds riſe, one on each hand, it is high time to make haſte to ſhelter.

That when a cloud is ſeen to riſe againſt the wind, or the ſide wind, it is a ſure ſign that when the cloud comes up near you, the wind will blow the way in which the cloud came. It is the ſame, too, with the motion of a clear place in the ſky, when all the parts of it are thick except one edge. That, at all times, when the clouds look black in the weſt, it is ſure to rain; or if raining, it is ſure to continue, whatever quarter the wind may be in: and that, on the contrary, if it ſhould break in the weſt, it is ſure to be fair. That fair weather for a week, with a ſouth wind, is likely to produce a great drought.

That the wind uſually turns from north to ſouth quietly, but comes back to north ſtrong and with rain. That ſudden rains never laſt long; but that when the air grows thick by degrees, and the ſun, or moon and ſtars, ſhine dimmer and dimmer, it is likely to rain for ſome time.

That when it begins to rain from the ſouth with a high wind for two or three hours, and then the wind falls but the rain continues, it is likely to rain twelve hours or more; and that it generally rains until a ſtrong north wind clears the air. But that when it begins to rain an hour or two before ſun riſing, it is likely to be fair before noon, and to continue ſo that day; but that if the rain begin an hour or two after ſun riſing, it is likely to rain all that day, unleſs the rainbow be ſeen before it rains.

That when miſts riſe in low ground and ſoon diſappear, it is a ſign that there will be fair weather; but that when they riſe to the hill tops, there will be rain in a day or two. That a general miſt before the ſun riſes, when near the time of full moon, is a ſign of fair weather. That when there are miſts in the new moon, there will be rain in the old; and if there are miſts in the old moon, there will be rain in the new. That in regard to the ſeaſons, as ſpring and ſummer, when the laſt eighteen days of the month of February and the firſt ten days of the following month are for the moſt part rainy, the ſpring and ſummer may be concluded likely to be ſo too. It is ſaid alſo, that a great drought has never been known by the writer, but which began at that time. In reſpect to the winter, when the end of October and the beginning of the following month are, for the moſt part, warm and rainy, the two beginning months of the new year are likely to be froſty and cold, except after a very

dry

dry ſummer. But that when October and the following month are ſnowy and froſty, the two beginning months of the new year may be likely to be open and mild.

Something may be drawn from the habits, cries, and courſe of animals, in reſpect to the weather. It is remarked, that in ſummer, when ſheep riſe early in the morning, it is a ſure ſign of either rain, or a very hot day; and that, in all ſeaſons, when they jump and play much about, it is an indication of rain or wind, but generally of both, in the ſummer, and of very ſtormy weather in the winter. That in winter, when the ſheep lie under a hedge, and ſeem loath to go off to paſture, and bleat much, it is conſidered a ſign of a ſtorm. And that, when ſheep are fed with hay in the winter, and in froſty and ſnowy weather they leave the hay, it is a certain ſign of the froſts breaking up.

That when rabbits get out to feed early in the morning, it is a ſign of rain in the night in ſummer, and of either rain or ſnow in winter; and that when it is likely to be a bad night, they will be apt to get home before it is dark.

That pigs appear very uneaſy before high winds, and run about ſqueaking as if they were in great pain.

That when owls ſcreech, it is a certain ſign of rain, and moſtly in a very ſhort time. Alſo, that when wood-peckers cry, it is a ſign of rain. For this reaſon, they are called, in ſome places, rain-fowl. That likewiſe, when peacocks cry much, it is a ſign of rain. That when the cocks begin to crow while it rains, it is a ſign of fair weather.

That before a wet ſummer, the ſwans build their neſts very high; but that before a dry ſummer they build very low. That the bittern or bitter bump does the ſame. But that when the raven is obſerved early in the morning ſoaring round and round at a great height in the air, it is a ſure ſign the day will be fine, and that the weather is likely to ſet in for fair. And that in ſummer when the bat is ſeen flying and flitting about very late in the evening, the next day is likely to be fair. That likewiſe when the ſwallow is obſerved to fly high, the weather will moſt likely be warm and fair. But that when it is noticed to fly low, and dip the tips of its wings in the water as it ſkims over the ſurface, the weather is likely to be rainy. And that the continued ſqualling of the guinea-fowl, and the quacking of ducks and geeſe, are certain ſigns of rain.

That before great ſtorms the miſſel thruſh ſings particularly loud, and continues to do ſo until the rain begins. On this account, in ſome places, it is called the ſtorm-fowl. Alſo, that in autumn, when flocks of wild geeſe are ſeen flying over in a weſterly direction, it is a ſign there ſoon will be hard weather. That the early appearance of the wood-cock and field-fare likewiſe indicate cold hard winters.

That when in the time of hay-making the black ſnails are to be ſeen ſtretched along on the ſwath of graſs, it is a ſign of rain. That when frogs look black inſtead of a golden yellow colour, it is a ſign of rain. And the loud hoarſe croakings of frogs are ſure ſigns of rain.

That in autumn, when the dor beetle is ſeen flying about in the evening, the next day is likely to be fine. Alſo, that when bees do not go out as uſual, but keep in their hives, it is a ſign of rain. Much information of this nature may be found in Marſhall's "Minutes of the Southern Counties," which may be conſulted by the cautious farmer with great utility and advantage, in regard to the weather he may have for ſecuring his produce in different caſes.

There are other concluſions, too, in reſpect to the weather, that may be drawn from plants of different kinds, as moſt vegetables expand their flowers and down in ſun-ſhiny weather; and towards the evening and againſt rain cloſe them up, eſpecially at the beginning of their flowering, when the ſeeds are ſenſible and tender. This is viſible and evident enough in the down of dandelion, and many other downs, and eminently ſo in the flowers of pimpernel; the opening and ſhutting of which make what is termed the countryman's *weather-wiſer*, by which he foretels the weather of the following day. The rule is, when the flowers are cloſe ſhut up, it betokens rain and foul weather; but when they are open and abroad fair weather. And lord Bacon obſerves, that the ſtalks of trefoil ſwell againſt rain, and grow more upright; and that the like may be noticed, though leſs ſenſibly, in the ſtalks of moſt other plants. It is added, too, that in the ſtubble fields there is found a ſmall red flower, called by the country people pimpernel, which opening in a morning is a ſure indication of a fine day.

"Eſt & alia (arbor in Tylis) ſimilis, folioſior tamen, roſeique floris; quem noctu comprimens, aperire incipit ſolis exortu, meridie expandit. Incolæ dormire eum dicunt. Plin. Nat. Hiſt. lib. xii. c. 11. See *Sleep of* PLANTS, and VIGILIÆ *Florum*.

It is readily conceivable that vegetables ſhould be affected by the ſame cauſes as the weather, as they may be conſidered as ſo many hygrometers and thermometers, conſiſting of an infinite number of *tracheæ* or air-veſſels, by which they have an immediate communication with the air or atmoſphere, and partake of its moiſture, heat, and other changes. And hence, too, it is, that all wood, even the hardeſt and moſt ſolid, ſwells in moiſt weather, the humid vapours eaſily inſinuating themſelves into the pores of it, eſpecially of the lighter and drier kinds, from which they become applicable to many purpoſes of art, and may tend to ſhew the change of the weather in ſome inſtances.

Hence we derive a very extraordinary uſe of wood, *viz.* for breaking rocks for mill-ſtones.

The method at the quarries is this:—Having cut a rock into a cylinder, they divide that into ſeveral leſs cylinders, by making holes at proper diſtances round the great one; the holes they fill with ſo many pieces of ſallow wood, dried in an oven, which, in moiſt weather, becoming impregnated with the humid corpuſcules of the air, ſwell; and, like wedges, break or cleave the rock into ſeveral ſtones.

The attentive farmer ſhould ſtore up in his mind as many of the uſeful rules relating to the weather as poſſible, as they may ſerve him very effectually, on many occaſions, in the performance of his various buſineſs. See ATMOSPHERE, METEOROLOGY, HEAT, RAIN, WIND, &c.

The members of our Royal Society, the French Academy of Sciences, and many authors of note, have made conſiderable eſſays this way; and the practice of keeping meteorological journals has, of late years, become very general. For inſtructions and examples pertaining to this ſubject, ſee Phil. Tranſ. vol. lxv. part ii. art. 16.

Eraſ. Bartholin has obſervations of the weather for every day throughout the year 1671. Mr. W. Merle made the like at Oxford, for ſeven years, with a very remarkable care and accuracy. Dr. Plott did the ſame at the ſame place, for the year 1684. Mr. Hillier, at Cape Corſe, for the years 1686, 1687. Mr. Hunt, &c. at Greſham college, for the years 1695, 1696. Dr. Derham, at Upminſter in Eſſex, for the years 1691, 1692, 1697, 1698, 1699, 1703, 1704, 1705. Mr. Townley, in Lancaſhire, in 1697, 1698. Mr. Cunningham, at Emin in China, for the years 1698, 1699, 1700, 1701. Mr. Locke, at Oats in Eſſex, 1692. Dr. Scheuchzer, at Zurich, in 1708; and Dr. Tilly, at Piſa, the ſame year. See the Phil. Tranſactions.

The form of Dr. Derham's obſervations we give as a ſpecimen of a journal of this kind; obſerving that he notes

 the

the ftrength of the winds, by 0, 1, 2, 3, &c. and the quantity of rain, as it fell through a tunnel, in pounds and centefimals.

Phenomena of the Weather, October 1697.

Day.	Hour.	Weather.	Wind.		Barometer.		Rain.
27	7	Fair.	S.W.	2	29	37	1 52
	12	Rain.	S.W. by W.	5	29	34	
	9	Stormy.		0	29	88	0 29

We have feveral fchemes for keeping meteorological journals or diaries of the weather, extant in the Philofophical Tranfactions, the Medical Effays of Edinburgh, and in other books. The Ephemerides Ultrajectinæ may alfo be confulted. The inftruments requifite for fuch journal are, a *Barometer*, *Thermometer*, *Anemofcope*, and *Ombrometer*, which fee in their proper places. See a Collection of ingenious obfervations, and meteorological conjectures, by Dr. Franklin, in his Experiments, &c. p. 182, &c. See EVAPORATION, RAIN, and WIND.

We fhall here fpecify fome of the common indications of changes of weather that may be obferved at fea. Under the article TIDES we have already ftated, that they are raifed by the joint actions of the fun and moon; the fpring-tides being raifed by the fum, and the neap-tides by the difference of the actions of thefe bodies; and, alfo, that the fpring-tides, near the time of an equinox, are higher than at other times of the year. Now, fince the atmofphere is a fluid much lighter than water, it muft, therefore, be more affected about the times of new and full moon, and in the months of March and September, than at other times. This is confirmed by obfervation; for, about the times of new and full moon, an alteration in the ftate of the weather ufually happens; and the violent gales about the time of the equinoxes, called *equinoxial gales*, are well known, and expected by every feaman.

According as the ftate of the atmofphere is more or lefs difturbed, it is evident the appearance of the heavenly bodies will be more or lefs altered. Thus, if the moon appears paler than ufual, or if there is a halo about the moon, rain will probably follow foon after. Several circles about the moon portend wind. Thefe obfervations are alfo applicable to the fun. If the moon appears of a red colour, or if the moon's horns are blunt, they are figns of wind, which may be expected from that quarter to which the blunteft horn is directed. In viewing the moon with a telefcope in a quiet evening, if one part of the moon's limb be obferved to be tremulous, while the oppofite part of the limb is without the leaft apparent tremor, the wind may be expected from that point to which the limb free of tremors is directed. A red circle about the moon towards the time of full moon indicates wind.

One of the beft known figns in the heavens is the *Rainbow;* which fee. When the blue and yellow parts of the rainbow are very bright, or if all of it vanifh at the fame time, it will be fair weather: if the bow appears to be broken in feveral places, tempeftuous weather may be expected.

From the various appearances of the clouds, (fee CLOUD,) which are vapours floating in the atmofphere, producing rain, hail, fnow, thunder, and lightning, the approaching weather may, in fome meafure, be predicted. The height of the clouds feldom exceeds a mile; and the fummits of high mountains are free of clouds.

When the fky is of a fine blue colour, without any clouds, it will continue to be fair weather; but if it is of a very dark blue, clouds will be formed, and rain, wind, or fog, will foon follow.

When the fky appears very much clouded for fome time, without rain, it generally firft clears up, and then changes to rain. This is accounted for as follows:—The atmofphere at that time being replete with vapours, which, though fufficient to intercept the rays of the fun, yet want denfity to defcend; and while the vapours continue in the fame ftate, the weather will do fo too; and fuch weather is commonly attended with moderate warmth, and with little or no wind to difturb the vapours, and an heavy atmofphere to fupport them, the barometer being commonly high. But when the cold approacheth, and, by condenfing the vapours, drives them into clouds or drops, then way is made for the fun-beams, till the fame vapours, by farther condenfation, be formed into rain, and fall down in drops.

If the clouds, in a fummer evening, gradually diminifh, and at laft vanifh, it will be fine weather; but, if they increafe, and fmall clouds be obferved to move very fwiftly underneath, it will be rain foon after; or, if the clouds change to a dark colour, thunder may be expected.

If the clouds in the weftern hemifphere, at the time of fun-fet, are tinged with a light red and yellow; or, if there are no clouds, and the fky, towards that part of the horizon where the fun fets, be of a beautiful red and yellow, it will be fine weather: but if the fun be of a pale colour, or if the clouds change to a dark red, and continue, it will be rain. The clouds tinged with a dark red in the oppofite hemifphere to the fun, whether at rifing or fetting, prefage wind.

In winter, when large clouds are obferved with white edges, and a ftrong blue fky above them, it will be hail or fnow; or probably thefe may be diffolved into rain before they reach the earth.

When there are two or more ftrata of clouds moving in different directions, rain generally follows. Many fmall clouds pretty high, and other appearing at the fame time in form of fleeces of wool, denote wind.

A cloud of an oblong form, fometimes called *Noah's Ark*, feen in a clear fky, and changing from a fine light to a dark colour, is a fign of rain; but, if it changes from dark to light, it is a fign of fair weather.

A fmall black cloud feen in a clear fky, or feveral fmall clouds collecting near each other, are an indication of wind from the quarter from whence they are obferved to move: alfo, if the clouds are obferved to diverge from a point in the horizon, wind may be expected from that, or from the oppofite point.

When ftars of the fecond and third magnitudes are fuddenly obfcured, wind or rain will foon follow. Thofe meteors, commonly called *falling* or *fhooting* ftars, are ufually the forerunners of wind.

That appearance in the heavens refembling a portion of the rainbow, but apparently broader than any part of the arch when complete, and generally known by the name of a *Wind-gall*, is an indication of an approaching gale.

The *Aurora Borealis*, (which fee,) or northern light, is a fign of wind from between the S. and S.W. points, attended with hazy weather, and fmall rain, the gale generally commencing between twenty-four and thirty hours after the firft appearance of the aurora. The violence of the gale, and the time of its commencement after the aurora borealis is feen, and duration, depend, in a great meafure, upon the brightnefs and motion of the aurora; for the more brilliant the aurora, and the quicker its motions, the gale will happen fooner, be more violent, and of fhorter duration.

A change

A change in the wind commonly produces a change in the weather. Thus, in fair weather, if the wind changes to the oppofite point, rain may be expected: but, in rainy or foggy weather, it will clear up foon after the change of the wind.

In a ftorm at fea, a fiery meteor, in form of a ball, affording an obfcure flame like a candle burning faintly, is fometimes feen adhering to the mafts, yards, &c. or leaping from one part to another. When only one is feen, it is called *Helena*, and is a fign that the fevereft part of the ftorm is yet to come. When two are obferved, they are called *Caftor* and *Pollux*, and fometimes *Tyndaridæ*, and denote the ftorm to be near an end. If five of thefe balls are feen together, which the Portuguefe call the *Virgin Mary's Crown*, it is confidered to be a fure fign that the ftorm will be foon over. When the meteor adheres to the mafts, yards, &c. it is concluded, from the air not having fufficient motion to diffipate the flame, that a calm will foon enfue; but if it leaps from one place to another, that it denotes a ftorm.

At the Cape of Good Hope, an approaching ftorm, or gale of wind, is eafily known by the following obfervations:—When a fmall black cloud, called the *Ox-eye*, is obferved to rife from the top of Table Mountain, which continues to increafe until the heavens be almoft entirely overclouded, the ftorm then commences. A fimilar phenomenon ufually precedes a ftorm at the Arabian gulf: this ftorm comes from the north, and is accompanied with a great quantity of red fand.

When a hurricane happens in the Weft Indies, it is generally either at new or full moon, or at the quarters, and the figns are as follow:—The fun and moon appear redder than ufual, and are fometimes furrounded with a halo; the ftars at night appear larger and fainter; the fky in the N.W. quarter is dark; the hills are clear of thofe clouds and mifts which ufually hover about them; the fea emits a ftrong fmell, and is violently agitated, often when there is no wind; the wind alfo veers about to the weft, from whence it fometimes blows with intermiffions violently and irregularly for about two hours at a time.

The tumbling of porpoifes indicates a gale of wind. When a fwell fets from any particular point, there being no wind, a gale may be foon expected from that point.

From a very great number of meteorological obfervations, made in England between the years 1677 and 1789, Mr. Kirwan has deduced the following probable conjectures of the weather:

1. That when there has been no ftorm before or after the vernal equinox, the enfuing fummer is generally *dry*, at leaft five times in fix.

2. That when a ftorm happens from any eafterly point, either on the 19th, 20th, or 21ft of March, the fucceeding fummer is generally *dry*, four times in five.

3. That when a ftorm arifes on the 25th, 26th, or 27th of March, and not before, in any point, the fucceeding fummer is generally *dry*, four times in five.

4. If there be a ftorm at S.W. or W.S.W. on the 19th, 20th, 21ft, or 22d of March, the fucceeding fummer is generally *wet*, four times in five.

We fhall further fubjoin the following obfervations:

1. A moift autumn, with a mild winter, is generally followed by a cold and dry fpring, which greatly retards vegetation.

2. If the fummer be remarkably rainy, it is probable that the enfuing winter will be fevere; for the unufual evaporation will have carried off the heat of the earth. Wet fummers are generally attended with an unufual quantity of feed on the white thorn and dog-rofe bufhes. Hence, the unufual fruitfulnefs of thefe fhrubs is a fign of a fevere winter.

3. The appearance of cranes, and birds of paffage, early in autumn, announces a very fevere winter; for it is a fign that it has already begun in the northern countries.

4. When it rains plentifully in May, it will rain but little in September, and *vice verfa*.

5. When the wind is S.W. during fummer or autumn, and the temperature of the air unufually cold for the feafon, both to the feeling and the thermometer, with a low barometer, much rain is to be expected.

6. Violent temperatures, as ftorms or great rains, produce a fort of crifis in the atmofphere, which produces a conftant temperature, good or bad, for fome months.

7. A rainy winter predicts a fteril year; a fevere autumn announces a windy winter.

For indications of the weather by the barometer, fee Barometer. By the *Thermometer*, (which fee,) Mr. Dalton deduces the following conclufions:

The mean altitude of the mercury in the thermometer in Britain is about 55°: if higher, the weather is warm; but if lower, it is cold.

A quick and confiderable alteration in the altitude of the mercury in the thermometer indicates rain.

If it begins to fnow when the thermometer is below 32°, the mercury generally rifes to that altitude, and continues while the fnow falls. If the weather clears up foon after, a fevere cold may be expected. See alfo Hygrometer, from which it is inferred, that, when the index of the hygrometer points to *dry*, and continues proceeding towards extreme drynefs, fair weather, and probably wind, may be expected; but if the index returns to the mean ftate, it will be rain. If the index points to *moift and increafing*, rain will foon follow; if it returns towards the mean, it will be fair weather.

As to the fuppofed influence of the moon upon the weather, fee *Influence of the* Moon.

Weather, in *Sea Language*, is ufed as an adjective, and applied by mariners to every thing lying to windward of a particular fituation: thus, a fhip is faid to have the weather-gage of another, when fhe is farther to windward. Thus alfo, when a fhip under fail prefents either of her fides to the wind, it is then called the weather-fide, or weather-board; and all the rigging and furniture fituated on it are diftinguifhed by the fame epithet; as the weather-fhrouds, the weather-lifts, the weather-braces, &c.

To Weather, is to fail to windward of fome fhip, bank, or head-land.

Weather-*Beaten*. Scattered by a ftorm.

Weather-*Bit*, denotes a turn of the cable of a fhip about the end of the windlafs, without the knight-heads. It is ufed to check the cable, in order to flacken it gradually out of the fhip, in tempeftuous weather, or when the fhip rides in a ftrong current. See Ring-*Ropes*.

Weather-*Boarding*, among *Carpenters*, &c. denotes the nailing up of boards againft a wall, and fometimes the boards themfelves when thus nailed up.

Weather-*Cock*, or *Weather-Vane*, a moveable vane, in form of a cock, or of other fhape, placed on high, to be turned round according to the direction of the wind, and point out what quarter the wind blows from. See Vane.

Weather-*Cord*. See Hygrometer.

Weather, *Hard-a*. See Hard.

Weather-*Houfe*. See Hygrometer.

WEATHER-*Gage*, in *Sea Language*. When a ſhip or fleet is to windward of another, ſhe is ſaid to have the weather-gage of her.

WEATHER-*Glaſſes* are inſtruments contrived to indicate the ſtate or diſpoſition of the atmoſphere, as to heat, cold, gravity, moiſture, &c. to meaſure the changes befalling it in thoſe reſpects; and by thoſe means to predict the alteration of weather, as rains, winds, ſnow, &c.

Under the claſs of weather-glaſſes, are comprehended *barometers*, *thermometers*, *hygrometers*, *manometers*, and *anemometers*, of each of which there are divers kinds. See their theories, conſtructions, uſes, kinds, &c. under BAROMETER, THERMOMETER, HYGROMETER, &c.

WEATHER-*Quarter*, in *Sea Language*, that quarter of the ſhip which is on the windward ſide.

WEATHER-*Quoil* or *Coile*, is the turning of the ſhip's head about, ſo as to lie that way which her ſtern did before without looſing any ſail, but only by bearing up the helm.

WEATHER-*Side*, the ſide of a ſhip upon which the wind blows.

WEATHER-*Shore*, a name given to the ſhore lying to windward.

WEATHER-*Tiling*, in *Building*, the covering of the upright ſide of a houſe with tiles.

WEATHERER, in *Geography*, one of the ſmaller Shetland iſlands. N. lat. 60° 35′. W. long. 1° 13′.

WEATHERING, a doubling, or ſailing by a point, or place.

WEATHERING, among *Mill-wrights*. See WIND-*Mill*.

The WEATHERING *of a Hawk*, among *Falconers*, is the ſetting of her abroad to take the air.

WEATHERSFIELD, in *Geography*, a town of the ſtate of Connecticut, in the county of Hartford, founded about the year 1639, containing 2868 inhabitants; 5 miles S. of Hartford.—Alſo, a townſhip of Vermont, in the county of Windſor, containing 2115 inhabitants; 3 miles S. of Windſor.—Alſo, a town of Ohio, in the county of Trumbull, containing 232 inhabitants.

WEAVER, in *Manufactures*, one who practiſes the art of weaving.

Perſons uſing the trade of a weaver, ſhall not keep a tucking or fulling-mill, or uſe dyeing, &c. or have above two looms in a houſe in any corporation or market-town, on pain of forfeiting 20*s*. a week: and ſhall ſerve an apprenticeſhip for ſeven years to a weaver or clothier, or ſhall ſhall forfeit 20*l*. &c. 2 & 3 Ph. & M.

WEAVER'*s Alarm*. This contrivance is only a weight faſtened to a packthread, which is placed horizontally, ſo that in a certain time a candle may burn down to it. Then the flame of the candle ſetting fire to the thread, the weight falls, and awakens the ſleeping perſon. See Phil. Tranſ. No. 477. ſect. 14, where we have a figure to explain the invention, which has got its name from being in frequent uſe among the weavers.

WEAVER'*s Lake*, in *Geography*, a lake of New York; 3 miles N.W. of Otſego lake.

WEAVING, in *Manufactures*, is the art of combining and uniting threads together, to form cloth. Stocking-knitting or weaving is a diſtinct art from cloth-weaving, the manner of combining the thread, being eſſentially different in the two. In the ſtocking fabric, the whole piece conſiſts of one continuous thread, which is formed into a ſeries of loops in ſucceſſive rows; and the loops of each row are drawn through the loops of a former row. See STOCKING-*Frame*.

Woven cloth is always compoſed of two diſtinct ſyſtems of threads, called the warp and the weft: theſe traverſe the piece of cloth in oppoſite directions, and are uſually at right angles to each other. Thoſe threads, (or, as the weavers call them, yarns,) which run in the direction of the length of the web or piece of cloth, are called the warp, and they extend entirely from one end of the piece to the other. The croſs thread, or yarn, runs acroſs the cloth, and is called the woof or weft. This is in fact one continued thread through the whole piece of cloth, being woven alternately over and under each yarn of the warp, which it croſſes, until it arrives at the outſide one. It then paſſes round that yarn, and returns back over and under each thread, as before; but in ſuch a manner, that it now goes over thoſe yarns which it paſſed under before, and *vice verſâ;* thus firmly knitting or weaving the warp together. The outſide yarn of the warp, round which the woof is doubled, is called the ſelvage, and cannot be unravelled without breaking the weft. The ſtrength of the cloth, in the direction of the length, muſt depend on the threads of the warp; but its ſtrength in the oppoſite direction will depend upon the weft; and the ſtrength of theſe two threads ſhould be always properly proportioned to each other.

The combined arts of ſpinning and weaving are among the firſt eſſentials of civilized ſociety, and we find both to be of very ancient origin. The fabulous ſtory of Penelope's web, and, ſtill more, the frequent alluſions to this art in the ſacred writings, tend to ſhew, that the fabrication of cloth from threads, hair, &c. is a very ancient invention. It has, however, like other uſeful arts, undergone a vaſt ſucceſſion of improvements, both as to the preparation of the materials of which cloth is made, and the apparatus neceſſary in its conſtruction, as well as in the particular modes of operation by the artiſt. Weaving, when reduced to its original principle, is nothing more than the interlacing of the weft or croſs threads into the parallel threads of the warp, ſo as to tie them together, and form a web or piece of cloth. This art is doubtleſs more ancient than that of ſpinning, and the firſt cloth was what we now call matting, *i.e.* made by weaving together the ſhreds of the bark, or fibrous parts of plants, or the ſtalks, ſuch as ruſhes and ſtraws.

This is ſtill the ſubſtitute for cloth amongſt moſt rude and ſavage nations. When they have advanced a ſtep farther in civilization than the ſtate of hunters, the ſkins of animals become ſcarce, and they require ſome more artificial ſubſtance for clothing, and which they can procure in greater quantities. Neverthelеſs, ſome people are ſtill ignorant of the art of weaving; for the cloth made in the iſlands of the South ſea appears to be made by cementing or glueing the ſhreds together, rather than by weaving. From the deſcription given by captain Cook, and other circumnavigators, and from the ſpecimens which have been brought to Europe, their cloth, or rather matting, is in general produced by coheſion of the parts, rather than texture. This aſſimilates it more to the ideas which we attach to paper, or paſteboard, than to thoſe which we form of cloth.

When it was diſcovered that the delicate and ſhort fibres, which animals and vegetables afford, could be ſo firmly united together by twiſting, as to form threads of any required length and ſtrength, the weaving art was placed on a permanent foundation. By the proceſs of ſpinning, which was very ſimple in the origin, the weaver is furniſhed with threads far ſuperior to any natural vegetable fibres in lightneſs, ſtrength, and flexibility; and he has only to combine them together in the moſt advantageous manner.

The art of weaving cloth has been ſo extenſively applied in in almoft every civilized country, and the knowledge of its various branches has been derived from fuch a variety of fources, that no one perfon can ever be practically employed in all its branches; and though every part bears a ftrong analogy to the reft, yet a minute knowledge of each of thefe parts can only be acquired by experience and reflection. We will endeavour to give the reader as comprehenfive an idea of the hiftory and progrefs of this ancient and invaluable art as the nature of the thing, and the limits to which we are neceffarily confined, will permit.

The hiftory of this art is very little known, and its great antiquity neceffarily involves the earlier eras of it in the moft perfect obfcurity.

The art of making linen, which was probably the firft fpecies of cloth invented, was communicated by the Egyptians, the inhabitants of Paleftine, and other eaftern nations, to the Europeans. By flow degrees it found its way into Italy; and it afterwards prevailed in Spain, Gaul, Germany, and Britain. The Belgæ manufactured linen on the continent; and when they afterwards fettled in this ifland, it is probable they continued the practice, and taught it to the people among whom they refided.

When it is confidered that the wants of mankind are nearly the fame in all countries, it is not improbable that the fame arts, however varied in their operations, may have been feparately invented in different countries. It is not, however, certain that the art of making cloth is one which the Britons invented for themfelves.

It is moft probable that the Gauls learned it from the Greeks, and communicated the knowledge of it to the people of Britain. It is very certain that the inhabitants of the fouthern parts of Britain were well acquainted with the arts of dreffing, fpinning, and weaving, both flax and wool, when they were invaded by the Romans. Neverthelefs, we have the authority of Julius Cæfar, that when he invaded Britain, the art of weaving was totally unknown to the Britons.

Whatever knowledge the Britons might poffefs of the clothing arts, prior to the invafion, it is very certain that thefe arts were much improved amongft them after that event. It appears from the Notitia Imperii, that there was an imperial manufactory of woollen and linen cloth, for the ufe of the Roman army then in Britain, eftablifhed at Venta Belgarum, now called Winchefter.

Many public acts relative to the woollen manufacture, in the earlier period of Englifh hiftory, evidently prove that the greater part of our wool was, for a very long feries of years, exported in a raw ftate, and manufactured upon the continent.

In bifhop Aldhelm's book concerning "Virginity," written about A.D. 680, it is remarked, "that chaftity alone forms not a perfect character, but requires to be accompanied and beautified by other virtues." This obfervation is illuftrated by the following fimile, borrowed from the art of figure-weaving: "It is not a web of one uniform colour and texture, without any variety of figures, that pleafeth the eye, and appeareth beautiful; but one that is woven by fhuttles, filled with threads of purple, and many other colours, flying from fide to fide, and forming a variety of figures and images, in different compartments, with admirable art."

Perhaps the moft curious fpecimen of this ancient figure-weaving and embroidery, now to be found, is that preferved in the cathedral of Bayeaux. It is a piece of linen, about 19 inches in breadth, and 67 yards in length, and contains the hiftory of the Conqueft of England by William of Normandy; beginning with Harold's embaffy, A.D. 1065, and ending with his death at the battle of Haftings, A.D. 1066. This curious work is fuppofed to have been executed by Matilda, wife to William, duke of Normandy, afterwards king of England, and the ladies of her court. Although it is certain that the art of figure-weaving was then known in Britain, it muft be owned, that the piece of tapeftry juft mentioned owes moft of its beauty to the exquifite needle-work with which it is adorned.

The filk manufacture was firft practifed in China, and the cotton in India. Both the woollen and linen were borrowed by the Englifh from the continent of Europe; and for many ages, all the improvements in them in this country were firft introduced into this country by foreign artificers, who fettled amongft us.

About the clofe of the eleventh century, the clothing arts had acquired a confiderable degree of improvement in this ifland. About that time, the weavers in all the great towns were formed into guilds or corporations, and had various privileges beftowed upon them by royal charters.

In the reign of Richard I., the woollen manufacture became the fubject of legiflation; and a law was made, A.D. 1197, for regulating the fabrication and fale of cloth.

The number of weavers, however, was comparatively fmall, until the policy of the wife and liberal Edward III. encouraged the art, by the moft advantageous offers of reward and encouragement to foreign cloth-workers and weavers, who would come and fettle in England. In the year 1331, two weavers came from Brabant, and fettled at York.

The fuperior fkill and dexterity of thefe men, who communicated their knowledge to others, foon manifefted itfelf in the improvement and fpread of the art of weaving in this ifland.

Many Flemifh weavers were driven from their native country, by the cruel perfecutions of the duke d'Alva, in the year 1567. They fettled in different parts of England, and introduced or promoted the manufacture of baizes, ferges, crapes, and other woollen ftuffs.

About the year 1686, nearly 50,000 manufacturers, of various defcriptions, took refuge in Britain, in confequence of the revocation of the edict of Nantz, and other acts of religious perfecution committed by Louis XIV. Thefe improvements chiefly related to filk-weaving.

The arts of fpinning, throwing, and weaving filk, were brought into England about the middle of the 15th century, and were practifed by a company of women in London, called filk-women. About A. D. 1480, men began to engage in the filk manufacture, and the art of filk-weaving in England foon arrived at very great perfection. See Silk.

The civil diffentions which followed this period, retarded the progrefs of thefe arts; but afterwards, when the nation was at reft, the arts of peace, and among others that of weaving, made rapid advances in almoft every part of the kingdom.

In the latter part of the laft century, the invaluable inventions of fir Richard Arkwright, introduced the very extenfive manufacture of cotton, and added a lucrative and elegant branch of traffic to the commerce of Britain. The light and fanciful department of the cotton manufacture has become, in fome meafure, the ftaple manufacture of Scotland, whilft the more fubftantial and durable cotton fabrics have given to England a manufacture inferior, in importance and extent, only to the woollen trade.

At the prefent day, our fuperiority in point of quality is is univerfally acknowledged in the cotton manufacture ; but in thofe of filk, linen, and woollen, it is ftill difputed by other countries.

Loom.—Weaving is performed by the aid of a machine called a loom. The common loom for plain cloth is a very fimple machine ; but fome of the varieties which are ufed for weaving ornamental and figured cloth are very curious : ftill there are parts common to all. The principal of thefe are as follows.

1. The yarn-beam, which is a round wooden roller, on which is wound or rolled the warp, or yarns that are to form the length of the piece of cloth. 2. The cloth-beam is a fimilar roller, on which the cloth is rolled up when woven. The yarns of the warp are extended in parallel lines, between the yarn-roll and the cloth-roll, fo as to form a horizontal plane, or fheet, and are combined together by the crofs-threads, or weft. 3. The fhuttle, which has a hollow to contain a bobbin or pirn of the weft. 4. The heddles, which are threads with loops or eyes, through which the yarns of the warp pafs : the heddles are connected with the treadles, upon which the weaver places his feet, to draw down one fet of heddles and raife up another, fo as to open and feparate the warp into two divifions, and allow a paffage, called the fhed, for the fhuttle between them. 5. The reed, which is a frame containing a row of parallel fhreds of reeds or cane, and the yarns of the warp pafs between them, as it were between the teeth of a comb. 6. The reed is fixed in a frame, called the lay or lathe, which fwings upon centres of motion. The ufe of the reed and lay is to comb or pufh the threads of the weft clofe to each other, and make the cloth clofe and denfe.

The operation of weaving or working the loom for plain cloth confifts of three very fimple movements, *viz.* 1. Opening the fhed in the warp alternately, by preffing the two treadles with his feet in oppofite directions. 2. Driving or throwing the fhuttle through the fhed when opened. This is performed by the right-hand, when the fly-fhuttle is ufed, and by the right and left alternately, in the common operation, wherein the fhuttle is thrown from one hand and caught in the other. 3. Pulling forward the lay or batten to ftrike home the woof, and again pufhing it back nearly to the heddles. This is done by the left-hand with the fly-fhuttle, or by each hand fucceffively in the old way.

There are feveral different ways of fetting up a loom for weaving plain cloth ; but the principal parts are always made the fame. We fhall firft defcribe that which is ufed for weaving plain filks : it is fhewn in perfpective in *Plate* II. *Weaving.* In this A is the yarn-roll or beam, on which the thread to form the warp is regularly wound ; B, the cloth-beam, or breaft-roll, on which the finifhed cloth is wound up ; D E, the treadles, on which the weaver preffes his feet ; *d d*, *e e*, are the heddles, or harnefs. Thefe are each compofed of two fmall rods *d d* and *e e*, connected together by feveral threads, forming a fyftem of threads, which is called a heddle ; *e e* is another heddle, behind the former. In the middle of each thread of the heddle is a loop, through which a yarn of the warp is paffed, every other yarn going through the loops of the heddle *e e*, and the intermediate yarns paffing between the threads of that heddle, and afterwards through the eyes or loops of the other heddle *d d*.

The two heddles, *d d* and *e e*, are connected together by two fmall cords going over pulleys, fufpended from the top of the loom, fo that when one heddle is drawn down, the other will be raifed up. The heddles receive their motion from the levers or treadles D E, moved by the weaver's feet. The yarns of the warp being paffed alternately through the loops of the two heddles, by preffing down one treadle, as E, all the yarns belonging to the heddle *e e* are drawn down ; and by means of the cords and pulleys, the other heddle *d d*, with all the yarns belonging to it, are raifed up ; leaving a fpace, called the fhed, of about two inches between the yarns, for the paffage of the fhuttle.

F, G G, H, (*fig.* 2.) is a frame, called the batten or lay, fufpended by the bar F, from the upper rails of the loom, fo that it can fwing backwards and forwards, as on a centre of motion ; the bottom bar H is much broader than the rails G G, and projects before the plane about an inch and a half, forming a fhelf, called the fhuttle-race. The ends of the fhuttle-race H have boards nailed on each fide, to form two fhort troughs or boxes I I, in which pieces of wood or thick leather *k k*, called peckers or drivers, traverfe. The peckers are guided by two fmall wires, fixed at one end to the uprights G G, and at the other to the end-pieces of the troughs I I. Each pecker has a ftring faftened to it, tied to the handle *y*, which the weaver holds in his right-hand when at work, and with which he pulls, or rather fnatches, each pecker either to the right or left alternately.

R is the reed : it is a fmall frame, fixed upon a fhuttle-race H, containing a number of fmall pieces of fplit reeds or canes ; or elfe of pieces of flat wire, of fteel or brafs ; but the cane is moft common, although the frame is called the reed. When *fig.* 2. is in its place in the loom, the yarns of the warp pafs between the canes or dents of the reed. In *fig.* 2. the reed is reprefented without the top or piece which covers it, and which is called the lay-cap. It is a rail of wood with a longitudinal groove along its lowermoft fide, for the purpofe of fuftaining the upper edge of the reed. The lay-cap is that part of the machine on the middle of which the weaver lays hold with his left-hand when in the act of weaving.

The fhuttle (fee *Plate* I.) is a fmall piece of wood pointed at each end, from three to fix inches long. It has an oblong mortife in it, containing a fmall bobbin or pirn, on which is wound the yarn which is to form the weft ; and the end of this yarn runs through a fmall hole in the fhuttle, called the eye. The fhuttle has two little wheels on the under fide, by which it runs eafily upon the fhuttle-race H.

Operation.—The weaver fits on the feat M, (*fig.* 1.) which hangs by pivots at its ends, that it may adapt itfelf to the eafe of the weaver when he fits upon it. It is lifted out when the weaver gets into the loom, and he puts it in again after him. He leans lightly againft the cloth-roll B, and places his feet upon the treadles D E. In his right-hand he holds the handle *y* (*fig.* 2.), and by his left he lays hold of the rail, called the lay-cap, which croffes the batten or lay G G, and ferves to fupport the upper edge of the reed R. He commences the operations by preffing down one of the treadles with his foot : this depreffes one-half of the yarns of the warp, and raifes the other, as before-defcribed. The fhuttle is previoufly placed in one of the troughs I, againft the pecker K, belonging to that trough. By the handle of the pecker, with a fudden jerk, he drives the pecker againft the fhuttle, fo as to throw it acrofs the warp upon the fhuttle-race, into the other trough I, leaving the yarn of the weft, which was wound on the bobbin after it, in the fpace between the divided yarns. With his left-hand he pulls the lay towards him ; and, by means of the reed, the yarn of the weft, which before was lying loofe between the warp, is driven up towards the

the cloth-roll: the weaver now preffes down his other foot, which reverfes the operation, pulling down the heddle which was up before, and raifing that which before was depreffed. By the other pecker he then throws the fhuttle back again, leaving the woof after it between the yarns of the warp; and, by drawing up the batten, beats it clofe up to the thread before thrown.

In this manner the operation is continued until a few inches are woven; it is then wound upon the cloth-roll, by putting a fhort lever into a hole made in the roll, and turning it round, a click acting in the teeth of a ferrated wheel, prevents the return of the roll. At each end of the yarn-roll A, (*fig.* 1.) a cord is tied to the frame of the loom; the other ends of the cords have weights hanging to them. The rope caufes a friction, which prevents the roll from turning (unlefs the yarn is drawn by the cloth-beam), and always preferves a proper degree of tenfion in the yarn.

T T (*fig.* 1.) are two fmooth fticks (cotton-weavers have ufually three) put between the yarns, to preferve the leafe, and keep the threads or yarns from entangling.

In cotton-weaving thefe fticks or rods are kept at an uniform diftance from the heddles, either by tying them together, or by a fmall cord with a hook at one end, which lays hold of the front rod, and a weight at the other, which hang over the yarn-beam.

The cloth is kept extended during the operation of weaving, by means of two hard pieces of wood, called a templet, with fmall fharp points in their ends, which lay hold of the edges, or felvages, of the cloth.

Thefe pieces are connected by a cord paffing obliquely through holes, or notches, in each piece. By this cord they can be lengthened or fhortened, according to the breadth of the web.

They are kept flat after the cloth is ftretched by a fmall bar turning on a centre fixed in one of the pieces of wood. This ftretcher is called the templet. Silk-weavers ufually ftretch their cloth by means of two fmall fharp-pointed hooks faftened to the ends of two ftrings, with little weights at the other ends; and the ftrings are made to pafs over little pulleys in each fide of the loom, at a fuitable diftance from the felvages of the cloth.

The perfection of the work depends very much upon the previous operations which the yarn muft undergo. It is obvious that the yarns of the warp muft be ftretched with great parallelifm and equality of tenfion, fo that when the cloth is finifhed, every individual yarn may bear an equal fhare of any ftrain which tends to tear the cloth; hence great care muft be taken to ftretch the yarns of the warp to an equal length, and roll them with great regularity upon the yarn-roll. Thefe operations are called warping and beaming. Previous to warping, the yarn muft be prepared by fizing or ftarching, in order to cement all the loofe fibres, and render the yarn fmooth.

The fpinners of yarn, whether they employ machinery or not, ufually reel the yarn into fkeins and hanks of a determinate length; and the weight of thefe hanks, or the number which will weigh one pound, is the denomination for the finenefs of the yarn. (See *Manufacture of* COTTON.) In this ftate the yarn is bought by the weaver. The hanks of yarn are firft boiled in water; if it is linen-yarn a little foap and potafh are put into the water, and for cotton-yarn a fmall portion of flour is added, to render the thread firm. When the hanks are perfectly dry they are wound off upon bobbins, each thread having a feparate bobbin, and a certain length is wound upon each. This winding is performed by a very fimple hand-wheel to turn the bobbin rapidly round, the hanks of yarn being extended upon a reel, or over two fmall reels placed at a diftance afunder, which are called wifks.

Warping.—The object of this operation is to ftretch the whole number of parallel threads which are to form the warp of the cloth to an equal length. For this purpofe as many of the above bobbins are taken as will furnifh the quantity of threads which is required in the warp of the piece of cloth. The bobbins are ufually one-fourth or one-fixth of the number of threads required, and are mounted on fpindles in a frame, fo that the thread can draw off freely from them. All thefe threads are drawn off at once, fo as to combine them all into one clue, which will be ready for the warp. The ancient method was to draw out the warp at full length, and ftretch it in a field; and this is ftill practifed in India and China, but is fo very uncertain in our climate that it is feldom ufed. The prefent mode of warping is either by the warping-frame or warping-mill.

The warping-frame is a large wooden frame, which is fixed up againft a wall in a vertical pofition. The upright fides of the frame are pierced with holes to receive wooden pins, which project fufficiently to wind the clue of yarns for the warp round them.

The operator having the threads which are to compofe the warp wound on the bobbins before-mentioned, places thofe bobbins in a frame; then tying the ends of all the threads together, and attaching them to one of the pins at one end of the frame, he gathered all the threads in his hand into one clue; and permitting them to flip through his fingers, he walked to the other end, where he paffed the yarns over the pin fixed there, and then returned to the former end of the frame and paffed the warp over another pin, then went back again, and fo on till he formed the required length of the warp. This being done, he fecured the end of the warp by croffing it round the pin, and then he worked back and returned over all the fame fpace again, laying the threads over the fame pins, fo as to double the clue; and he repeated the doubling until the number of threads neceffary for the breadth was made up. The number of doublings would be according to the number of bobbins and threads which he took in his hand at once.

This method is ufed very much in France, particularly at Lyons: it is alfo ufed in Devonfhire. It is adapted to the weaving carried on in cottages, becaufe the frame is fixed clofe to the wall, and takes little or no room; but the warping-mill or reel is very fuperior, and is adopted in all improved manufactures where the warping is a feparate bufinefs, and is ufually done at the mill where the yarn is fpun.

The warping-mill is a large reel of a cylindrical form, or rather of a prifmatic form, being made with twelve, eighteen, or more fides. The reel is ufually about fix feet diameter and feven feet high: it is turned round on a vertical axis by a band, paffing from a grooved wheel which is turned by a winch, and is placed beneath the feat on which the warper fits. (See a figure of the warping-machine for filk *Plate Silk*, *fig.* 6.) The bobbins which contain the yarn are placed on a vertical rack fufpended from the ceiling, and the threads from them are all collected together and paffed between two fmall upright rollers in a clue, which is wound up by the reel when it is turned round. To guide the clue and diftribute it equally on the length of the reel, the above rollers are fixed on a piece of wood, which flides perpendicularly on an upright bar fixed at one fide of the reel. The fliding-piece is fufpended by a fmall cord, wrapped round a part of the perpendicular axis that rifes above the reel. The cord paffes over a pulley at the top of the upright bar, and goes down to the fliding-piece which carries the two rollers. When the reel turns round, the guide-rollers are flowly drawn up by the coiling of this cord round the axis; and the yarn is wound in a regular fpiral about the reel, until the length which the warp requires is wound upon it. When the full length of the yarn is wound on the reel, the clue of thread is croffed over pins projecting from the frame of the reel, and the mill is then turned the reverfe way, fo that the flider and guide-rollers defcend, and the yarn is laid downwards along the fame fpiral which it before afcended, fo as to double the clue of thread; and this doubling is repeated until the required number of threads is collected together in one clue upon the reel.

When the warp is thus completed, it is taken off the reel and wound upon a ftick into a ball; the croffings which diftinguifh the different returns or doublings of the fimple clue being firft properly fecured, as a means of dividing the warp into as many equal portions as is neceffary for the convenience of the weaver, in counting the threads in the fucceeding operation of beaming.

There is likewife another kind of divifion of the threads of the warp; this is called the leafe, and ferves to feparate all the threads which are to go through one of the heddles of the loom, from thofe which are to go through the other heddle. To effect this feparation, the bobbins from which the threads are drawn are arranged in two rows, and a thread is alternately drawn from the upper row and from the lower row. Then at the beginning and end of every doubling of the warp, the threads of one row of bobbins are croffed over the threads of the other row, and two pins are put into the croffings to retain them. Thefe pins are put into holes made in pieces of board fixed to the warping-reel. One of thefe boards at the top of the reel is fixed faft, but the other is moveable, and can be fixed at any part of the reel, according to the length of the warp.

In the moft improved warping-machines, the feparation is made by an apparatus called in Scotland the heck. It confifts of a row of fteel pins with eyes through one end of each for the threads to pafs through like large needles. Thefe are ftuck into two pieces of wood, by which they are fupported in a row near to the warping-reel. Every alternate pin in the row is faftened in one piece of wood, and the intermediate pins are faftened in the other piece, fo that by lifting up one piece of wood the pins and threads belonging to it will be raifed up, whilft the intermediate pins and threads are held down. This occafions the divifion of the threads, and a pin is put in to keep them fo divided. The other piece of wood is then lifted up, which occafions all the threads to be croffed; that is, every thread forms a crofs over that which is adjacent to it. A fecond pin is then put in, and before the warp is taken off from the reel, this croffing is fecured by a ftring.

Beaming.—When the weaver receives his warp in a large ball or bundle, he proceeds to roll it up regularly upon the yarn-roller of his loom: this is called beaming. For this purpofe he employs an inftrument called a feparator, or ravel, which confifts of a number of fhreds of cane, faftened together, and fixed to a rail of wood, like the teeth of a long comb; the threads are intended to be put into the fpaces between thefe teeth, fo as to ftretch the warp to its proper breadth.

Ravels are fomewhat like reeds, but much coarfer, and are alfo of different dimenfions. One proper for the purpofe being found, one of the fmall divifions of the warp is placed in every interval between two of the teeth. The upper part of the ravel, called the cape, is then put on, to fecure the threads from getting out between the teeth, and the operation of winding the warp upon the beam commences. In broad works, two perfons are employed to hold the ravel, which ferves to guide the threads of the warp, and to fpread them regularly upon the beam; one or two other perfons keep the threads at a proper degree of tenfion, and one more turns the beam upon its centre.

The knottings which fecure the croffings or doublings made in warping, are very ufeful to the weaver in beaming, to afcertain the number of threads, and to diftribute them with regularity. He cuts the knotting before he can put the warp in the ravel, but he ftill keeps them diftinct by a fmall cord.

The French weavers ufe a fmall reel, upon which they wind the warp from the ball, and then from this reel they draw off the warp through the ravel, by winding up the beam. The reel is loaded with a weight, to make a regular friction, and draw the warp with a regular tenfion.

Drawing.—The warp being regularly wound upon the beam, the weaver muft pafs every yarn through its appropriate eye or loop in the heddles: this operation is called drawing. Two rods are firft inferted into the leafe formed by the pins in the warping-mill, and the ends of thefe rods are tied together; the twine by which the leafe was fecured is then cut away, and the warp ftretched to its proper breadth. The yarn-beam is fufpended by cords behind the heddles, fomewhat higher, fo that the warp hangs down perpendicularly. The weaver places himfelf in front of the heddles, and opens the eye of each heddle in fucceffion; and it is the bufinefs of another perfon, placed behind, to felect every thread in its order, and deliver it to be drawn through the open eyes of the heddles. The fucceffion in which the threads are to be delivered is eafily afcertained by the leafe-rods, as every thread croffes that next to it. The warp, after paffing through the heddles, is drawn through the reed by an inftrument called a fley, or reed-hook, and two threads are taken through every interval in the reed.

The leafe-rods being paffed through the intervals which form the leafe, every thread will be found to pafs over the firft rod, and under the fecond; the next thread paffes under the firft, and over the fecond, and fo on alternately. By this contrivance every thread is kept diftinct from that on either fide of it, and if broken, its true fituation in the warp may be eafily and quickly found. This is of fuch importance, that too much care cannot be taken to preferve the accuracy of the leafe. There is likewife a third rod, which divides the warp into what is ufually called *fplitfuls*, for two threads alternately pafs over and under it; and thefe two threads alfo pafs through the fame interval betwixt the fplits of the reed.

Thefe operations being finifhed, the cords or mounting which move the heddles are applied; the reed is placed in the lay, or batten, and the warp is knotted together into fmall portions, which are tied to a fhaft, and connected by cords to the cloth-beam, and the yarns are ftretched ready to begin the weaving.

Manner of Weaving.—The operations of weaving are fimple, and foon learned, but require much practice to perform them with dexterity.

In preffing down the treadles of a loom, moft beginners are apt to apply the weight or force of the foot much too fuddenly. The bad confequences of this are particularly felt in weaving fine or weak cotton-yarn; for the body of the warp muft fuftain a ftrefs nearly equal to the force with which the weaver's foot is applied to the treadle. The art of fpinning has not yet been brought to fuch perfection as to make every thread capable of bearing its fair proportion of this ftrefs. Befides this, every individual thread is fubjected to all the friction occafioned by the heddles and fplits of the reed, between which the threads pafs, and with which

which they are generally in contraft when rifing and finking. A fudden preffure of the foot on the treadle muft caufe a proportional increafe of the ftrefs upon the warp, and alfo of the friction. As it is impoffible to make every thread equally ftrong and equally tight, thofe which are the weakeft, or the tighteft, muft bear much more than their equal proportion of the ftrefs, and are broken very frequently. Even with the greateft attention, more time is loft in tying and replacing them, than would have been fufficient for weaving a very confiderable quantity into cloth.

If the weaver, from inattention, continues the operation after one or more warp-threads are broken, the confequence is ftill worfe. The broken thread cannot retain its parallel fituation to the reft, but croffing over or between thofe neareft to it, either breaks them alfo, or interrupts the paffage of the fhuttle: it frequently does both.

In every kind of weaving, and efpecially in thin wiry fabrics, much of the beauty of the cloths depends upon the weft being well ftretched. If the motion given to the fhuttle be too rapid, it is very apt to recoil, and thus to flacken the thread. It has alfo a greater tendency, either to break the woof altogether, or to unwind it from the pirn or bobbin of the fhuttle in doubles, which, if not picked out, would deftroy the regularity of the fabric. The weft of muflins and thin cotton goods is generally woven into the cloth in a wet ftate.

This tends to lay the ends of the fibres of cotton fmooth and parallel, and its effect is fimilar to that of dreffing of the warp.

The perfon who winds the weft upon the pirn ought to be very careful that it be well formed, fo as to unwind freely. The beft fhape for thofe ufed in the fly-fhuttle is that of a cone; and the thread ought to traverfe freely round the cone, in the form of a fpiral, or fcrew, during the operation of winding.

The fame wheel which is ufed for winding the warp upon the bobbins preparatory to warping, is alfo fit for winding the weft on the pirn. It only requires a fpindle of a different fhape, with a fcrew at one end, upon which the pirn, or bobbin of the fhuttle, can be fixed. The wheel is fo conftructed, that the fpindles may be eafily fhifted, to adapt it for either purpofe.

The reeds are formed of a number of fhort pieces of reed or cane, or of brafs wire, faftened parallel to each other between two fticks, and cemented with pitch. This frame is enclofed between two pieces of the frame of the lay, one of which is made wide, to form the fhuttle-race; the other piece, which is the lay-cap, extends acrofs the frame, but is fitted fo that it can be eafily removed to take away the reeds, and fubftitute a finer or coarfer fort, as the nature of the goods to be woven require. The manufacture of reeds, both of cane and of fteel, is a feparate trade. Thefe are fully defcribed in Les Arts et Metiers, vols. 9 and 15.

To render the fabric of the cloth uniform in thicknefs, the lay or batten muft be brought forward with the fame force every time.

In weaving fome kinds of foft or light goods, the reed is not fixed faft to the lay-cap, but is held in its place by a long thin piece of wood, which is elaftic, and yields or fprings when the weft is beaten up. In fome cafes the reed is fuftained by a double woollen cord, ftretched acrofs the lay, juft beneath the lay-cap, and twifted; this bears the reed, and is very elaftic, but can be rendered more ftiff by twifting the two cords tighter.

In the common operation of weaving, a regular force of the ftroke for beating up the weft muft be acquired by practice. It is, however, of confequence to the weaver to mount or prepare his loom in fuch a manner, that the range or fwing of the lay may be in proportion to the thicknefs of his cloth. As the lay fwings backwards and forwards, upon centres placed above, its motion is fimilar to that of a pendulum. Now the greater the arc, or range through which the lay paffes, the greater will be its effect in driving home the weft ftrongly, and the thicker the fabric of cloth will be, as far as that depends upon the clofenefs of the weft. For this reafon, in weaving coarfe and heavy goods, the heddles ought to be hung at a greater diftance from the place where the weft is ftruck up, and confequently where the cloth begins to be formed, than would be proper in light work. The line of the laft wrought fhot of weft is called by the weavers the fell. The pivots upon which the lay vibrates ought, in general, to be fo placed, that the reed will be exactly in the middle, between the fell and the heddles, when the lay hangs perpendicularly. As the fell is conftantly varying in its fituation during the operation, it will be proper to take its medium; that is, the place where the fell will be when half as much is woven as can be done without taking it up on the cloth-roll, and drawing frefh yarn from the yarn-roll.

The periods for taking up the cloth ought always to be fhort in weaving light goods; for the lefs that the extremes of the fell vary from the medium, the more regular will be the arc or fwing of the lay. Mr. James Hall had a patent, in 1803, for a method of perpetually winding up the cloth-beam, fo as to take away the cloth as faft as it was woven, or fhoot by fhoot. This was effected in a fimple manner by a ratchet-wheel fixed on the end of the cloth-beam, and a proper catch to move it round one tooth at a time: the catch was actuated by the motion of the lay. A fimilar method is ufed in ribband-weaving.

The variations in the ftructure of looms from that which we have defcribed, are not material. The framing is varied in almoft every different kind of loom, and ought always to be fuitable in ftrength to the kind of cloth which is to be woven. The loom ufed for filk is very flight in all its parts; but for carpet and fail-cloth it muft be very ftrong.

In looms for heavy goods, the cloth-beam is not placed at the breaft of the weaver, as it is fo large that it would impede his working; the cloth is therefore paffed over a fixed bar in the place of the cloth-beam reprefented, and the beam is placed lower down, and near the weaver's feet, out of the way of his knees. The heddles are connected by levers, in fome looms, inftead of pulleys; but the effect is always the fame; *viz.* to make one heddle afcend when the other defcends. For weaving fine goods, the heddles would be inconveniently clofe together, if all the yarns went through two heddles; hence they ufe four heddles inftead of two; but their action is juft the fame, becaufe they are connected together in pairs, and when one pair rifes the other pair finks. Many looms are ftill made without the fly-fhuttle; and in that cafe the fhuttle is merely thrown from one hand to the other, and then thrown back again: this obliges the weaver to change his hands continually, and the operation is more complicated. For wide cloths, which are more than a man can reach acrofs, two perfons were always employed before the fly-fhuttle was introduced, which is only within a few years; but by its affiftance one perfon can weave the greateft breadths. The fly-fhuttle is the beft for all kinds of work, and its conftruction is fo fimple that no other ought to be ufed.

Treatment of different Kinds of Yarns. — The manner of weaving all kinds of plain cloth is much the fame, whether it is wool, filk, flax, or cotton; except that the two latter

 require

require what is called dreffing. Silk and woollen warps require little preparation after being put into the loom, except to clear the yarn occafionally with a comb, to remove knots or lumps which might catch in paffing through the reed ; the comb detects fuch lumps, and they are removed with the affiftance of a pair of fciffors. Flax and cotton, but particularly the latter, require the warp to be dreffed with fome glutinous matter, to cement the fibres, and lay them clofe. This is applied in a fluid ftate, and as the weaving does not proceed well after it is fuffered to dry, the warp is dreffed with a brufh when in the loom, a fmall quantity at a time, immediately before it is woven.

Dreffing.—The ufe of dreffing is to give to yarn fufficient ftrength or tenacity, to enable it to bear the operation of weaving into cloth. By laying fmooth all the ends of the fibres of the raw materials, from which the yarn is fpun, it tends both to diminifh the friction during the procefs, and to render the cloth fmooth and gloffy when finifhed. The dreffing in common ufe is fimply a mucilage of vegetable matter boiled to a confiftency in water. Wheat-flour, boiled to a pafte like that ufed by book-binders, or fometimes potatoes, are commonly employed. Thefe anfwer fufficiently well in giving to the yarn both the fmoothnefs and tenacity required ; but the great objection to them is, that they are too eafily affected by the action of the atmofphere. When dreffed yarn is allowed to ftand expofed to the air for any confiderable time, before being woven into cloth, it becomes hard, brittle, and comparatively inflexible. It is then tedious and troublefome to weave, and the cloth is rough, wiry, and uneven. This is chiefly remarked in dry weather, when the weavers of fine cloth find it neceffary to work up their yarn as fpeedily as poffible, after it is dreffed. To counteract this inconveniency, herring or beef brine, and other faline fubftances which attract moifture, are fometimes mixed in fmall quantities with the dreffing : but this has not been completely and generally fuccefsful ; probably, becaufe the proportions have not been fufficiently attended to ; for a fuperabundance of moifture is equally prejudicial with a deficiency. The variations of the moifture of the air are fo great and frequent, that it is impoffible to fix any univerfal rule for the quantity of falt to be mixed. Some weavers put butter-milk in the pafte.

To apply the dreffing, the weaver muft fufpend the operation of weaving, whenever he has worked up that quantity of warp which he has dreffed, or within two or three inches ; he then quits his feat, and applies the comb to clear away knots and burs ; next pufhes back the leafe-rods towards the yarn-roll, one at a time, and if they flide freely between the yarns, it fhews they are clear from knots ; he then brufhes the yarn with the pafte by two brufhes, holding one in each hand. The fuperfluous humidity is afterwards dried by fanning the yarns with a large fan, and then a fmall quantity of greafe is brufhed over the yarn ; the leafe-rods are returned to their proper pofition, and the weaving is refumed.

Dreffing is of the firft importance in weaving warps fpun from flax or cotton ; for it is impoffible to produce work of a good quality, unlefs care be ufed in dreffing the warp.

The fame practice, when ufed upon filk, has a very deftructive tendency : it injures the colours of the filk when ufed, as it is fometimes very improperly, by the weavers of white fatin. The injury done to the work is irreparable. In cotton, the operation of dreffing is indifpenfable ; but in filk, this is by no means the cafe.

The preparation of pafte or fize for warp, has been the fubject of feveral patents. Mr. Foden, in 1799, recommends a quantity of calcined gypfum, or plafter of Paris, to be reduced to a very fine powder, and then mixed with alum, fugar, and the farina or ftarch of potatoes, or any other vegetable farina. This powder, when mixed well with cold water, forms a foft pafte, to which boiling water is to be added, and the mixture thoroughly ftirred till it becomes fufficiently gelatinous for ufe.

Another fize, for which Mr. Wilks had a patent in 1801, is prepared as follows :—The ftarch or flour is to be extracted from any kind of potatoes which are mealy when boiled, by grating them while raw (but wafhed clean) into a tub of water. The water, thus impregnated with the grated potatoes, is run through a fieve or ftrainer, which will retain the coarfer and fibrous parts of the potatoes, but admit the finer particles, conftituting the ftarch or flour, to pafs with the water into a veffel beneath the fieve or ftrainer. This water muft remain in the veffel feveral hours undifturbed, to permit the ftarch to fubfide to the bottom ; then the water is poured off, and the ftarch fo obtained is put into frefh water, and paffed through a finer fieve into another tub, where the ftarch is left to fubfide to the bottom as before, and the water is again poured off.

About two-thirds the quantity of potatoes, which furnifhed the ftarch, are alfo to be boiled without peeling, fo as to make them mealy when boiled ; they are then mafhed, and diluted with water, fo that they will pafs through a fieve into a boiler. In this the mafhed potatoes are heated till they almoft boil; and the ftarch from the grated potatoes is then to be added, and the whole boiled and ftirred for 20 minutes, when it will become pafte proper for ufe. It fhould be fpread in a flat open veffel to cool.

Improved Syftem of Weaving by Machinery.—In our article Cotton we mentioned that weaving-looms, worked by mechanical power, were then coming into ufe : fince the time that article was printed thefe have made great advances ; but to ufe them with advantage, the preparatory proceffes of warping and dreffing muft be conducted in a particular manner. Many attempts have been made to diminifh the number of operations through which the yarn muft pafs by combining feveral together. Mr. Stuart had a patent in 1800 for fizing or ftarching cotton-yarn whilft in the cop, fo that it would be ready to warp at once. Mr. Marfland had a patent in 1805 for the fame object : his plan was to expofe the cops of cotton to the action of the hot ftarch in an exhaufted receiver ; the preffure of the atmofphere being thus removed, the fize penetrated readily to the centre. It was found difficult to dry the cop perfectly, and the threads were fometimes fo glued together as to render the winding off difficult.

Another plan has therefore been introduced both for flax and cotton : this is to wind off the yarn from the cop or bobbin in which it is fpun, and gather it upon the bobbins ready for the warping ; by this manner the reeling is faved. A fmall quantity of ftarch is applied to the yarn during the operation, by caufing it to pafs over a horizontal wooden cylinder, which revolves on its axis in a trough filled with fluid ftarch. The threads, in paffing from the cop to the bobbin, are drawn over the upper furface of the cylinder, and receive the ftarch with which it is covered. The winding machine for this actuated a great number of bobbins at once ; the warping is then conducted, as we have before defcribed, and the dreffing is performed in the loom whilft weaving, that is, if woven by hand ; but for the power-loom it is dreffed previoufly to placing it in the loom.

Dreffing Machines.—Mr. Johnfon, of Stockport, had a patent, in 1804, for a method of dreffing whole webs of warp at once,

once, by a machine. The yarns were wound off from the bobbins or cops of the ſpinning machines upon beams or rollers. Several of theſe rollers were placed parallel to each other, in an horizontal direction, at the oppoſite ends of the machine, from three to ſix at each end; and the yarns from them were all combined together in one web, which was received and rolled up on the yarn-beam of the loom placed in the middle of the machine, and raiſed up conſiderably above the other rollers, ſo that the yarns proceeded from both ends of the machine towards the middle. In their paſſage they paſſed through ſeveral reeds to keep them ſeparate, and were ſupplied with the paſte by paſſing over two cylinders revolving in a trough of fluid paſte. This paſte was dreſſed or worked into the yarn by means of two bruſhes, of a length equal to the breadth of the web; one of the bruſhes acted upon the upper ſide of the yarns, and the other on the lower ſide. A ſimilar pair of bruſhes were applied at both ends; each bruſh had a motion given to it by means of cranks, exactly ſimilar to the movement with which the weaver bruſhes the yarn in the loom. Near the yarn-rolls a fan was placed, like that uſed in a winnowing machine, which blew a current of air through the yarns of the warp to dry them before they were rolled up by the beam. To preſerve the leaſe, the yarns were conducted through a pair of heddles, ſimilar to thoſe of the loom, but they remained ſlack to avoid friction. The machine was moved by the mill with a conſtant and regular movement.

When a warp is thus warped, beamed, and dreſſed, the yarn-beam is carried to a loom, on which the yarn is juſt exhauſted, and is made to replace the empty yarn-roll. The ends of the yarn are joined to the old yarns by twiſting, and are thus drawn through the heddles and reed, ſo that the weaving can be reſumed with very little loſs of time, and the weaver can proceed with his work without any interruption for dreſſing. The principal objection to the above machine is the friction which the yarns muſt undergo in bruſhing, and in paſſing through ſo many reeds: it was, however, practiſed in a large work at Stockport; but the weaving was performed by hand.

Another dreſſing machine was invented by Mr. M'Adam, and he obtained a patent in 1806: it is practiſed by Mr. Monteith, at Pollockſhaws near Glaſgow. This machine is very much like the former in its manner of action. Inſtead of uſing three, four, or ſix beams at each end of the machine, there are only two beams, each containing one half the number of yarns for the intended warp. The ſtarch is ſupplied in the ſame manner as the former, or ſometimes by making the two yarn-beams themſelves turn in a trough of ſtarch without employing a ſeparate cylinder. The bruſhing is performed in a more ſimple and effectual manner by uſing cylindrical bruſhes, which revolve with a regular motion, two of them are applied on the upper ſide of the warp, and two on the lower ſide; alſo four fanners are applied to dry the warp inſtead of one. The yarns were conducted between reeds and through heddles, like the firſt machine; and hence the ſame objection of friction applies to both.

Mr. Duncan, in his Eſſays on Weaving, deſcribes another method of dreſſing warps, which is practiſed by Mr. Dunlop at Barrowfield. In this the yarn is warped and beamed in the uſual manner, upon a yarn-roll: from this the yarn is unwound, and taken up upon another beam; and in its paſſage from one to the other it is extended, ſo that the picking and clearing can be performed in the uſual way by hand with a comb and ſciſſors, and the dreſſing is applied with bruſhes in the uſual way: beneath the warp a fan is placed, to blow a current of air up through the yarns and dry them. In this machine all the operations, except the fanning, are performed by hand; the advantage, therefore, conſiſts only in the diviſion of labour, by making the dreſſing and weaving diſtinct operations.

Power-Looms.—In the article COTTON we have mentioned Mr. Dolignon's claim to the invention of weaving by mechanical power.

The original project, we believe, was by M. De Gennes, and is publiſhed in the Philoſophical Tranſactions for 1768, N° 140. See alſo Lowthorp's Abridgment, vol. i. p. 499. This is a very ingenious invention. The fly-ſhuttle was not then invented, and he ſupplied the want of it by a contrivance which held the ſhuttle as it were in a hand by fingers; this carried it half way through the cloth, and then it was transferred to another ſimilar hand, which drew it through the remainder. By this means there was a greater certainty than in throwing the ſhuttle from one ſide to the other, becauſe the ſhuttle always continued engaged with the mechaniſm: the whole machine is ingenious and worthy of notice.

M. Vaucanſon, the celebrated French mechaniſt, made a machine for weaving ten ribbands at a time, which was worked by a circular motion given by the workman; and it might, therefore, have been worked by mechanical power. This is deſcribed in the Encyclopede Methodique in great detail, with ten folding plates, and is an ingenious machine.

We believe both theſe inventions were prior to that of Mr. Dolignon; and alſo that the merit of inventing the machine, and firſt reducing it to practice, is due to Mr. Auſtin, of Glaſgow. In this gentleman's memoir to the Society of Arts, he ſtates, that his firſt attempt was made in the year 1789, when he entered a caveat for a patent, but did not apply for it further; ſince that time he made many improvements upon the original plan. In 1796 a report in its favour was made by the Chamber of Commerce and Manufactures at Glaſgow; and in 1798, a loom was ſet at work at Mr. J. Monteith's ſpinning works, at Pollockſhaws near Glaſgow, which anſwered the purpoſe ſo well, that a building was erected by Mr. Monteith for containing thirty looms, and afterwards another to hold about two hundred.

Mr. Auſtin's Power-Loom.—The model from which our drawing (*Plate* I. *Weaving*) was made, is depoſited in the Society of Arts: it is an improvement upon the looms conſtructed for Mr. Monteith.

The drawing *Plate* I. is a perſpective view, exhibiting the whole loom at one glance: it is viewed from the back rather than from the front.

A is a ſquare iron axis extending through the whole length of the machine; to this the power of the firſt mover is applied by a cog-wheel B, of thirty-ſix teeth, turned by a pinion of twelve leaves fixed to the axis of the fly-wheel D. A handle is fixed to one of the arms of the wheel to give motion to the model; but in the large machine a live and dead pulley are adapted to the axis of the fly-wheel; and by means of an endleſs ſtrap, the power is communicated from any convenient part of the mill in which a great number of looms are placed together.

The axis A has ſeveral eccentric wheels or camms fixed upon it; as theſe revolve they give motion to a number of levers or treadles, by which all the uſual operations of the loom are performed at the proper intervals: theſe are,

Firſt, To ſeparate the two parts of the yarns of the warp, as ſhewn at G, and admit of the paſſage of the ſhuttle.

Secondly, To throw the ſhuttle, in order to lay the weft or croſs-threads of the cloth.

Thirdly, To move the lay 7.8, and return it; ſo that the reed *g* will beat up the weft cloſe to the fell, or preceding

ceding ſhoot of the weft: this renders the cloth of uniform texture.

Fourthly, To wind up the cloth upon the cloth-roll, as faſt as it is formed by the preceding operations.

The yarns, which are to form the warp of the cloth, are warped in the manner before deſcribed upon the yarn-roll F; and from thence they are extended horizontally to the cloth-roll E, of which only a ſmall part can be ſeen at the oppoſite ſide of the loom: in their way the yarns paſs through the eyes of the heddles G H, which effect the firſt operation above-mentioned. Each heddle is compoſed of a number of perpendicular threads equal to half the number of yarns in the warp; theſe are ſtretched between two ſmall rods *a a* and *b b*, and in the middle of each thread is a ſmall eye, through which a yarn of the warp is paſſed; thus, the firſt yarn of the warp is paſſed through the eye of the heddle G, but has no connection with the heddle H, becauſe it paſſes between its threads. The ſecond yarn is put through the eye of the heddle H, but has no connection with G; the third yarn is attached to H; the fourth to G, and ſo on alternately throughout the whole number. By this means if one heddle is raiſed up, and the other at the ſame time depreſſed, a ſeparation of the yarns will take place as ſhewn at G, every other yarn being raiſed up, whilſt the intermediate ones are drawn down, ſo as to admit the paſſage of the ſhuttle and weft between them.

The two heddles are moved by camms upon the main axis A; and they are ſo connected by ſhort levers I I, which are ſuſpended from the upper part of the loom, that when one heddle is pulled down, the other will be drawn up at the ſame time, becauſe they are ſuſpended from the oppoſite ends of the levers I.

The camms on the main axis for the heddles are marked L; the two are exactly ſimilar, but are reverſed upon the axis; that is, the ſhorteſt radius of one is placed on the ſame ſide with the longeſt of the other. They act upon two levers, which are the ſame as the treadles in a common loom; only one of theſe treadles or levers (*viz.* that which belongs to the camm L) can be ſeen at M, the other lever being concealed from the view; both levers move on centres at *n* between the ſmall uprights *d d*; the other ends ſlide freely up and down between ſimilar uprights at the oppoſite ſide of the frame, which cannot be ſeen in the figure; the levers are connected with the heddles, which being ſuſpended from the levers I as before mentioned, the levers will therefore move in contrary directions, the one riſing when the other is preſſed down by the action of the camm on the axis A.

The connection between the levers or treadles M and the heddles G H, is made by cords communicating with two counter-levers O P, which are centered in uprights ſupported by the frame at the ends of the machine. The counter-levers O P are connected with rods *h* and *k*, and theſe by a double cord are attached to the heddle-rods *a a* and *b b*.

This machinery which we have now deſcribed effects the ſeparation of the warp thus: when the axis A turns round, every revolution of its camms L will cauſe two ſeparations of the warp, and each one in a different manner, for thoſe yarns which are raiſed up at one time are drawn down the next.

The ſecond operation, *viz.* throwing the ſhuttle, is performed by two camms R S, which are reverſed to each other upon the axis A. They act upon two levers, only one of which can be ſeen at T; they are placed beneath the camms. The ſhuttle requires to be projected with a ſudden jerk; theſe levers are therefore centered at *d* on the ſame pin as the levers M and N, but the other ends preſs down ſmaller levers W, which are centered at the oppoſite end of the frame, and lie beneath the long levers. The extreme ends of theſe ſmaller levers are connected by a ſtrap *f* with a ſegment of a wheel, which has a long ſtem of whalebone Y faſtened to it; and by means of two ſtrings, one of which is ſhewn at *q* 4, it moves the peckers or drivers *z* upon the wires 3, 3, and throws the ſhuttle. The ſhuttle, which is ſhewn in a ſeparate figure, is pointed at each end, and ſhod with iron: it contains two ſmall rollers 31 31 upon which it runs; and as they project through both ſurfaces, it will run either way upwards, or either end firſt. In the centre of the ſhuttle is an oblong mortiſe, containing the pirn or bobbin 33, on which the thread for the weft of the cloth is wound; and the end of the weft marked 34, is brought through a ſmall glaſs tube, called the eye of the ſhuttle.

The action of the mechaniſm for throwing the ſhuttle is as follows:—By the revolution of the camm R, the long lever beneath it is depreſſed, and at the ſame time the extremity of the ſhorter lever W deſcends, but with an increaſed velocity; this by means of the ſtrap *f* turns the ſegment of a wheel on its centre, and its tail Y ſnatches the ſtring *q* 4 of the pecker *z*, and makes it ſtrike againſt the ſhuttle with ſuch a velocity, as to drive the ſhuttle out of the trough Q, acroſs the ſhuttle-race, into the oppoſite trough, where it will puſh back the pecker, and remain at reſt in the trough ready for the next ſtroke: by this ſtroke it will be returned back again with an action ſimilar to the laſt, but occaſioned by the other camm S, and its correſponding levers.

The threads of the warp, which are loweſt when the ſeparation takes place, are drawn down by their heddle G or H, ſo as to lie cloſe upon the ſhuttle-race, and cauſe no obſtruction to the paſſage of the ſhuttle. To facilitate this, the ſhuttle muſt be very ſmooth on the ſurface, that it may not catch the threads and be ſtopped. The ſhuttle-race is inclined towards the reed, both that the yarn may lie flat upon it, and that the ſhuttle may not be liable to run off its race; for as it leaves the weft, which is drawn off from its bobbin, in the ſpace between the divided yarns of the warp, it might be drawn off its race ſideways, without this precaution. In this manner the ſecond operation is performed.

The third motion is that of the reed *g*: this is fixed cloſe behind the ſhuttle-race, and is a frame containing a great number of parallel ſlips of reed or cane; between theſe the yarns of the warp paſs, and when the whole frame of reeds is moved towards the cloth-roll E, they will act in the manner of a comb, to beat up the thread of the weft, which is left by the ſhuttle lying looſely between the yarns of the warp.

For this purpoſe, the ſhuttle-race, reeds, peckers, &c. and their ſtem Y, with its ſegment of a wheel, are all placed on a frame which moves on hinges at the lower ends, 8, of the two upright ſides 7 8. This frame, which is termed the lay, is drawn backwards by means of ſtraps 10, 10, rolled upon pulleys 11, faſtened upon the axis 12; upon this ſame axis are two other ſmaller pulleys, upon which two ſtraps, 13, are rolled, to connect with the long levers 14, which are moved by the camms 15, upon the axis A.

The long levers, 14, are centered at one end of the frame, and the pulleys on the axis, 12, being of different diameters, the motion of the reeds will be performed very quickly. To move the lay in a contrary direction, and give the ſtroke to beat up the weft, two large weights, like *m*, are ſuſpended by ſtraps from pulleys on an horizontal axis, which carries two larger wheels *x*; on theſe, ſtraps are wound, to communicate

nicate with the upright fides, 7 8, of the lay, and draw it forwards.

When the loom is acting very quickly, thefe weights would not act with fufficient fharpnefs to throw the reeds againft the threads of the weft with the proper force.

The weights are therefore connected by fpiral wire-fprings, with long levers 16, which are preffed down by a camm or rather tappet 17, fixed on the main axis. Thefe levers act before the lay is at liberty to move, and by preffing down the levers extend the fprings; confequently, as foon as the camm 15 fuffers the lever 14 to rife, the fprings act inftantaneoufly, to throw the lay and the reeds forwards to beat up the weft.

The inftant after the blow has been given, the lay is drawn back again by the camm 15, and returned into the vertical pofition, in which fituation the lay muft continue whilft the fhuttle is thrown; for this purpofe, the outfides of the camms 15 are portions of circles. This completes the third motion.

As faft as the cloth is fabricated by the foregoing movements, it is gathered upon the cloth-roll E. This is turned flowly round by a fmall crank 19, on the extreme end of the main axis A; the crank moves a fmall rod 20 up and down, in order to turn a fmall ratchet-wheel round one tooth each revolution of the main axis; the return of the ratchet is prevented by a click. On the axis 21 of the ratchet-wheel is an endlefs fcrew, to engage the teeth of a cog-wheel upon the end of the cloth-roll, and give it a flow motion.

The yarn is kept to a proper degree of tenfion by the friction occafioned by a line 28 paffed twice round the yarn-roll, one end being faftened to the frame, and the other to a lever 30, loaded with a weight.

The framing of the loom is too evident to need defcription. In the conftruction of the machine, the principal circumftance to be attended to, is the figure of the different camms; alfo that they are placed upon the axis A in the proper pofitions relative to each other. Thefe cautions will enfure the accurate performance of the machine.

The camm R or S, for throwing the fhuttle, is formed with a fudden beak or projection, that it may ftrike the levers T down inftantaneoufly, and throw the fhuttle; from this beak the curve continues circular for fome diftance, that the lever may be held ftationary; the remainder of the camm gradually diminifhes its radius like a fpiral, and quits the lever, in order to leave it at liberty to rife up when its correfponding lever is forced down by the beak of the other fimilar camm S.

The camm L for the heddles is made circular where it is to come in contact with the lever, and which is all the time it is in action. This occafions the levers and heddles to be ftationary whilft the fhuttle is thrown.

The inventor ftates that, by the addition of fome fimple improvements, his looms have the following advantages; *viz.* 300 or 400 of them may be worked by one water-wheel, or fteam-engine, all of which will weave cloth in a fuperior manner to what can be done in the common way. They will go at the rate of 60 fhoots in a minute, making two yards height of what is called a nine hundred web in an hour. They will keep regular time in working, ftop and begin again, as quick as a ftop-watch. They will keep conftantly going, except at the time of fhifting two fhuttles, when the weft on the pirns is exhaufted. In general, no knots need be tied, and never more than one in place of two, which are requifite in the common way when a thread breaks. In cafe the fhuttle ftops in the fhed, the lay will not come forwards, and the loom will inftantly ftop working. They will weave proportionally flower or quicker, according to the breadth and quality of the web, which may be the broadeft now made. They may be mounted with a harnefs or fpot-heddles, to weave any pattern, twilled, ftriped, &c.

There is but one clofe fhed, the fame in both breadths, and the ftrain of the working has no effect on the yarn behind the rods.

The fell and temples always keep the fame proper diftance. There is no time loft in looming, or cutting out the cloth; but it is done while the loom is working, after the firft time.

The weft is well ftretched, and exactly even to the fabric required.

Every piece of cloth is meafured to a ftraw's breadth, and marked where to be cut at any given length.

The loom will work backwards in cafe of any accident, or of one or more fhoots miffing. Every thread is as regular on the yarn-beam as in the cloth, having no more than two threads in the runner. If a thread fhould appear too coarfe or fine in the web, it can be changed, or any ftripe altered at pleafure. They will weave the fineft yarn more tenderly and regularly than any weaver can do with his hands and feet.

When a thread, either of warp or weft, breaks in it, the loom will inftantly ftop, without ftopping any other loom, and will give warning by the ringing of a bell. A loom of this kind occupies only the fame fpace as a common loom; the expence of it will be about half more; but this additional expence is more than compenfated by the various additional machinery employed for preparing the yarn for the common loom, and which this loom renders entirely unneceffary.

The preparatory proceffes of reeling, winding, warping, beaming, and looming, and the interruptions occafioned by combing, dreffing, fanning, greafing, drawing bores, fhifting heddles, rods, and temples, which is nearly one-half of the weaver's work, do not happen in thefe looms. The general wafte accompanying the above operations is ftated at about fix *per cent.* of the value of the yarn, all which occur in the operations of the common loom. The power-loom, without further trouble, performs every operation after the fpinning, till the making of the cloth is accomplifhed, by which a faving is effected of about 20 *per cent.* of the yarn.

The heddles, reed, and brufhes, will wear longer than ufual, from the regularity of their motion. More than one-half of workmanfhip will be faved; one weaver and a boy being quite fufficient to manage five looms of coarfe work, and three or four in fine work.

Mr. Miller's Power-Loom.—A patent was taken out for this in 1796. It is fo much like Mr. Auftin's in its general principle, that it is unneceffary to enter into the defcription. The motions are all produced by camms fixed on a horizontal axis, and operate upon a number of horizontal levers, difpofed beneath the loom, in the fituation of treadles: in other refpects the arrangement of the parts is very different. This is fometimes called the wiper-loom, wiper being a different name for a camm.

Crank Loom by Power.—In this the treadles are actuated by cranks, inftead of camms or wipers. The reciprocating motion produced by a crank is not uniform, but accelerated at one time, and retarded at another. This is an advantage in fome of the operations of a loom. It is true, that, by means of wipers, any required law of acceleration may be produced; but in a crank, the acceleration muft proceed according to one law. The fuperiority of cranks arifes from

from the circumftance, that they will communicate motion in both directions; whereas a camm will only pufh a lever in one direction, and the return of the motion muft be made by a fpring or counterweight. Now, if this counterweight is too large, it makes unneceffary lofs of power and friction; and if it is too fmall, there is fome uncertainty in the return of the lever.

Mr. Todd of Boulton had a patent, in 1803, for improvements in power-looms.

Mr. Horrocks of Stockport had three fucceffive patents for this kind of machinery, in 1803, 1805, and 1813. The machine defcribed in the latter is a crank-loom; that is, the lay is actuated by a crank to beat up the weft. The principal improvement confifts in a fyftem of levers, which tranfmit the action of this crank to the lay, and fo modify it, that the lay will advance quickly, and give an effective ftroke to the weft, and then withdraw quickly to a ftationary pofition, in which it will remain whilft the fhuttle is thrown. The advantages which are ftated are, that a large fhuttle may be ufed, fufficient to hold a full-fized cop of weft: the wafte and lofs of time by renewing the cop will, therefore, be lefs. From the fmartnefs of the ftroke, lefs weight will be required on the yarn-beam, and this will occafion the heddles to work more lightly, fo as to break fewer threads. From the fame caufe, more threads of the weft may be laid in an inch, and make clofer work.

Mr. Johnfon of Prefton had a patent in 1805, and another in 1807, for a power-loom, in which the warp is ftretched on a vertical plane, inftead of horizontal, as in former machines. The advantages of this are ftated to be, 1ft, that it takes lefs fpace; 2d, the reed ferves for the fhuttle-race, becaufe the fhuttle runs upon the reed itfelf, and, therefore, makes no friction upon the yarns; 3d, alfo in dreffing, picking, and clearing the warp, the attendant always remains in front of the machine, and can continue to watch the machine; whereas, in the other looms, he muft quit his poft in front, and go round behind the looms for thefe operations. When the dreffing is to be applied to the warp, whilft it is in the loom, that part of the warp is conducted horizontally for that purpofe, and a fan is applied to dry the warp.

The lateft inventions of power-looms are Mr. Peter Ewart's patent, 1813; and Mr. Duncan's loom, which he calls a vibrating loom.

The Indian Loom.—This is a ftriking contraft to our power-looms; it confifts merely of two bamboo rollers, one for the warp, and the other for the finifhed cloth; and a pair of heddles. The fhuttle performs the double office of fhuttle and reed: for this purpofe, it is made like a large netting-needle, and of a length fomewhat exceeding the breadth of the piece of cloth which is to be woven.

This apparatus the weaver carries to any tree which affords a fhade moft grateful to him: under this he digs a hole large enough to contain his legs, and the lower part of the geer or heddles; he then ftretches his warp, by faftening his bamboo rollers at a due diftance from each other on the turf, by wooden pins; the balances of the geer or heddles he faftens to fome convenient branch of the tree over his head; and two loops underneath the geer, in which he inferts his great toes, ferve inftead of treadles; his long fhuttle, which performs alfo the office of a batten, draws the weft, throws the warp, and afterwards ftrikes it up clofe to the web. In fuch looms as this are made thofe admirable muflins, whofe delicate texture the Europeans can never equal, with all their complicated machinery.

The weaving, even of their fineft muflins, is thus conducted in the open air, expofed to all the intenfe heat of their climate. We know well that this would be impracticable with fine work in this country, even in an ordinary fummer day, on account of the fudden drying of the dreffing. It is not known what is the fubftance which the Indian weavers employ for dreffing their warps. It might be of ufe to our manufacturers, were this inveftigated in a fatisfactory manner. It is faid to be a decoction of rice, formed by boiling the rice in a fmall quantity of water, and expreffing the juice: when this is cool, it forms a thick glutinous fubftance, which undergoes fome kind of fermentation before it is ufed.

Figure-weaving.—Having given an account of the nature and procefs of plain weaving, we muft notice the fanciful and ornamental parts of the bufinefs. The extent to which this fpecies of manufacture is carried renders it an object of very great national importance, and deferving a more minute defcription than our limits will admit.

Figures or patterns are produced in cloth, by employing threads of different colours, or of different appearance, in the warp, or in the weft. By the weaving, the threads muft be fo difpofed, that fome colours will be concealed and kept at the back, whilft others are kept in the front; and they muft occafionally change places, fo as to fhew as much of each colour, and as often as it is neceffary, to make out the figure or pattern.

The weaver has three means of effecting fuch changes of colour: Firft, by ufing different coloured threads in the warp, or threads of different fizes and fubftances; thefe are arranged in the warping, and require no change in the manner of weaving. This is confined to ftriped patterns, the ftripes being in the direction of the length of the piece.

Secondly, by employing feveral fhuttles charged with threads of different colours or fubftances, and changing one for another every time a change of colour is required. This makes ftripes acrofs the breadth of the piece; or, when it is combined with a coloured warp, it makes chequered and fpotted patterns of great variety.

Thirdly, by employing a variety of heddles, inftead of two, as we have hitherto defcribed; each heddle having a certain portion of the warp allotted to it, and provided with a treadle. When this treadle is depreffed, only a certain portion of yarns which belong to that heddle will be drawn up, and the reft will be depreffed; confequently, when the weft is thrown, all thofe yarns which are drawn up will appear on the front or top of the cloth; but in the intervals between them, the weft muft appear over thofe threads which are depreffed. The number of threads which are thus brought up may be varied as often as the weaver choofes to prefs his foot upon a different treadle, and by this he produces his pattern.

All thefe means may be combined together, and give the weaver the means of reprefenting the moft complicated patterns.

The principal varieties of woven cloth, including only thofe which require a different procefs for their fabrication, are the following:

Stripes are formed upon the cloth either by the warp or by the woof. When the former of thefe ways is practifed, the variation of the procefs is chiefly the bufinefs of the warper; but in the latter cafe, it is that of the weaver, as he muft continually change his fhuttle.

By unravelling any fhred of ftriped cloth, it may eafily be difcovered whether the ftripes have been produced by the operation of the warper or thofe of the weaver.

When the fly-fhuttle is ufed, the changing of the fhuttle is very readily effected by a fimple contrivance. One of the fhuttle-boxes or troughs, as we have before called them,

(*Plate*

(*Plate* II. *Weaving*, *fig.* 2.) is made in two parts, fo that a part of the trough I near the pecker, where the fhuttle lies during the time it is at reft, can be removed, and another trough fubftituted, which contains a different fhuttle. For the purpofe of making the change with facility, a moveable fhuttle-box *n* is fufpended by two perpendicular ftems *o* from a wire or centre of motion *m* attached to the lay, as is fhewn by the dotted lines. The moveable box is juft on the fame level with the fhuttle-trough I, and is divided by partitions into two or three feparate troughs, each exactly the width of the regular trough, and as long as is neceffary to contain a fhuttle. The pecker *k*, and the wire upon which it flides, remain exactly as before defcribed; but by fwinging the moveable box *n* on its centre any one of its compartments may be brought to line with the real place for the fhuttle-trough in which the pecker runs. The moveable box muft have proper catches to hold it exactly in its true pofitions.

In working with this contrivance a fhuttle of a different colour muft be placed in each cell or divifion of the moveable box *n*; and when the weaver defires to change the fhuttle he pulls the connecting ftring. This moves the fhuttle-troughs either backwards or forwards, fo as to carry away that fhuttle which had been juft before in ufe, and place another before the pecker. Then if he pulls the pecker-handle *y* the new fhuttle will be thrown acrofs the fhuttle-race, juft as the old one was in the former inftance. If only one moveable fhuttle-box is ufed there will be fome limitation in the pattern, becaufe the ftripes of different colour muft always confift of an even number of the fame coloured thread, as two, four, fix, &c. This may be obviated, and a greater change of fhuttles may be introduced, by ufing two moveable fhuttle-boxes, one at each end of the fhuttle-race: in that cafe the two moveable boxes are provided with cranks and ftrings, fo that the weaver can reach either of them with eafe.

Checks are produced by the combined operations of the warper and the weaver.

Tweeled cloths are fo various in their textures, and fo complicated in their formation, that it is difficult to convey an adequate idea of the mode of conftructing them without the aid of feveral drawings.

In examining any piece of plain cloth, it will be obferved that every thread of the weft croffes alternately over and then under every thread of the warp which it comes to; and the fame may be faid of the warp: in fhort, the threads of the warp and weft are thus interwoven at every point where they crofs each other, and are therefore tacked alternately.

Tweeled cloth is rather different, for only the third, fourth, fifth, fixth, &c. threads crofs each other, to form the texture.

Hence two, three, four, or more, of the fucceffive threads or fhoots of the weft will be found to pafs under or over the fame thread of the warp; or, in other words, by tracing any thread of the warp it will be found to pafs over two, three, four, or more threads of the woof at once, without any interweaving the warp. Then it croffes and paffes between the threads of the weft, and proceeds beneath two, three, four, or more threads, before it makes another paffage between the threads of the weft.

Tweeled cloths are of various defcriptions, and produce different kinds of patterns; becaufe at all the interfecting points where the threads actually crofs or interweave both threads of warp and weft are feen together, and thefe points are therefore more marked to the eye, even if the warp and weft are of the fame colour. Thefe points in plain tweels form parallel lines extending diagonally acrofs the breadth of the cloth, with a different degree of obliquity, according to the number of weft-threads over or under which the warp-threads pafs before an interfection takes place. In the coarfeft kinds every third thread is croffed: in finer fabrics they crofs each other at intervals of four, five, fix, feven, or eight threads; and in fome very fine tweeled filks the croffing does not take place until the fixteenth interval.

Tweeling is produced by multiplying and varying the number of heddles, or, as the weavers exprefs it, the number of leafes in the harnefs, which is the name given to the whole number of heddles employed in a loom; by the ufe of a back-harnefs or double-harnefs, by increafing the number of threads which pafs through each fplit of the reed, and by an endlefs variety of modes in drawing the yarns through the heddles; alfo by increafing the number of treadles, and changing the manner of treading them.

The number of treadles requifite to raife all the heddles which muft be ufed to produce very extenfive patterns, would be more than one man could manage; for if he placed his foot by miftake on a wrong treadle he would disfigure his pattern. In thefe cafes, recourfe is had to a mode of mounting or preparing the loom, by the application of cords to the different heddles of the harnefs; and a fecond perfon is employed to raife the heddles in the order required, by pulling the ftrings attached to the refpective heddles of the back-harnefs, and each heddle is returned to its firft pofition by means of a leaden weight underneath. This is the moft comprehenfive apparatus ufed by weavers, for all fanciful patterns of great extent, and it is called the DRAW-*Loom*. See that article.

The manner of mounting the harnefs of looms, to produce all the principal varieties of fabrics, is detailed in our articles DESIGN, DRAUGHT, and CORDING *of Looms;* alfo DAMASK, DIAPER, DIMITY, DORNOCK, FUSTIAN, and TAPESTRY. A perufal of thofe articles will render it unneceffary for us to proceed farther on that fubject in the prefent article. We fhall however defcribe a moft valuable invention, which has of late years come into ufe, as a fubftitute for the fecond perfon or draw-boy, who muft be employed in the draw-loom, by which loom alone all the complicated patterns can be woven.

Machine called the Draw-Boy, becaufe it performs the Office of a Draw-Boy in Weaving.—The faving of labour is not the only advantage of this machine; the certainty of its operation and fecurity from miftake are obvious. The weaver produces the required action upon the moft complicated harnefs by two treadles only, which he works alternately, juft with the fame motion as in plain cloth-weaving. The machine, when once fet up, performs every thing elfe.

Like moft other inventions, this was at firft imperfect, but has been gradually improved. We do not know its hiftory, but we have feen great numbers of machines, for carpet-weaving and coarfe goods, which have been fome years in ufe. The machine is fituated in a fmall fquare frame, not larger than a chair, which ftands at the fide of the loom, and cords from all the different heddles are conducted from the draw-loom down to this frame, where they are arranged in order. Each cord has a knot anfwering to the handle, which the boy muft pull in the common draw-loom; and there is a piece of mechanifm actuated by the treadles which at every ftroke felects the proper cord, and draws it down fo as to raife the heddles belonging to it. The next time it changes its pofition and takes another cord, and fo on until the whole number of cords has been drawn and the pattern completed.

Thefe original machines have a great defect, *viz.* that they only proceed with regularity to raife up all the beddles, until all the cords have been drawn, and one feries of changes has

has been gone through; but when this is completed, and a repetition of the pattern is wanted, the weaver muft ftop and reftore the machine to its original pofition by pulling a ftring. This appears very eafy, but it diverts his attention; and if he does not do it at the exact moment his pattern may be fpoiled. This defect was remedied by Mr. Alexander Duff, who received a fmall and inadequate premium from the Society of Arts in 1807, probably becaufe they were not aware of its value and importance; but in 1810 we find them with a liberality truly difcouraging to real merit, giving an equal reward to another perfon, for the moft trivial alteration of Duff's machine. The latter machine is alone defcribed in their Tranfactions; fee vol. xxviii.

Mr. Duff's Draw-Boy.—Fig. 4. *Plate* II. *Weaving*, is a plan of this machine, and *fig.* 2. a perfpective view. It is fixed at the fide of a draw-loom, in the fame place as a draw-boy would ftand, and H fhew the cords which are to draw the harnefs. The fame letters are ufed in both figures. A A is a fquare wooden axis, mounted fo as to turn backwards and forwards in the frame B B, on points or centres of motion. At one end of it a pulley D is fixed, to receive a line *a a* faftened to it at the higheft point, by means of which the axis receives motion from the two treadles of the loom, one of the treadles being attached to one end of the line, and the other to the oppofite end of it. E E are two rails of wood, fixed acrofs the frame parallel to the axis; and *e e* are two brafs plates fcrewed to the rails, and pierced with a great number of holes to receive as many cords. Each cord is tied by one end to a central rail F of the frame beneath the axis; and after paffing through one of the holes in the above plate *e*, and turning over a round wooden rod G, has a lead weight fufpended to the other end of it. Thefe weights are fhewn at *b b*. The rods G G are fufpended by ftrings at their ends from the ceiling of the room. To each of the above cords another is tied juft before it paffes over G. Thefe are reprefented by H, and hang loofely. The upper ends of thefe cords are tied to horizontal cords extended acrofs the ceiling of the room, and made faft to the ceiling at one end; the other ends pafs over pulleys fituated at the top of the loom, in a frame called the table of mullets, and the harnefs or heddles are fufpended by them.

By this arrangement it will be feen, that when any one of the cords faftened at F is pulled down, it muft draw one of the ftrings H, and raife fuch an arrangement of the harnefs or heddles as is proper to produce the figure which is to be woven. The weight *b* draws the cord fo as to keep it ftraight; all that is therefore neceffary is to draw down the cords at F one at a time, but to take a different one each time, and thus raife a different feries of the heddles each time; this is the bufinefs of the machine, and which it accomplifhes in the following manner.

The bar, or axis, A A, has an iron femicircle, *d*, grooved like a pulley, and each of its ends divided, fo as to form a cleft-hook or claw.

Each of the ftrings made faft at F has a large knot tied in it, juft beneath where it paffes through the brafs plate *e e*, and which knot ftops the farther afcent of the cord, in confequence of the pull of the weight *b*. Now when the axis A vibrates backwards and forwards by the treadles of the loom, as before mentioned, the hook of the femicircle *d* feizes the knot of one of the cords F, and draws down that cord, and raifes the heddles belonging to it. The weaver throws the fhuttle, and then returns the treadles, and the axis A with the femicircle returns back again, and allows the cord F to take its original pofition. When the femicircle *d* inclines over to the other fide, its oppofite hook takes hold of the cord F, which is next to the one oppofite to that which it juft quitted; it draws down this cord, and the weaver again throws his fhuttle, then returns the femicircle to the oppofite fide, and it will take the cord next to the oppofite one, and fo on; fo that the femicircle will in fucceffion take every alternate cord in each of the rows *e e*, and leave every other.

This is effected by the femicircle fliding along its axis A every time, by means of two wooden racks, *h* and *i*, in the plan, which are let into grooves in the axis A; thefe racks have teeth like faws, but inclined in contrary directions. The racks move backwards and forwards in their grooves, the extent of a tooth at each vibration of the axis, by the action of two circular inclined planes of iron faftened to the frame at L M, againft which the ends of the racks are thrown by fpiral fprings concealed beneath each rack. The femicircle is fixed on a box or carriage N, which flides upon the axis A, and has two clicks upon it; one at *l*, which falls into the teeth of the rack *h*; the other at *m* for the rack *i*: *n* is a roller fixed over the box, and connected with the two clicks *l* and *m*, by threads wound in oppofite directions; fo that one click is always raifed up, and difengaged from its rack, while the other is in action. O is a piece of wire fixed to the frame, fo as to intercept a fmall wire projecting from the roller when the axis is inclined, and turn the roller a fmall quantity; P is another wire for the fame purpofe, but fixed to a crofs bar, Q, which is moveable, and can be faftened at any required place, farther or nearer from the end of the axis. Suppofe the roller *n* to be in fuch a pofition that the click *m* is down, and *l* drawn up, the action will be as follows: the femicircle firft inclines to the direction of *fig.* 2., its hook taking down one ftring; during this motion the end of the rack *i* comes to the inclined part of the circular inclined plane M, and moves by its fpring towards D, the fpace of one tooth, which the click *m* falls into. On the return of the axis, the rack *i* is thruft back, and the box N and femicircle with it towards L, caufing the hook to take the next oppofite ftring: in this manner it proceeds, advancing a tooth each vibration, till it gets to the end of its courfe; the tail of the roller *n* then ftrikes againft the pin P, and turns the roller over, raifes the click *m*, and lets down the other, *l*, into the teeth of the rack *h*; this was all the time moving in a contrary direction to *i*, by its inclined plane L, but had no action, as its click *l* was drawn up; this being let down, the femicircle is moved back, a tooth at a time, towards M, until it meets O, which upfets the roller *n*, and fends the femicircle back again.

Tweeled Silks.—In weaving very fine filk tweels, fuch as thofe of fixteen leafes, the number of threads required to be drawn through each interval of the reed is fo great, that if they were woven with a fingle reed, the threads would obftruct each other in rifing and finking, and the fhed, or opening of the divided warp, would not be fufficiently open to allow the fhuttle a free paffage. To avoid this inconvenience, other reeds are placed behind that which ftrikes up the weft; and the warp-threads are fo difpofed, that thofe which pafs through the fame interval in the firft reed are divided in paffing through the fecond, and again in paffing through the third. By thefe means the obftruction, if not entirely removed, is greatly leffened.

In the weaving of plain thick woollen cloths, to prevent obftructions of this kind arifing from the clofenefs and roughnefs of the threads, only one-fourth of the warp is funk and raifed by one treadle, and a fecond is preffed down to complete the fhed between the times when every fhot of weft is thrown acrofs.

Double Cloth is compofed of two webs, each of which confifts

confifts of feparate warps and feparate wefts, but the two are interwoven at intervals. The junction of the two webs is formed by paffing each of them occafionally through the other, fo that any particular part of both warps will be found fometimes above and fometimes below.

This fpecies of weaving is almoft exclufively confined to the manufacture of carpets in this country. The material employed is dyed woollen, and as almoft all carpets are decorated with fanciful ornaments, the colours of the two webs are different, and they are made to pafs through each other at fuch intervals as will form the patterns required. Hence it happens that the patterns at each fide of the carpet are the fame, but the colours are reverfed. Carpets are ufually woven in the draw-loom, or with the machine called the draw-boy before defcribed.

Marfeilles is a fabric woven of cotton, which is a double cloth. The loom for weaving Marfeilles is fomewhat fimilar to the diaper loom. A good idea of the manner in which it is prepared may be had, by conceiving two webs woven one under the other in the fame loom, which are made to intermingle at all the depreffed lines, and form the reticulations on the furface, in imitation of the quilting performed by hand.

When the fpecies of Marfeilles, called Marfeilles quilting, is made, a third warp, of fofter materials than the two others defcribed, lies between them, and merely ferves as a fort of ftuffing to the hollow fquares formed by them.

Quilting is another fort of cotton ftuff, folely appropriated to quilts, which fhould, in ftrictnefs, be fet down exclufively to the cotton manufacture, although there is nothing to prevent its being made of other materials.

The weft of thofe quilts is of very coarfe and thick yarn, which is drawn out by a fmall hook into little loops, as it is woven, that are fo arranged as altogether to form a regular pattern; every third or fourth fhoot of the fhuttle, the weaver has to ftop to form thofe loops from a draft, which caufes the weaving of thofe quilts to take up more time than that of any other ftuff, except tapeftry; which accounts for the greatnefs of the price at which they are fold, in proportion to the value of the materials of which they are principally compofed.

Gauze differs in its formation from other cloths, by having the threads of the warp croffed over each other, inftead of lying parallel. They are turned to the right and left alternately, and each fhot of weft preferves the twine which it has received.

This effect is caufed by a fingular mode of producing the fheds, which cannot eafily be defcribed without the aid of drawings.

Crofs, or *Net Weaving*, is a feparate branch of the art, and requires a loom particularly conftructed for the purpofe.

Spots, brocades, and lappets, are produced by a combination of the arts of plain, tweeled, and gauze weaving, and as in every other branch of the art are produced in all their varieties by different ways of forming the divifion of the warp by the application of numerous heddles, and their connections with the treadles which move them. Indeed the great fkill of the art confifts in the proper management of this part of the apparatus of a loom.

Ribband Weaving.—This was formerly performed by a fmall common loom, weaving one ribband at a time. Ribbands are commonly ftriped in the length by laying a ftriped warp, and patterns are produced by changing the colour of the weft occafionally; fometimes an ornamented edging is formed by a fucceffion of open loops at the borders of the ribband. Figured ribbands are alfo woven by a great number of treadles, but as they rarely extend to a greater number than the weaver can manage by his feet, they feldom employ a draw-loom.

Engine-Loom for weaving Ribbands.—The weavers at Coventry, which is the principal feat of the ribband trade, univerfally employ what they call an engine-loom: it is worked by the hands and feet like a common loom, but weaves twelve, fixteen, or even twenty ribbands at once. The fhuttles are of courfe fly-fhuttles, and are driven by what is called a ladder, becaufe it is a fmall frame exactly like a ladder, which flides horizontally in a groove in the lay; and every crofs-bar of the ladder acts upon one fhuttle in the manner of a pecker: the ladder has a handle to give it motion.

Another peculiarity of this loom is, that the ribbands are taken away as they are woven, with very few interruptions to wind up the work: for this purpofe they conduct the warps over pulleys, and the ribbands alfo, fo that both hang down in long loops. Thefe looped parts are conducted through pulleys, which are loaded with weights, and tend always to draw the loops down, and keep the warp tight. The weight which is thus fufpended by the finifhed ribband tends to draw it forwards at every ftroke which the lay makes; and the weight which is fufpended by the yarn of the warp is drawn up. When thefe weights have run through their refpective courfes, the weaver muft ftop to wind up the finifhed ribband, and unwind a frefh length of yarn. In fome looms this is rendered unneceffary by a fimple mechanifm, which continually winds up the ribband as faft as it is woven.

In 1801 the Society of Arts rewarded Mr. Thomas Clulow, for an improved loom for weaving figured ribbands.

This loom differs from the common figured ribband-looms in the method of forming the figure, which, in the old mode, was tedious, from the work being ftopped, whilft the figure was drawn by hand.

In the prefent loom, the tire-cords which form the figure are drawn or worked by a cord or leather-ftrap fixed to the centre-treadle, which ftrap paffes over two vertical and one horizontal pulley to the back of the loom, and has a weight hung to the end thereof. Upon this ftrap above the weight is fixed an iron, of a bevel or floping form, which when the ftrap is pulled up by preffing with the foot upon the treadle, raifes a wire-lever placed acrofs the main-wheel of the movements placed vertically, and allows this main-wheel to move one-fourth of its circumference, where it is ftopped by an iron pin, placed on its rim, and prevented from returning by a clitch or catch on the edge of the wheel on its right fide.

Within the rim of the main-wheel is a fmall catch-ftrap connected with the ftrap above-mentioned; this catch-ftrap pulls forward the main-wheel one-fourth of its circumference, until it is ftopped by the wire-lever and one of the pins on the rim, of which there are four in number in the ground.

There are alfo four iron pins projecting from the left fide of the main-wheel in oppofite quarters of it: thefe act on a hanging lever, to the lower part of which a ftring is attached, which paffes behind the box containing the whole machinery, and raifes four clicks or catches on four rollers, which permits any one of the four rollers to run back as the figure may require, each roller by fuch motion drawing up the number of threads neceffary to form the figure, by cords extending from thefe rollers over pulleys to the pafs-cords, which draw the figure.

Machine Loom for Ribbands.—We have before mentioned M. Vaucanfon's loom for weaving ten ribbands by a rotatory motion. We do not know that this is in ufe in this country.

Mr. James Birch invented an improvement on the fwivel-loom, fo as to weave fatin-guard or figured laces, and received a reward from the Society of Arts in 1804.

This loom is worked by a circular motion of the hands, without treadles, or any application of the feet.

A wooden bar, to which the hands are applied, works two cranks on a large iron axle, extending the width of the loom ; one crank is near each end of the above axis. A fly-wheel is attached to one of the ends of the axis, to regulate the motion of the machinery ; an endlefs fcrew is placed upon the axis, works a ftar-wheel underneath it, which turns a barrel that has a refemblance to that of a hand-organ, and has wooden pegs fixed in different parts around it : thefe pegs catch upon levers, which draw forward the cords that form the figure, and pull them down by a claw, which fecures the cords thus brought within its power, and by thofe means raife the upper geer connected with the cords.

In this loom fourteen pieces of fatin-guard or bed-lace are wove at the fame time, either one pattern and breadth, or all of different patterns and breadths, as may be required. The figure may be extended to any number of fhoots defired.

The loom takes up no more fpace than a common fwivel-loom, fuch as is employed in plain-work. It appears to work with eafe and expedition, to make good work, and to be eafily managed. It does not break or chafe the filk during its working. The weaver can move to any part of the front of the loom to infpect the work, and to continue the motion during that time ; and the figure or pattern may be formed double the length of thofe ufually done in the engine-loom. The loom can be ftopped when required, at any one fhoot of the fhuttle ; and it will anfwer to weave articles made of filk, wool, cotton, or linen, or mixtures of thofe articles, or gold or filver lace, and performs its work in half the time of an engine-loom.

The want of uniformity in the technical phrafeology of the art of weaving, and the intricacy of the fubject, have compelled us to render our defcriptions far more intricate and difficult than they otherwife would have been.

We muft acknowledge the affiftance which we have derived from the very excellent "Effays on the Art of Weaving," by Mr. Duncan, 1808, in 2 vols. 8vo. It is a moft curious and valuable publication, embracing almoft every thing neceffary to be known concerning the art on which it profeffes to treat ; if we except fome of the recent improvements in machine-weaving, which are only flightly noticed.

The French have long excelled in the various branches of figure-weaving ; but this is more from dexterity of their weavers than from their machinery. Defcriptions and drawings of all looms ufed by them, with every detail of their ftructure, will be found in the different articles of L'Encyclopede Methodique, and Les Arts et Metiers, D'Art de Fabriquer le Soie, &c.

Weaving *of Cloth, Cotton, and Silk.* See Weaving *fupra.*

Weaving *of Tapeftry*, &c. See Tapestry, &c.

Weaving, *Stocking.* See Stockings.

WEAUME, in *Geography*, a river of France, which runs into the fea, near Marfeilles.

WEAUS, or Weeas, Indians dwelling near the head of the river Wabafh.

WEAUTENANS, Indians of North America, about N. lat. 40° 20′. W. long. 87° 20′.

WEB, a fort of plexus, or texture, formed of threads interwoven with each other ; fome of which are extended in length, and called the *warp*, and others drawn acrofs them, called the *woof* or *weft*. See Weaving *fupra.*

Web is alfo a technical term for all weavers and bleachers, both in Great Britain and Ireland, for a piece of linen cloth.

Web, *Spider's*, or *Cob-Web*, is a very delicate and wonderful plexus, which that infect fpins out of its own bowels ; ferving it as a fort of toil, or net, to catch flies, &c. See Spider.

For the manner in which the fpider fpins his web, the admirable mechanifm of the parts fubfervient to it, and the ufes of it, fee Silk, and *Ductility of Spider-*Webs *infra.*

Dr. Lifter tells us, that, attending nearly to a fpider weaving a net, he obferved it fuddenly to defift in the mid-work ; and turning its tail to the wind, it darted out a thread, with the violence and ftream we fee water fpout out of a jet : this thread, taken up by the wind, was immediately carried to fome fathoms long ; ftill iffuing out of the belly of the animal. By-and-bye the fpider leaped into the air, and the thread mounted her up fwiftly. After this difcovery he made the like obfervation in near thirty different forts of fpiders, and found the air filled with young and old, failing on their threads, and doubtlefs feizing gnats and other infects in their paffage : there being often manifeft figns of flaughter, legs and wings of flies, &c. on thefe threads, as well as in their webs below.

Dr. Hulfe difcovered the fame thing about the fame time. In a letter of Dr. Lifter to Mr. Ray, he thinks there is a fair hint of the darting of fpiders in Ariftotle, Hift. An. lib. ix. cap. 39. and in Pliny, lib. x. cap. 74. But with regard to their failing, the ancients are filent, and he thinks it was firft feen by him. In another letter to Mr. Ray, dated January, 1670, fpeaking of the height fpiders are able to fly to, he fays, "Laft October, &c. I took notice that the air was very full of webs ; I forthwith mounted to the top of the higheft fteeple on the minfter (in York), and could there difcern them yet exceeding high above me."

*Ductility of Spider-*Webs. M. Reaumur obferves, that the matter of which fpiders and filk-worms form their threads, is brittle when in the mafs, like dry gums. As it is drawn out of their bodies, it affumes a confiftence, much as glafs-threads become hard, as they recede from the lamp, though from a different caufe. The ductility of this matter, and the apparatus for this purpofe, being much more extraordinary in fpiders than in filk-worms, we fhall here only confider the former. Something alfo has already been faid of each under Silk.

Near the anus of the fpider are five or fix papillæ, or teats. The extremities of the feveral papillæ are furnifhed with holes, that do the bufinefs of wire-drawers, in forming the threads. Of thefe holes, M. Reaumur obferves, there are enough in compafs of the fmalleft pin's-head, to yield a prodigious quantity of diftinct threads. The holes are perceived by their effects: take a large garden-fpider ready to lay its eggs, and applying the finger on a part of its papillæ, as you withdraw that finger, it will take with it an amazing number of different threads. M. Reaumur has often counted feventy or eighty with a microfcope, but has perceived that there were infinitely more than he could tell. In effect, if he could fay, that each tip of a papilla furnifhed a thoufand, he is perfuaded he fhould fay much too little. The part is divided into an infinity of little prominences, like the eyes of a butterfly, &c. each prominence, no doubt, makes its feveral threads ; or rather, between the feveral protuberances, there are holes that give vent to threads ; the ufe of the protuberances, in all probability,

bility, being to keep the threads at their firft exit, before they are yet hardened by the air, afunder. In fome fpiders thofe protuberances are not fo fenfible; but in lieu thereof there are tufts of hair, which may ferve the fame office, *viz.* to keep the threads apart. Be this as it will, there may threads come out at above a thoufand different places in every papilla; confequently, the fpider having fix papillæ, has holes for above fix thoufand threads. It is not enough that thefe apertures are immenfely fmall: but the threads are already formed before they arrive at the papilla, each of them having its little fheath or duct, in which it is brought to the papilla from a confiderable diftance.

M. Reaumur traces them up to their fource, and fhews the mechanifm with which they are made. Near the origin of the belly he finds two little foft bodies, which are the firft fource of the filk. Their form and tranfparency refemble thofe of glafs-beads, by which name we fhall hereafter denote them. The tip of each bead goes winding, and makes an infinity of turns and returns towards the papilla. From the bafe, or root of the head, proceeds another branch much thicker; which winding varioufly, forms feveral knots, and takes its courfe like the other, towards the hind part of the fpider. In thefe beads and their branches, is contained a matter proper to form the filk, only that it is too foft. The body of the bead is a kind of refervoir, and the two branches two canals proceeding from it. A little farther backwards, there are two other leffer beads, which only fend forth one branch a-piece, and that from the tip. Befide thefe, there are three other larger veffels on each fide of the fpider, which M. Reaumur takes for the laft refervoirs, where the liquor is collected. The biggeft is near the head of the infect, and the leaft near the anus. They all terminate in a point; and from the three points of thefe three refervoirs it is, that the threads, at leaft the greateft part of the threads drawn out at the three papillæ, proceed. Each refervoir fupplies one papilla. Laftly, at the roots of the papillæ, there are difcerned feveral flefhy tubes; probably, as many as there are papillæ. Upon lifting up the membrane, or pellicle, that feems to cover thefe tubes, they appear full of threads, all diftinct from each other, and which, of confequence, under a common cover, have each their particular one; being kept like knives in fheaths. The immenfe quantity of threads contained here, M. Reaumur concludes, upon tracing their courfe, does not wholly come from the points of the refervoirs; but fome from all the turns, and angles; nay, probably from every part of it. But by what conveyances the liquor comes into the beads, and out of the beads into the refervoirs, remains yet to be difcovered.

We have already obferved, that the tip of each papilla may give paffage to above a thoufand threads; yet the diameter of that papilla does not exceed a fmall pin's-head: but we were there only confidering the largeft fpiders.

If we examine the young growing fpiders produced by thofe, we fhall find, that they no fooner quit their egg, than they begin to fpin. Indeed their threads can fcarce be perceived; but the webs may: they are frequently as thick, and clofe, as thofe of houfe-fpiders; and no wonder: there being often four or five hundred little fpiders concurring to the fame work. How minute muft their holes be? the imagination can fcarce conceive that of their papillæ! The whole fpider is, perhaps, lefs than a papilla of the parent which produced it.

This is eafily feen; each big fpider lays four or five hundred eggs; thefe eggs are all wrapped up in a bag; and as foon as the young ones have broke through the bag, they begin to fpin. How fine muft their threads at this time be!

Yet is not this the utmoft nature does: there are fome kinds of fpiders fo fmall at their birth, that they are not vifible without a microfcope. There is ufually found an infinity of thefe in a clufter, and they only appear like a number of red points. And yet there are webs found under them, though well nigh imperceptible. What muft be the tenuity of one of thefe threads; the fmalleft hair muft be to one of thefe what the moft maffive bar is to the fineft gold-wire.

The matter of which the threads are formed, we have obferved, is a vifcid juice. The beads are the firft receptacles where it is gathered, and the place where it has the leaft confiftence. It is much harder when got into the fix great refervoirs, whither it is carried by canals from the former; this confiftence it acquires in good meafure in its paffage; part of the humidity being diffipated in the way, or fecreted by parts deftined for that purpofe.

Laftly, the liquor is dried ftill farther, and becomes thread, in its progrefs through the refpective canals to the papillæ. When thefe firft appear out at the holes, they are ftill glutinous; fo that fuch as fpring out of neighbouring holes ftick together. The air completes the drying.

By boiling the fpider, more or lefs, the liquor is brought to a greater or lefs confiftence, fit to draw out into threads; for it is too fluid for that purpofe while yet inclofed in its refervoirs.

The matter contained in thefe refervoirs, when well dried, appears a tranfparent gum, or glue, which breaks when much bent: like glafs, it only becomes flexible by being divided into the fineft threads. And probably it was on this account nature made the number of holes fo immenfe. The matter of filk formed in the bodies of fpiders being much more brittle than that formed in filk-worms, needed to be wound fmaller. Otherwife we do not conceive, why they fhould form a great number of threads, which were afterwards to be re-united: a fingle canal might elfe have done.

The thread of a fpider being ftrong enough to bear five or fix times the weight of the fpider's body, is compofed of feveral finer threads, that are drawn out feparately, but unite together at the diftance of two or three hairs' breadth from the body of the fpider. The threads are coarfer or finer, according to the fize of the fpider that fpins them. Mr. Leewenhoeck computes that 100 of the fineft threads of a full grown fpider, are not equal to the diameter of the hair of his beard; and confequently, if the hair be round, 10,000 fuch threads are not bigger than fuch a hair. He calculated farther, that when young fpiders firft begin to fpin, 400 of them are not larger than one that is full-grown; and therefore the thread of fuch a little fpider is 400 times fmaller than the thread of a full-grown one; allowing this, four millions of a young fpider's threads are not fo big as the fingle hair of a man's beard.

Web, in *Ship-Building*, the thin partition on the infide of the rim, and between the fpokes of an iron or brafs-fheave.

Web *of a Coulter*, in *Agriculture*, that part of it which is drawn out thin and fharp, in order to cut and feparate the ground, in oppofition to the others which are thick and blunt. In the fock, too, any thin fharp part has the name of web or wing.

Web *on the Eye*, among *Animals*, a term fometimes ufed to fignify a film on that part. See Eye, Film, and *White* Film.

WEB-*Case*. See CHRYSALIS.

WEB, *Pin and*. See PANNUS.

WEBB, PHILIP-CARTERET, in *Biography*, a member of the society of antiquaries, was born in 1700, and admitted an attorney in 1724, and distinguished for his acquaintance with the records of the kingdom, and with constitutional and parliamentary law. He was returned in 1754, and again in 1761, as a member for the borough of Haslemere; and being attached to the then existing administration, he obtained the place of secretary of bankrupts in the court of chancery, and in 1756 became one of the joint solicitors of the treasury. He was employed in 1763 in conducting the prosecution against Mr. Wilkes, for writing a number of the North Briton; and printed on that occasion "A Collection of Records about General Warrants," and "Observations on discharging Mr. Wilkes from the Tower." He died at his house in Busbridge, Surrey, in June 1770, and left a valuable library, and curious collection of coins, medals, and relics of antiquity, which were sold by auction. He had sold 30 MSS. of the rolls of parliament to the house of lords, and a number of other MSS. were sold to lord Shelburne, and afterwards to the British Museum. Among his publications we may reckon "A Letter to the Rev. Mr. Warburton, on some passages of his Divine Legation;" "Various Pieces relative to the State of the Law in this Kingdom;" "Account of some Particulars concerning Domesday Book;" "A short Account of Danegeld;" "Account of a Copper Table, discovered near Heraclea." Mr. Webb was twice married, and by his first wife left a son of his own name. Nichols's Lit. Anecd. Gen. Biog.

WEBB *Pond*, in *Geography*, a town of the district of Maine, in the county of Oxford, containing 318 inhabitants.

WEBBER, JOHN, in *Biography*, who accompanied captain Cook in his last voyage to the South sea, in the capacity of draughtsman, was a native of London, though his father was a Swiss. He was born in 1752, and was sent young to Paris for his education as an artist. After his return he studied at the Royal Academy, of which in 1785 he became a member. His talents for drawing landscape recommended him to the lords of the admiralty, who appointed him to go with captain Cook on his voyage of discovery; and when the vessels returned in 1780, they also commissioned him to superintend the engraving of the prints from his own drawings of the scenes he had beheld. When these were completed, he was permitted to publish a work consisting of other views which he had made, which he etched and aquatinted himself, and published on his own account; and these produced him a handsome remuneration. He afterwards applied himself to painting, but his pictures are weak and unsubstantial, without colour or effect, or any great degree of merit, though they please from their neatness and minuteness. He died in 1793, aged 41.

WEBERA, in *Botany*, owes its name to Schreber, who dedicated this genus to the memory of George Henry Weber, late professor of medicine and botany at Kiel; an excellent cryptogamic botanist, most celebrated for his *Spicilegium Floræ Goettingensis*, published in 1778, and one of the classical books in that department of the science. He died in 1786, at the age of 35. Hedwig had previously commemorated Weber in a genus of Mosses, some species of which are now referred to *Bartramia*, others to *Bryum*. (See MUSCI and FRINGE *of Mosses*.) It is to be regretted that *Webera* did not take place of *Bartramia*, the person after whom the latter was named, however meritorious, being scarcely at all conversant with mosses.—Schreb. Gen. 794. Willd. Sp. Pl. v. 1. 1224. Mart. Mill. Dict. v. 4. Ait. Hort. Kew. v. 1. 371. (Chomelia; Linn. Gen. ed. 2. 72.) Class and order, *Pentandria Monogynia*. Nat. Ord. *Rubiaceæ*, Juss.

Gen. Ch. *Cal.* Perianth superior, of one leaf, divided half way down into five erect, acute, permanent segments. *Cor.* of one petal, funnel-shaped; tube cylindrical, longer than the calyx: limb in five ovate-oblong, reflexed segments. Nectary a fleshy ring, surrounding the base of the style. *Stam.* Filaments five, very short, inserted into the margin of the tube; anthers linear, incumbent, spreading. *Pist.* Germen roundish, inferior; style simple, longer than the tube of the corolla; stigma club-shaped, with ten furrows. *Peric.* Berry nearly globular, of two cells, crowned with the permanent enlarged calyx. *Seeds* from two to four in each cell, angular.

Eff. Ch. Calyx superior, in five permanent segments. Corolla funnel-shaped, five-cleft. Stamens in the mouth of the tube. Stigma club-shaped, with ten furrows. Berry inferior, of two cells. Seeds several, angular.

A genus of evergreen East Indian shrubs, with opposite branches and leaves; and axillary or terminal, aggregate flowers, which are occasionally augmented in the number of their divisions and stamens, from five to six. *Canthium* of Lamarck's Dict. v. 1. 602. Juss. 204. Cavan. Ic. v. 5. 21, confounded by Willdenow with this genus, is certainly very distinct in its habit, peltate stigma, solitary seeds, and four-cleft flowers.

1. W. *corymbosa*. Corymbose Webera. Willd. n. 1. Ait. n. 1. (Rondeletia asiatica; Linn. Sp. Pl. 244. Cupi; Rheede Hort. Malab. v. 2. 37. t. 23. Raii Hist. v. 2. 1494.)

Leaves elliptic-oblong. Corymb terminal, forked, many-flowered.—Native of sandy ground in the East Indies; cultivated by Miller in the stove at Chelsea, in 1759, but it is not recorded by Mr. Aiton to have flowered, nor do we recollect having ever seen the plant in any collection. A wild specimen from Dr. Rottler is before us. The *stem* is shrubby, about the height of a man, with smooth, leafy, somewhat compressed, *branches*. *Leaves* on short thick stalks, entire, coriaceous, very smooth, four inches long, rather acute, with a stout rib, and numerous reticulated veins; their upper side shining; lower paler. *Stipulas* intrafoliaceous, triangular, short, pointed. *Flower-stalks* hairy. *Flowers* three-quarters of an inch long, whitish, agreeably fragrant, turning yellowish as they fade. *Berries* firm, the size of a currant, blackish, sweetish, but not eatable. Rheede describes 7 or 8 *seeds* in each fruit.

This plant has the appearance of an *Ixora* or *Pavetta*, as we have observed at the end of our article RONDELETIA; but perhaps the *stigma*, very important in this natural order, may keep it distinct.

2. W. *cymosa*. Cymose Webera. Willd. n. 2.—"Leaves ovate, pointed. Cymes axillary, stalked, many-flowered."—Native of the East Indies. "A *tree*, with round downy *branches*. *Leaves* stalked, ovate, obtuse with a point, entire, very smooth, rigid, simply veiny; shining above. *Cymes* convex. *Flower-stalks* downy. *Corolla* half the size of the former. *Style* much longer than the corolla. *Stigma* capitate, cloven. *Berry* the size of Juniper."—*Willdenow*, from a dried specimen.—We have not seen this species. The description of the *stigma* does not answer to the generic character.

WEBHAMET, in *Geography*, a river of the district of Maine, which runs into the Atlantic, near Wells.

WEBUCH, Cape, a cape on the E. coaſt of Labrador. N. lat. 55° 21′. W. long. 58° 10′.

WECHMAR, or Warihmar, a town of Germany, in the principality of Gotha; 4 miles S.E. of Gotha.

WECHQUETANK, a Moravian ſettlement in Pennſylvania; 30 miles N.W. of Bethlehem.

WECHSELBURG, a townſhip of Germany, in the lordſhip of Schonburg; 4 miles N.N.E. of Penig.

WECHSTEN, a town of Germany, in the county of Verden; 12 miles S.E. of Verden.

WECHTERBACH, a town of Germany, in the county of Iſenburg; 7 miles S.E. of Budingen.

WECHTERSWINCKEL, a town of the duchy of Wurzburg; 3 miles N.N.W. of Neuſtadt am Saal.

WECKHOLM, a town of Sweden, in the province of Upland; 22 miles S.W. of Upſal.

WED el Casaab, a river of Algiers, which runs into the Mediterranean, 5 miles S. of Cape Falcon.

Wed *el Kibbeer*, a river of Algiers, anciently called *Ampſaga*, which runs into the Mediterranean, 15 miles S. of Sebba Rous. N. lat. 36° 57′. E. long. 6° 28′.

Wed *el Mailah*, *i. e.* the *Salt River*, a river of Algiers, which runs into the Mediterranean, 10 miles S.S.E. of Cape Figalo.

Wed *el Shaier*, a river of Africa, which riſes about 12 miles E. from the mountain of Zeckar, in the Sahara, and after a north-eaſt courſe about 30 miles changes its name to Mailah, and finally loſes itſelf in the Short.

WEDDER, the name of a certain ſtate of ſheep. See Wether-*Sheep*.

WEDDRA, in *Commerce*. See Vedro.

WEDEKINSTEIN, in *Geography*, a town of Weſtphalia, in the principality of Minden; 3 miles S.W. of Minden.

WEDEL, George Wolffgang, in *Biography*, an eminent phyſician, was born in 1645, at Golzan, in Luſatia, and ſtudied phyſic and took his doctor's degree at Jena, in 1667, where, after a temporary exerciſe of his profeſſion at Gotha, he became medical profeſſor, in which ſtation he continued with reputation for almoſt fifty years. He combined with his medical ſkill a conſiderable acquaintance with mathematics and philology, as well as with the oriental and claſſical languages. He was an aſſociate to the Academy Naturæ Curioſorum, and to the Royal Society of Berlin, phyſician to ſeveral German ſovereigns, a count palatine, and an imperial counſellor. Notwithſtanding theſe high offices and numerous engagements, he was attentive to the poor, and aſſiduous in his literary labours. His pathology was derived from the ſyſtems of Helmont and Sylvius; in his practice he depended much on abſorbents, and the volatile ſalts of vegetables. Wedel was addicted to aſtrology; but he is chiefly celebrated for his pharmaceutical knowledge, and his elegance of preſcription, ſo that many of his compoſitions have been adopted in diſpenſatories. Of his works, beſides his academical diſſertations, the principal are the following; *viz.* "Opiologia;" "Pharmacia in Artis formam redacta;" "De Medicamentorum Facultatibus cognoſcendis et applicandis;" "De Morbis Infantum;" and "Exercitationes Medico-Philologicæ." Haller. Eloy.

Wedel, in *Geography*, a town of Holſtein; 13 miles N.W. of Hamburg.—Alſo, a town of the New Mark of Brandenburg; 11 miles E. of Reetz.

WEDELIA, in *Botany*, was ſo called by Jacquin, in honour of Dr. John Wolffgang Wedel, of Jena, whom he celebrates as a highly meritorious botaniſt, and who wrote a *Tentamen Botanicum*, publiſhed at Jena in 1747, with a preface by his friend Hamberger. The deſign of this work is to combine the ſyſtems of Rivinus and Linnæus, the claſſes of the latter making ſubdiviſions of the former. We preſume that no ſcheme could be leſs natural or uſeful, whatever the botanical ſkill of the author might be; of which indeed we are not diſpoſed to think highly, as he made a point of excluding the fruit from his principles of claſſification. He wrote a German eſſay againſt Haller, on the ſubject of botanical terms, of which the latter ſpeaks as full of taunts and reproaches. Wedel died in 1757, at the age of 49. Some others of the ſame name, and probably the ſame family, who were Profeſſors at Jena, appear full as well entitled to botanical honours; eſpecially George Wolffgang Wedel, who died in 1721, aged 76, and has left behind him numerous diſſertations on botany and the materia medica.—Jacq. Amer. 217. Willd. Sp. Pl. v. 3. 2334. Juſſ. 189. Gærtn. v. 2. 435. (Alcina; Cavan. Ic. v. 1. 10. Ait. Hort. Kew. v. 5. 164.)—Claſs and Order, *Syngeneſia Polygamia-neceſſaria*. Nat. Ord. *Compoſitæ oppoſitifoliæ*, Linn. *Corymbiferæ*, Juſſ.

Gen. Ch. *Common Calyx* ſimple, of four or five large leaves. *Cor.* compound, radiant. *Florets* of the diſk perfect, numerous, funnel-ſhaped, five-cleft; thoſe of the radius from eight to twelve, roundiſh-ovate, cloven. *Stam.* in the florets of the diſk. Filaments five, capillary ſhort; anthers united into a tube, as long as the partial corolla. *Piſt.* in the ſame florets, Germen minute, imperfect; ſtyle thread-ſhaped, the length of the anthers; ſtigma ſimple or divided: in thoſe of the radius, Germen oblong, quadrangular; ſtyle thread-ſhaped; ſtigmas two, revolute. *Peric.* none, the calyx remaining unaltered. *Seeds* in the diſk imperfect; in the florets of the radius ſolitary, obovate, gibbous, crowned with four, five, or ten teeth. *Recept.* chaffy, ſlightly convex; the ſcales ovate, concave, as long as the florets.

Eſſ. Ch. Receptacle chaffy. Seed-crown of from five to ten teeth. Calyx ſimple, of four or five leaves.

Obſ. This genus is ſeparated from Polymnia, (ſee that article,) on account of its ſimple calyx, and the preſence of a crown to the ſeeds, which appear to us ſufficient characters.

1. W. *fruteſcens*. Shrubby Wedelia. Willd. n. 1. Jacq. Amer. 217. t. 130. (Polymnia Wedelia; Linn. Mant. 118. Poiret in Lam. Dict. v. 5. 506.)—Stem ſhrubby. Leaves diſtinct, ſtalked, lanceolate. Seed-crown of ten teeth.—Native of Carthagena, South America, in buſhy woody places, flowering in July and Auguſt. *Stem* ſhrubby, climbing, with round leafy branches, rough in our ſpecimen with minute points. *Leaves* acute, two or three inches long, ſomewhat ſerrated, briſtly on both ſides; the upper rough with callous points; lower paler. *Footſtalks* linear rough, hardly half an inch in length, combined at the baſe by a narrow annular *ſtipula*. *Flowers* terminal, ſtalked, ſolitary, yellow, near an inch broad, with a rough *calyx*; the outer ſcales of their *receptacle* looking like a coloured inner calyx. *Seeds*, according to Jacquin, each with a little cup-ſhaped crown, having about ten teeth.

2. W. *perfoliata*. Perfoliate Wedelia. Willd. n. 2. (Alcina perfoliata; Cavan. Ic. v. 1. 11. t. 15. Ait. Hort. Kew. v. 5. 164.)—Stem herbaceous. Leaves rhomboid, tapering at the baſe, perfoliate. Seed-crown of five teeth.—Native of Mexico, from whence its ſeeds were brought to Madrid, and thence diſperſed through the botanic gardens of other parts of Europe. This is an annual plant, with nothing to attract the attention of floriſts. It flowers late, and does not always ripen ſeed in England. The *ſtem* is four feet high, angular or furrowed, leafy, branched, nearly ſmooth, often purpliſh. *Leaves* three or four inches

long,

long, including their narrow base, pointed, serrated, triple-ribbed, light green, roughish. *Flowers* yellow, stalked, much smaller than the foregoing. *Calyx* broad, extending far beyond the rays. *Seeds* of the marginal *florets* large, tumid, each crowned with four, five, or more, irregularly placed tubercles, or teeth, not agreeing precisely with the crown of the first species, but scarcely affording sufficient reason to form a generic distinction.

WEDENSCHWEIL, in *Geography*, a town of Switzerland, and principal place of a bailiwick, in the canton of Zurich, on the S.W. coast of lake Zurich; 9 miles S. of Zurich.

WEDGE, Cuneus, in *Mechanics*, the last of the five powers, or simple machines.

The wedge is a triangular prism, whose bases are isosceles acute-angled triangles.

Authors are divided about the principle whence the wedge derives its power.

Aristotle considers it as two levers of the first kind, inclined toward each other, and acting opposite ways. Guido Ubaldus, Mersennus, &c. will have them levers of the second kind. But Fr. de Lanis shews, that the wedge cannot be reduced to any lever at all.

Others refer the wedge to the inclined plane. Others, again, with De Stair, deny the wedge to have scarce any force at all; and ascribe much the greatest part to the mallet that drives it.

Its doctrine (according to some writers) is contained in this proposition. "If a power be applied to a wedge, in such manner, as that the line of direction C D (*Plate* XL. *Mechanics*, *fig.* 1.) perpendicular to A B, is to the resistance to be overcome, as A B to C D; the power will be equal to the resistance."

Or thus: "If the power directly applied to the head of the wedge, be to the resistance to be overcome by the wedge, as the thickness of the wedge is to its height; then the power will be equivalent to its resistance; and, if increased, will overcome it."

In proof of this proposition, they allege, that the firmness by which the parts of the obstacle, suppose wood, adhere to one another, is the resistance to be overcome by the wedge; and that while the wedge is driven into the wood, the way or length it has gone is B H (*fig.* 2.); and D C is the way or length gone in the same time, by the impediment; that is, the parts C and D of the wood are so far divided asunder: and according as the wedge is driven down farther and farther along its height; so the parts C and D of the wood are divided more and more, along the thickness of the wedge.

But Dr. Desaguliers has proved, that, when the resistance acts perpendicularly against the sides of the wedge, the power is to the whole resistance as the length of both sides of the wedge, taken together, is to the thickness of its back.

According to the preceding theory, if the thickness of the wedge (that is, the way of the impediment, and consequently its velocity) be to the height of the wedge (that is, the way, and consequently the velocity of the power) as the power to the impediment, or resistance; then the momentum of the power, and the impediment, will be equal the one to the other: and consequently the power, being increased, will overcome the resistance.

Hence, 1. The power equivalent to half the resistance, is to it as A C to D C, (*fig.* 1.) that is, as the whole sine to the co-tangent of half the angle of the wedge A D C. And 2. As the tangent of a less angle is less than that of a greater, the power must have a greater proportion to half the resistance, if the angle be greater than if less; consequently, the acuter the wedge is, the more does it increase the power.

The above proportion is adopted by Wallis, (Op. Math. vol. i. p. 1016.) Keil, (Int. ad Ver. Phys.) and S'Gravesande (El. Math. lib. i. cap. 14.); but S'Gravesande, in his Scholium de ligno findendo (ubi supra), observes, that when the parts of the wood are separated before the wedge, the force by which it is thrust in is to the resistance of the wood as a line, drawn from a point in the middle of the base to the side of the wedge, and at right angles with the side of the separated wood continued, to the height of the wedge; but when the parts of the wood are separated no farther than the wedge is driven in, the equilibrium will be, when the power is to the resistance as the half base of the wedge to its side.

To this method of estimating the power of the wedge it has been objected that, by allowing each part of the weight to have moved through a space equal to half the back of the wedge, whilst the power has moved through its height, and the whole weight to have moved through a space equal to the whole back, the whole is made to move farther than its parts.

M. Muschenbroeck states the proportion of the power to the weight in a simple wedge, or half the wedge (*fig.* 1.) bisecting it by a plane passing through C D, as its back is to its length, or in that case as A C to C D: and in a double wedge or the wedge A B D, as A B to 2 C D. Int. ad Phil. vol. i. p. 132.

Mr. Ferguson estimates the power of the wedge, in the two cases mentioned by S'Gravesande, in the following manner. When the wood does not cleave at any distance before the wedge, there will be an equilibrium (he says) between the power impelling the wedge downward, and the resistance of the wood acting against the two sides of the wedge, if the power be to the resistance as half the thickness of the wedge at its back is to the length of either of its sides; and if the power be increased so as to overcome the friction of the wedge, and the resistance arising from the cohesion or stickage of the wood, the wedge will be drove in, and the wood split asunder.

But when the wood cleaves at any distance before the wedge (as it generally does), the power impelling the wedge will be to the resistance of the wood as half its thickness is to the length of either side of the cleft, estimated from the top or acting part of the wedge: for supposing the wedge to be lengthened down to the bottom of the cleft, the power will be to the resistance as half the thickness of the wedge is to the length of either of its sides; or, which amounts to the same thing, as the whole thickness of the wedge is to the length of both its sides.

In proof of this proportion we may suppose the wedge divided lengthways into two equal parts, and then it will become two equally inclined planes; one of which, as *a b c* (*fig.* 3.) may be made use of as a half-wedge for separating the moulding *c d* from the wainscot A B. When this has been driven its whole length *a c* between the wainscot and moulding, its side *a c* will be at *c d*, and the moulding will be separated to *f g* from the wainscot.

From the property of the inclined plane, it appears, that to have an equilibrium between the power impelling the half-wedge and the resistance of the moulding, the former must be to the latter, as *a b* to *a c*; that is, as the thickness of the back which receives the stroke is to the length of the side against which the moulding acts. Consequently, since the power upon the half-wedge is to the resistance against its side, as the half back *a b* is to the whole side *a c*, it is plain,

plain, that the power upon the whole wedge (where the whole back is double the half back) muſt be to the reſiſtance againſt both its ſides, as the thickneſs of the whole back is to the length of both the ſides, ſuppoſing the wedge at the bottom of the cleft; or as the thickneſs of the whole back to the length of both ſides of the cleft, when the wood ſplits at any diſtance before the wedge. For when the wedge is driven quite into the wood, and the wood ſplits at ever ſo ſmall a diſtance before its edge, the top of the wedge then becomes the acting part, becauſe the wood does not touch it any where elſe. And ſince the bottom of the cleft muſt be conſidered as that part where the whole ſtickage or reſiſtance is accumulated, it is plain from the nature of the lever, that the farther the power acts from the reſiſtance, the greater is the advantage.

Some writers have, indeed, advanced, that the power of the wedge is to the reſiſtance to be overcome, as the thickneſs of the back of the wedge is to the length only of one of its ſides; but this, ſays Mr. Ferguſon, ſeems very ſtrange; for, if we ſuppoſe A B (*fig.* 4.) to be a ſtrong inflexible bar of wood or iron fixed into the ground at C B, and D and E to be two blocks of marble lying on the ground on oppoſite ſides of the bar; it is evident that the block D may be ſeparated from the bar to the diſtance *d* equal to *a b*, by driving the inclined plane or half-wedge *a b o* down between them; and the block E may be ſeparated to an equal diſtance on the other ſide, in like manner, by the half-wedge *c d o*. But the power impelling each half-wedge will be to the reſiſtance of the block againſt its ſide, as the thickneſs of that half-wedge is to the length of its acting ſide. Therefore the power to drive both the half-wedges is to the reſiſtances, as both the half backs are to the length of both the acting ſides, or as half the thickneſs of the whole back is to the length of either ſide. And, if the bar be taken away, the blocks put cloſe together, and the two half-wedges joined to make one; it will require as much force to drive it down between the blocks, as is equal to the ſum of the ſeparate powers acting upon the half-wedges when the bar was between them. Ferguſon's Lect. p. 40, &c. 4to. See alſo Deſag. Exp. Phil. vol. i. p. 107, &c.

Mr. Ludlam, in an Eſſay on the Power of the Wedge, printed in 1770, propoſes, with a particular view to the machines deſcribed by S'Graveſande, Deſaguliers, and Ferguſon, for eſtimating the power of the wedge, to determine this power, when two equal forces act on the ſides of an iſoſceles triangle in directions parallel to the back but oppoſite to each other, and are ſuſtained by a third force acting perpendicularly on the back of the wedge. For this purpoſe, let A B C (*fig.* 5.) be an iſoſceles wedge, whoſe angular point is C, ſides A C and B C, back A B, and perpendicular height H C: let F E repreſent the quantity and direction of the force applied to one of the ſides; this may be reſolved into two other forces F D and D E, the former parallel and the latter perpendicular to the ſide A C; and the oblique force F E will have juſt the ſame effect upon the wedge as a leſs perpendicular force D E; the former being to the latter as A C is to H C. But this laſt perpendicular force on the ſide A C is to that on the back which balances it as A C is to A H; whence compounding theſe ratios, the oblique force againſt one ſide of the wedge is to the perpendicular force on the back which balances it, as AC^2 is to $AH \times HC$. The oblique force *f e* on the other ſide of the wedge, being equal to F E, will require another perpendicular force on the back to balance it equal to the former perpendicular force; whence the whole force on both ſides of the wedge is to the whole force on the back as AC^2 is to $AH \times HC$; or as the ſquare of the ſide of the wedge to the rectangle under half the back and the perpendicular height.

For other methods of eſtimating the effect of the wedge in various caſes, ſee Mechanical *Powers*.

The wedge is a very great mechanical power, ſince not only wood but even rocks can be ſplit by it; which it would be impoſſible to effect by the lever, wheel and axle, or pulley; for the force of the blow or ſtroke, ſhakes the cohering parts, and thereby makes them ſeparate the more eaſily.

To the wedge may be referred all edge-tools, and inſtruments which have a ſharp point, in order to cut, cleave, ſlit, chop, pierce, bore, or the like; as knives, hatchets, ſwords, bodkins, &c.

Wedge, in *Ship-Building*, a triangular ſolid made of wood or iron. It is one of the mechanic powers, the moſt ſimple, and of the greateſt force.

WEDGE Island, in *Geography*, a ſmall iſland in the North Pacific ocean, near the E. coaſt of the Prince of Wales's Archipelago, in the Duke of Clarence's Strait. N. lat. 55° 8′. E. long. 228° 20′.

WEDGES, in *Agriculture*, are a ſort of levers or diſtending powers that are of great uſe to the farmer on many occaſions, as in tearing and ſplitting wood of all ſorts, the roots of trees in taking them out of the ground, ſtones, and many other ſorts of hard materials. About farm-houſes of any extent, it is always of advantage to have a proper mallet and ſet of wedges for tearing up wood and other matters.

WEDGWOOD, Josias, in *Biography*, was the younger ſon of a Staffordſhire potter, and born in July 1730. His education was reſtricted, but his mental powers were of a ſuperior kind, ſo that by the fixed and perſevering exerciſe of them he made very conſiderable improvement in the art of pottery to which his attention was directed, and gave a name as well as reputation to the place of his nativity. (See Pottery and The Potteries.) His patrimony was ſmall, but by his ſuper-eminent ſkill and ſteady application he was the founder of his own fortune as well as fame. The principal ſeat of the potteries of Staffordſhire was Burſlem; and there is reaſon to believe that they have exiſted in or near this place for many centuries, and even, as ſome ſay, ſince the time of the Romans. But they had continued for a long time in the ſame rude ſtate in which Plot found them when he ſurveyed this county. The merit of introducing into this country improvements in the art of pottery muſt be aſcribed to two brothers of the name of Eders, who came hither from Holland about the year 1700, and ſettled in the neighbourhood of the Staffordſhire potteries. They manufactured a red unglazed porcelain from a clay, which they found in the eſtate on which they ſettled, called "Bradwell;" but this was only the brown ſtone ware, in the compoſition of which no flint is uſed; but they made uſe of ſalt in glazing it: this ſalt, or muriate of ſoda, was thrown into the oven at a certain ſtage of the firing proceſs, and the pieces of ware were ſo diſpoſed as to receive the fumes of it on every part of their ſurfaces. The fumes, however, occaſioned an alarm in the neighbourhood, which obliged them to leave the country. A ſimilar manufactory, however, was ſoon after eſtabliſhed at Shelton, in the Potteries, by one of their workmen, whoſe name was Aſtbury, and who had poſſeſſed himſelf of their ſecret; and as it was found very uſeful, it was tolerated by the inhabitants, though on the day of glazing, the denſe offenſive fumes from fifty or ſixty manufactories filled the valleys, and covered the hills through an extent of ſeveral miles. The white ſtone ware, and

and the ufe of ground flints in pottery, were introduced at a later period, and, as it is faid, (fee Parkes's Chem. Catechifm,) in confequence of the following incident. About the year 1720, a potter, fuppofed to be the above-mentioned Aftbury, ftopped at Dunftable in his way to London, and fought a remedy for a diforder in his horfe's eyes; and the oftler of the inn by burning a flint ftone reduced it to a fine powder, which he blew into them. The potter, obferving the beautiful white colour of the flint after calcination, inftantly thought of applying the difcovery to the improvement of his art, and afterwards introduced the white pipe-clays found on the fouth fide of Devonfhire, inftead of the iron-clays of his own country, and thus produced the white ftone ware. At firft the flints were pulverized to the great injury of the perfons employed; till the famous Brindley, in the early period of his life, conftructed the mills that are now ufed for grinding them in a moift ftate. It is farther faid, that an ingenious mechanic, named Alfager, afterwards improved the conftruction of the potter's wheel, fo as to give much greater precifion and neatnefs to the work. But ftill the French pottery exceeded in beauty that of Staffordfhire; and about the year 1760, a confiderable quantity of it was imported, and purchafed by perfons of opulence to the great detriment of the Englifh manufacture. Mr. Wedgwood directed his attention to this article, and made feveral improvements with regard to the forms, colours, and compofition of his manufacture; and in the year 1763 invented a kind of ware for the table, which gave a turn to the market, and under the name of queen's ware, conferred upon it in confequence of the patronage of her majefty, came into very general ufe. Its materials were the whiteft clays from Devonfhire and Dorfetfhire, mixed with ground flint, and covered with a vitreous glaze. By varying and repeating his experiments, Mr. Wedgwood difcovered the mode of manufacturing other fpecies of earthenware and porcelain, excellent and beautiful, and adapted to various purpofes both of ufe and ornament. With a view of profecuting his improvement in pottery he applied to the ftudy of chemiftry, and for his farther affiftance engaged the ingenious Mr. Chifholme, who had been employed in a fimilar department by the celebrated Dr. Lewis, author of the "Commercium Philofophico-Technicum;" for whom he not only built a comfortable habitation near the manufactory, but liberally afforded him an annuity for his fupport under the decays of age, which he continued till his death. Aided alfo by the claffical tafte of his partner, Mr. Bentley, potteries were furnifhed which ferved as models for various articles, formed of other materials, that were held in high eftimation. We learn from Dr. Bancroft, that almoft all the finely diverfified colours which Mr. Wedgwood applied to his pottery were produced only by the oxyds of iron. In the manufacture of his beautiful jafper ware, which rivalled the productions of antiquity, and which found its way into the collections of the curious in all parts of Europe, he employed the native fulphate of barytes, and from this ufe of it he derived great profit, until by the infidelity of a fervant the fecret was difclofed and fold, fo that others employed inferior workmen at a reduced falary, and thus prevented Mr. W. from employing his exquifite modellers on that branch of the manufacture.

Among other curious productions of this inventive manufacturer we may mention his imitation of the Barberini or Portland vafe, which was difcovered in the tomb of Alexander Severus, and for which the late duchefs of Portland paid 1000 guineas. The fubfcription for Mr. W.'s manufacture was at the rate of 50*l.* each for fifty vafes, but fuch were the expences of its execution, that the partners loft money by the undertaking. Mr. Webber, it is faid, received 500 guineas merely for modelling it. See VASE.

We cannot forbear in this connection noticing two cameos of Mr. Wedgwood's manufacture; one of a flave in chains, of which he diftributed many hundreds, with a view of exciting the humane to affift in the abolition of the flave-trade; and the other a cameo of Hope, attended by Peace and Art and Labour, which was made of argillaceous earth from Botany Bay, to which place he fent many of them, in order to fhew what their materials were capable of, and to encourage the induftry of the inhabitants.

To this brief account of fome of the numerous productions of Mr. Wedgwood, we fhall fubjoin the tribute paid to his induftry and genius by an elegant modern poet:

"Gnomes! as you now diffect with hammers fine
The granite rock, the noduled flint calcine;
Grind with ftrong arm, the circling chertz betwixt,
Your pure kaolins and petuntfes mixt;
O'er each red faggar's burning cave prefide,
The keen-eyed fire-nymphs blazing by your fide;
And pleafed on Wedgwood ray your partial fmile,
A new Etruria decks Britannia's ifle.
To call the pearly drops from Pity's eye;
Or ftay Defpair's difanimating figh,
Whether, O Friend of Art! the gem you mould
Rich with new tafte, with ancient virtue bold;
Form the poor fetter'd flave on bended knee
From Britain's fons imploring to be free;
Or with fair Hope the brightening fcenes improve,
And cheer the dreary waftes of Sydney-cove;
Or bid Mortality rejoice and mourn
O'er the fine forms on Portland's myftic urn.
Whether, O Friend of Art! your gems derive
Fine forms from Greece, and fabled gods revive;
Or bid from modern life the portrait breathe,
And bind round Honour's brow the laurel wreath;
Buoyant fhall fail, with Fame's hiftoric page,
Each fair medallion o'er the wrecks of age;
Nor Time fhall mar, nor Steel, nor Fire, nor Ruft,
Touch the hard polifh of the immortal buft."

The demand for Staffordfhire ware very much increafed, and it became a commercial article of exportation of very confiderable value.

The diftrict which Mr. Wedgwood inhabited became by his means the feat of population and abundance. The vicinity was enriched, and a new canal of importance, called the Grand Trunk canal, and connecting the Trent and the Merfey, was obtained and executed by his influence. The ample fortune which he acquired was liberally enjoyed, and benevolently applied to many purpofes of private charity and public utility. Chemiftry and the arts in their mutual connection were objects of his attention; and he contrived an inftrument for meafuring high degrees of heat, called a pyrometer, of which he gave an account in the Phil. Tranf. for 1782, 1784, and 1786. See THERMOMETER.

The difpofition and manners of Mr. Wedgwood were no lefs eftimable than the powers of his mind; fo that he was as much the object of admiration and efteem for his moral as for his intellectual qualities. So much was he refpected, and fo defirable was the continuance of his ufeful life, that he died, univerfally regretted, at his houfe in Staffordfhire, to which he gave the name of Etruria, in January 1795, in the 65th year of his age. Aikin's Chem. Dict. Gent. Mag. Parkes's Chemical Catechifm. Parkes's Effays.

WEDINOON, in *Geography*, a diftrict of Sufe in the fouthern divifion of Morocco, inhabited by a tribe of Arabs. This

This territory is adjacent to the river Akaffa, called by fome Wed Noon, that is, the river of Noon. Jackfon ftates the population of Wedinoon at 200,000 perfons. In this diftrict the fovereignty of the emperor of Morocco is fcarcely acknowledged; and the difficulty of paffing an army over that branch of the Atlas, which feparates Sufe from Haha, fecures to the Wedinoonees their arrogated independence. Wedinoon is a kind of intermediate depot for merchandize on its way to Soudan, and for the produce of Soudan conveyed to Mogodor. Gums and wax are produced here in abundance; and the people, living in a ftate of independence, indulge in the luxuries of drefs, and ufe many European commodities. A great quantity of gold duft is bought and fold at Wedinoon. The inhabitants fometimes trade to Mogodor, but prefer felling their merchandize on the fpot, as they do not wifh to truft their perfons with property within the territory of the emperor of Morocco. With Tombuctoo they carry on a conftant and advantageous trade, and many of the Arabs are immenfely rich. They alfo fupply the Moors of Morocco with (ftatas) convoys through the defert, in their travels to Tombuctoo. The coaft of Wedinoon extends a long way to the fouthward, nearly as far as Cape Bojador. The river Akaffa, commonly called the river of Non or Nun, and in fome maps Daradus, is a large ftream from the fea to the town of Noon, which is about fifteen miles inland, and about two miles in circumference: from hence the river becomes fhallow and narrow; and it is to the fouthward of this river that fhips are generally wrecked. The diftrict of Wedinoon is nominally in the dominions of the emperor of Morocco; but lately an army having been fent farther fouth than Terodant, and the Pacha Alkaid Mahommed ben Delamy being dead, that diftrict has fuffered neglect, and the people pay no tenth, according to the mode of raifing taxes in Weft Barbary, *viz.* ten *per cent.* on the produce of the land, and two *per cent.* on that of cattle; and the emperor has recently ordered his Pacha of Haha to purchafe the Britifh flaves that had been wrecked there. This place being only thus nominally in his dominions is another impediment to the redemption of the failors who happen to be fhipwrecked about Wedinoon; for if the emperor had the fame authority over this diftrict, that he has over the provinces north of the river Sufe, meafures might be adopted by the conful, acting under his orders, for their delivery, without pecuniary difburfements. Jackfon's Morocco. See Vled de Nun.

WEDLOCK. See Marriage, Wife, Husband, &c.

WEDNESBURY, in *Geography*, an ancient market-town in the fouth divifion of the hundred of Offlow, and county of Stafford, England, is fituated at a fhort diftance from the fource of the river Tame; 19 miles S.S.E. from the county-town, and 125 miles N.W. from London. In the time of the Mercians, this place had a noble caftle, which was fortified by Adelfleda, who was for fome time governefs of this extenfive kingdom: but no part of the fortrefs now remains, except a few traces of its foundations. At the Norman Conqueft, the manor became a portion of the royal demefnes. Henry II. beftowed it on the family of the Heronviles, from whom it paffed, after various fucceffions, to the Beaumonts. The town is diftinguifhed for its numerous and valuable manufactures, the principal of which are of guns, coach-harnefs, iron axle-trees, faws, trowels, edge-tools, bridle-bits, ftirrups, nails, hinges, fcrews, and caft-iron works of every defcription. For their proficiency in thefe various branches, the inhabitants are chiefly indebted to the abundance and excellence of the coal obtained in the immediate vicinity. This coal is indifputably the beft in the kingdom for the fmith's forge, on account of the intenfe heat which it produces. It extends in a variety of feparate veins or ftrata, which are particularized by the miners with the greateft accuracy. Here is alfo found that peculiar fpecies of iron-ore denominated blond-metal, ufed in the manufacture of horfe-fhoes, hammers, axes, and heavy tools. Some fpots likewife abound with a fort of reddifh earth, called hip, employed in painting and glazing veffels of various kinds. A weekly market on Wednefday affords the town a plentiful fupply of all kinds of provifions. The population of the parifh, in the return of the year 1811, was ftated to be 5372, the number of houfes 1004. One of the collateral branches of the Birmingham canal, entering this parifh, affords the inhabitants great facility of commercial communication. The church is an ancient ftructure, and fome writers abfurdly relate, that it was built in the year 711, by Dudo, lord of Dudley. At one end rifes a tower, fupporting a lofty fpire: the interior is divided into a chancel, nave, and two aifles; the latter are feparated from the nave by a range of arches, fupported by octagonal pillars. In the chancel are feveral prebendal ftalls, ornamented with exquifite carved work. Here is alfo a variety of monuments in honour of the anceftors of the Dudley and Harcourt families, and feveral other ancient tombs and memorials. Round the church-yard fome veftiges of the caftle may be diftinctly traced.—Shaw's Hiftory of Staffordfhire, folio, 1798. Beauties of England and Wales, vol. xiii. Staffordfhire, 1811.

WEDNESDAY, the fourth day of the week, formerly confecrated by the inhabitants of the northern nations to Woden or Odin, who, being reputed the author of magic and inventor of all the arts, was thought to anfwer to the Mercury of the Greeks and Romans, in honour of whom they called the fame day *dies Mercurii.*

Wednesday, *Afh.* See Ash-*Wednefday.*

WEDNOCH, in *Geography*, a river of England, which joins the Wever, near Northwich, in Chefhire.

WEDUM, a town of Sweden, in Weft Gothland; 18 miles S. of Skara.

WEE-CHAUNG-HOO, an extenfive lake of China, which divides the province of Shan-tung from that of Kiang-nan, and fupplies an adjoining canal when it is deficient of water. This lake affords a charming profpect, particularly at fun-rife; when its borders fringed with wood-houfes and pagodas on the floping grounds behind, and the furface of the water almoft covered with veffels croffing it in different directions, and by all the various modes of navigation that poles, paddles, oars, and fails, could furnifh, are exhibited to advantage. Fifhing forms a confiderable part of the occupation of the people on this lake, and they have various modes of conducting it. Befides nets, which are in moft common ufe, they have another method, which is more fingular: to one fide of a boat a flat board, painted white, is fixed at an angle of about forty-five degrees, the edge inclining towards the water on moon-light nights; the boat is fo placed that the painted board is turned to the moon, from whence the rays of light ftriking on the whitened furface give it the appearance of moving water, on which the fifh being tempted to leap as on their element, the boatman raifing with a ftring the board, turns the fifh into the boat. Water-fowl are alfo taken upon this lake by a peculiar device. Empty jars or gourds are fuffered to float upon the water, that fuch objects may become familiar to the birds; the fifherman then wades into the lake with one of the empty veffels on his head, and walks gently towards a bird, and lifting up his arm draws it down below the furface of the water, without difturbing or alarming the reft, and thus prefently fills the bag with which he was provided for fecuring his prey. A fimilar practice exifts, as we learn from Alloa, among the nations of Carthagena, upon the lake Cienego de Terias. Staunton's Embaffy, vol. ii.

WEED, in *Agriculture* and *Gardening*, any fort of uncultivated and unprofitable plant or vegetable which grows in ground, and which, in confequence of the mifchief it does, requires to be extirpated and deftroyed.

Weeds may be diftinguifhed, according to the different periods of their duration, into the *annual*, *biennial*, and *perennial* kinds.

The firft divifion comprehends all fuch as die after perfecting their feeds in the firft year. Weeds of this clafs, though abundantly productive in feeds, and confequently in plants, are capable of being deftroyed without any great difficulty.

The fecond divifion includes all fuch weeds as endure a greater length of time than one year, and which after perfecting their feeds in the fecond year perifh. Thefe, like the former, are in general abundant in the production of feeds as well as plants, but they are deftroyed with greater difficulty.

The third divifion comprifes all thofe weeds which are capable of continuing many years. Some of which have the property of perfecting their feeds annually, without being thereby deftroyed: while others, lefs prolific in feeds, have the faculty of reproduction in their vivaceous roots; and there are others that are capable of increafe both by feeds and roots. The plants of this clafs are therefore much more troublefome and difficult of deftruction than the others.

In the nature and vegetation of the feeds of weeds of different forts, there is confiderable diverfity. Some are found to fprout forth as foon as they have a fufficient degree of moifture, fending down their roots though not in exact contact with the earth; others only begin to germinate when they are depofited and inclofed in a fuitable foil, and have the proper influence of the atmofphere; and there are many of thefe kinds of feeds, even of the very fmall fort, which are capable of remaining in a dormant or inactive ftate for a very confiderable length of time, and afterwards vegetate on being placed in a favourable fituation, in regard to the influence of the air, and other matters.

There are other feeds of weeds, too, which are provided with a foft feathery material which performs, in fome meafure, the office of wings, by which they are conveyed from their native fituations, and differninated over lands and places at a confiderable diftance.

There is likewife a difference of fome confequence in the vivaceous roots of vegetable weeds; fome being branched, others entire; fome defcending directly downwards, others inclining; fome fibrous, others tuberous; fome creeping, others knotted or jointed, &c.

The great variety and multiplicity of weeds render it a difficult matter to arrange them in any ufeful manner for the purpofes of the farmer, as different forts of them are found to prevail in different fituations and kinds of land. A late intelligent writer has, however, confidered them as affecting gardens; corn-fields and tillage-lands; meadows and paftures; wafte and uncultivated grounds; the hedges of inclofures; and woods and plantations.

Weeds injurious to garden grounds are chiefly thefe:

Couch-grafs, or which in fome places is known by the names of twitch, fquitch, and many others, and which not unfrequently comprehends the creeping roots of the hardy perennial graffes, which are particularly tenacious of growth, as dog's-grafs, white bent-grafs, tall oat-grafs, and fome others. Of which, the two firft are readily diftinguifhed by their flowering ftalks, as well as by the ears which contain the feeds; and the laft has been obferved to have a bulbous-jointed root, that affords fhelter to various deftructive grubs, worms, and infects: they fhould all be carefully rooted out and deftroyed. Thefe are to be deftroyed in gardens by carefully picking out the roots in digging, and as carefully rooting up whatever remaining fragments of the roots may fend out a fhoot above the ground. Thefe fhould never be allowed to get to any height, but be exterminated as foon as poffible. See TRITICUM *Repens*, AGROSTIS *Alba*, AVENA *Elatior*, &c.

Suffolk-grafs, or dwarf meadow-grafs, is another grafs, which, though ufeful in paftures, is a very pernicious weed in gardens and places about houfes. It is common in places where the furface is not liable to be often difturbed by means of cultivation. Its prolific quality, in refpect to feeds, is fo great, that it is faid to be capable of producing and reproducing itfelf four times in the courfe of one fummer. It may be deftroyed by rooting it out before its feeds are perfected and fhed about, otherwife the vegetation of them will be fo abundant and extenfive as almoft to bid defiance to the powers of the weeder. See POA *Annua*, &c.

Catchweed, or what in different fituations is called goofegrafs, cleavers, hariff, &c. is fometimes a troublefome garden weed, but it is more common in the hedges. This is a weed that may be readily deftroyed in garden-grounds, by pulling it up before the feeds are perfected.

It is faid that young geefe are very fond of the tender branches of this weed; and that the feeds of it are capable of being ufed inftead of coffee. See GALIUM *Aparine*.

Garden night-fhade is faid to be a common weed in the garden-grounds about Chelfea and Brompton, but which is feldom found in thofe in the country, though fometimes met with on dung-hills, and other fuch places. See SOLANUM *Nigrum*.

Goofefoot, which is a weed of the wild orache defcription, is common and luxuriant in many garden-grounds, being very prolific in feeds, and in the produce of weeds therefrom, if not rooted out before the feeds are fcattered about on land under cultivation. Thefe, like all other annual feedling weeds, is to be deftroyed only by rooting up before the feeds of it are fcattered. See CHENOPODIUM *Album*, *Viride*, and *Hybridum*.

Wild orache, or fat-hen, is a weed nearly allied to the above, and from which it is diftinguifhed only by fome of the flowers having pointals only, while others on the fame weed-plant have both chives and pointals, in common with the above fort of weeds. The flowers are fmall, fo that this diftinction can only be afcertained by the microfcope. It is a weed which grows much in kitchen-gardens, on rubbifh, and on dung-hills; is an hardy annual, very fertile in feeds; and which is to be prevented or deftroyed in the fame way as the above kinds. See ATRIPLEX *Haftata*.

Fools' parfley, or leffer hemlock, is a weed common in gardens, and which, in its early growth, has much refemblance to parfley, for which it is often miftaken, and when eaten occafions ficknefs, fwelling, and uneafinefs about the ftomach: it fhould always be rooted out of garden-ground, when it is running to feed, as at that time it is eafily known and beft deftroyed. See ÆTHUSA *Cynapium*.

Knot-grafs is a weed that fometimes grows much on the gravel-walks of gardens and pleafure-grounds, trailing to a confiderable length in all directions, being very prolific in feeds, which readily take root. It is, therefore, neceffary to root it well up before they become ripe: hogs are

are ſaid to be very fond of eating it. See POLYGONUM *Aviculare.*

Ground-aſh is ſaid to be a very troubleſome weed in the garden-grounds in the neighbourhood of London; but which ſome ſuppoſe to be moſtly confined to the ſhade of hedges. It is believed to be perennial in its nature. In order to get rid of it, the beſt mode is to cut it up on its firſt appearance. See ÆGOPODIUM *Podragraria.*

Chickweed is a weed that ſometimes grows with great rapidity, and in a very luxuriant manner on garden-ground that is much pulveriſed and reduced by operoſe cultivation by the ſpade, and which is much enriched by good manure: it is an annual weed, very productive of ſeeds, and where it abounds much, it is perhaps improper to give the land or ground a fine culture until it in ſome meaſure diſappears: ſwine are extremely fond of this weed, and it is ſaid to be a grateful food for young chickens. See ALSINE *Media.*

Black-bind-weed in ſome places is called bear-bind. It is a paraſitical weed-plant, often climbing up bean and other garden crops: it is hardy, and extremely prolific in ſeeds. To keep garden-ground clear of it, the ſeeds ſhould never be ſuffered to ſhed or ſow themſelves: the ſeeds contain a white flower, and are ſaid to be good for pigeons, poultry, and ſmall birds of different kinds. See POLYGONUM *Convolvulus.*

Sun ſpurge is an annual weed, ſaid to be not very troubleſome or difficult of eradication, yet not uncommon in garden-grounds. See EUPHORBIA *Helioſcopa*, &c.

Red dead nettle, or dee nettle, is a weed of the annual kind, according to ſome, but which others conſider as a perennial. It is common in garden-grounds, flowering early, and for the greater part of the year. The ſeeds ſhould not be ſuffered to ſhed or diſperſe themſelves over the ground, but the weeds be cut up as ſoon as they appear. See LAMIUM *Purpureum.*

Henbit is an annual garden-weed, that ſhould likewiſe be weeded out before the ſeeds of it are perfected and ſcattered. See LAMIUM *Amplexicaule.*

Nettle hemp is a weed of the luxuriant, diſagreeable, garden kind, that ſhould always be rooted out of the ground, and kept under in time to prevent its future miſchief. See GALEOPSIS *Tetrahit.*

Garden ſow-thiſtle is a common weed of luxuriant growth, doing great injury to the cultivated crops. It is directed that the ſeeds of this weed ſhould never be ſuffered to ſhed and ſpread themſelves in any ſituation; for, being furniſhed with feathers, they fly over a country with the wind, diſſeminating themſelves widely, and vegetate on the firſt looſe or cultivated ground on which they ſettle. It is a favourite food with rabbits and hogs. See SONCHUS *Oleraceus*, and THISTLE.

Fumitory is a common, though not very injurious or hurtful weed. It is an annual, and may, conſequently, be deſtroyed by preventing its ſeeding in an effectual manner. See FUMARIA *Officinalis.*

Common thiſtle is a diſagreeable and troubleſome weed; the ſeeds of which are numerous, and provided with a downy material to carry them any diſtance before the wind. They ſhould be drawn up by the roots in moiſt weather with forceps or tongs for the purpoſe, as they cannot be pulled by the naked hand.

Garden-grounds are always to be kept well freed from weeds of this ſort by all proper means. See SERRATULA *Arvenſis*, and THISTLE.

Groundſel, which is another very common and troubleſome weed in garden-grounds, and the ſeeds of which are feathered, as in the former caſe, being capable of ſowing and ſpreading themſelves far and near, with this farther chance of propagating themſelves, that the plant or weed is extremely quick of growth. The eradication of this weed from gardens muſt conſequently require unremitting attention, by cutting up the young plants as ſoon as ever they can be diſcovered, and letting them run to ſeed as little as poſſible. See SENECIO *Vulgaris.*

Common nettle is a weed that generally grows in hedges or other ſhady places, but which ſometimes appears in other places and in garden-grounds; in which caſes, it muſt be deſtroyed by rooting it up in a complete manner. The leaves of this weed, when cut ſmall, may, it is ſaid by ſome, be mixed with the food of turkeys, and other poultry, with benefit. See URTICA *Dioica.*

Miſletoe may be ranked as a garden-weed, and is very common on fruit-trees, and it is ſaid to be very hurtful in preventing their bearing; it ſhould, of courſe, be pulled off in time, ſo as to prevent that ſort of injury. It is ſometimes, too, plucked off as a ſheep-food in the winter, in hard ſtormy ſeaſons. See VISCUM *Album.*

Cultivated early potatoe, though it cannot be properly ranked as a weed, is often troubleſome in gardens. It is ſaid, that however valuable as a crop, it is very apt to remain in the ground, and intrude itſelf among other after-crops, to their injury, as well as giving a ſlovenly appearance to the culture. As, however, it is now found that the ſhoots of this root will crop well after being tranſplanted, it would ſeem to be the beſt way to have them taken up from among other crops as they appear, taking the advantage of ſhowery weather, and putting them into a bed by themſelves, where they may ſucceed ſome early crop, ſuch as winter greens, ſpinach, forward cabbage, and ſuch like, by which means other crops may be rendered clean, and theſe roots be provided without any expence of ſeed or ſets. See SOLANUM *Tuberoſum*, and TRANSPLANTING.

Weeds injurious in Tillage and Corn Lands.—The principal of thoſe weeds which decidedly infeſt and injure grounds under the plough are thoſe given below.

Ivy-leaved chickweed is a weed that is ſaid ſometimes to abound very much amongſt wheat very early in the ſpring, but that as feeding and leaving the ground early, may perhaps not much injure the crop: the ſeed is aſſerted to ripen in twenty-eight days from the firſt vegetation of it and the ſpringing up of the plant, which moſtly appears in the month of March, and often ſends forth a plentiful produce of ſeeds, which will lie in the gronnd many years, ready to vegetate the next time the land is broken down and pulverized early in the ſpring: this ſort of work ſhould, therefore, in this caſe, be done in the fallow, where that practice is in uſe, which would occaſion the ſeeds to vegetate; but in other caſes it may be deſtroyed by being ploughed under before the ſeeds of it begin to ripen. See VERONICA *Hederifolia.*

Lamb's lettuce, or corn-ſallad, is a weed that has lately been obſerved to be more frequent in ſome diſtricts than formerly. It has been found in a hard tilled field in great abundance. It is an annual weed; and, though not very formidable, ought to be removed from tillage-lands, as it takes away a portion of the nouriſhment belonging to the cultivated crops. This may pretty readily be done by pulling or cutting it up, or turning it under by the plough, where it can be uſed, before the ſeeds of it be perfectly formed. See VALERIANA *Locuſta.*

Couch of tillage-land is the produce of the three graſſes already noticed in a ſimilar title, under the head of garden-weeds, with the addition of the roots of the creeping ſoft

graſs,

grafs, and probably fome others. It is faid to be the plague of arable cultivation; and that the roots of thefe weeds are fometimes fo interwoven together in the land or foil in ground that has been under hard tillage and bad management, as to form a perfect matting, and to choak the plough: they abound moft, it is obferved, in light and mixed foils, not infefting ftrong clays in an equal manner. The arable land fquitch-grafs, which is the moft general, is, it is faid, of the *agroftis* family; but to which particular fpecies or fort that the moft complained of by farmers belongs, is not yet well agreed upon. Some refer it to the fine bent, while others affert it to be a variety of the white. And there are others of great authority who think this fquitch-grafs has never yet been rightly fpecified or referred. The ear or awn of this grafs has, however, been often obferved to have the general habit of the *agroftis*; and that it is very probable that more fpecies than one of this genus have the property of running in the roots, and producing couch.

It is noticed, in addition, that the creeping red-ftalked bent grafs, and the creeping foft grafs, are common fquitch or couch-graffes on ftrong or cold wet tillage-lands; and that the tall oat-grafs is a very ufual fquitch-grafs, on the light gravelly foils of fome neighbourhoods; that its roots are compofed of a bunch of bulbs, which afford fhelter to pernicious vermin, as already feen; and that it is difficult of eradication, and very pernicious to crops, efpecially in wet feafons.

The *dog-grafs couch*, which, in the county of Salop, is often termed *fcutch*, is very common every where, and well-known to the coft of the farmers.

Withering, after obferving that it can only be deftroyed by fallowing in a dry fummer, ftates, that at Naples the roots are collected in quantity, and difpofed of in the market to feed horfes. The tafte is much fimilar to that of liquorice, dried and ground into meal, which has been made into bread in years of fcarcity. They have befides a detergent quality, and may be ufeful in the difeafed livers of animals.

However, thefe graffes, though fo troublefome and injurious as weeds on arable lands, are yet probably good as affording meadow-herbage, where their roots are not fo liable to run or fpread themfelves as on tillage-land that is loofened, broken, and reduced, by being conftantly wrought by the plough, and other tools.

The deftruction of weeds of this fort on arable land, is chiefly effected by the free ufe of the plough, and other fuitable implements, when the weather is in a proper ftate of heat for the purpofe: fome think the bufinefs can only be effected by giving an early and complete fpring and fummer fallow, by repeated ploughings in time of hot weather, with fufficient harrowings between each ploughing, to work out the fquitch, and bring it to the top; and that unlefs the fummer prove dry for fome length of time, even this will be infufficient; in which cafe, many active and induftrious farmers have it forked together by hand and burnt: others have it collected and carried into heaps to rot; and it is fometimes mixed with quick-lime, and reduced into a fort of compoft heap, which is a practice to be much commended, as wholly deftroying it, and at the fame time converting it to ufe: it fhould not, however, be forgot, that the great increafe of the roots of thefe weeds is occafioned by hard tillage, or bad management, and often by both. In the county of Gloucefter, it is faid by the writer of the corrected account of the agriculture of that diftrict, to be a moft troublefome and almoft unconquerable weed on clay-lands, but that on light lands and loams it may be dragged out and finifhed by hand-picking with tolerable eafe; while on the ftiff foils, and particularly in the wet furrows, nothing but repeated ploughings and expofure to the heat of the fun during the fummer can check the increafe of it; hence, in that county, the vale-lands, after a wet fummer, are generally foul. A crop of fpring-vetches is faid to be well fuited to fmother and keep it down, and other fmothering green crops may be had recourfe to in the fame intention. See Triticum *Repens*, &c. Alfo Agrostis *Stolonifera*, Holcus *Mollis*, &c.

Wild oat, or haver, is a common weed on hard tilled land, and when abundant, very unfightly and injurious to a crop. It has been obferved by Dr. Anderfon, it is faid, that this weed-plant abounds fo much in the corn-fields in moft parts of Aberdeenfhire, as in many cafes to conftitute nearly one-half of the bear or fix-rowed barley-crop, which is much grown in that part of the kingdom: it may be deftroyed or greatly reduced by the turnip-culture, or by well-managed early fallowing; and prevented by fhort tillages, and frequent feeding down to grafs. Dr. Withering, and the Flora Ruftica, have ftated, that the awns of it are ufed for hygrometers, and the feeds inftead of artificial flies in fifhing for trout. The author of the Corrected Report of the Agriculture of the County of Gloucefter ftates, that it is the growth of particular diftricts, and that it cannot be deftroyed; that in fields where the greateft care has been taken to hand-pull every ftalk, it has appeared in the following year in equal abundance. That in new broken up leys, which have been in turf or fward beyond the memory of man, thefe weeds often fpring up with as much luxuriance as if they were the natural produce of the foil. When the land is planted with beans or peas, hoeing will check and reduce them; but when they grow among wheat, it is not eafy to diftinguifh the plants while young; and that in this cafe, they are left until they are nearly in ear, and are then drawn out by the hand. See Avena *Fatua*.

White darnel is a weed not unfrequently found in wheat-crops, though, it is believed, almoft always produced from the feed of it fown with that grain, to prevent which, confequently, great attention fhould be paid to clean feed-wheat, and particularly that it contain none of the feeds of this weed, as it is extremely prolific, very injurious to a crop while growing, and to the value of the produce at market. It is an annual weed, which has never been recollected to have been feen growing, except in a crop, and but rarely there without neglect in the management of the feed grain, and in other ways. See Lolium *Temulentum*.

Goofe-grafs, or catchweed, &c. is a weed in tillage-land, the feeds of which are roundifh, rough, two from each flower, fo large as not all to be eafily feparated from the grain in dreffing. This weed is not very common in well-managed lands and crops, being more generally reftricted to the hedge banks. It is obferved, in the Gloucefter Corrected Agricultural Survey, to be a troublefome and frequent weed, on all forts of foils among corn, and which is not eafily deftroyed, except by much early care and attention. See Galium *Aparine*, and *Spurium*.

Field fcabius is a weed found fometimes in corn-fields, as well as paftures, though not very abundant. See Scabiosa *Arvenfis*.

Parfley-piert is a diminutive weed of but fmall account, though fometimes too much abounding in tillage-lands. This weed might probably be weakened and leffened when in too great quantity by pulverifing and reducing the foil well when in fallow, very early in the fpring feafon, and by ploughing

ploughing it under in due time, fo as to prevent its feeding. See APHANES *Arvenfis*.

Dodder is a parafitical weed, that is faid not to be uncommon, in fome diftricts, in the corn-lands. This weed has been obferved twining round the ftems or ftalks of a bean crop in the county of Buckingham, climbing in a fpiral direction round them, from which, by means of veffels for the purpofe, it draws its nourifhment and fupport, and muft, confequently, very much fret and injure any plant to which it may attach itfelf: it is called in different places, as ftated by writers on hufbandry, beggar's-weed, hell-weed, and devil's guts, names which fufficiently fhew in what fort of eftimation it is held by farmers. It is an annual weed, and produced from feed, which takes no root in the earth, but in fome part of its fofter-plant. It is remarked, by the author of the Corrected Report on Agriculture for the County of Gloucefter, to be a great enemy to beans, vetches, and fome other fuch plants, but is never there feen among wheat, barley, or oat-crops. That as foon as it has fixed itfelf upon the plant, it feparates from the root, and, like other parafitical weeds, draws all its nourifhment from the plant it has fo fixed upon and embraced. Large quantities of beans are, it is faid, often ruined completely by it, fo as not to carry a fingle pod; and that no method has yet been difcovered to deftroy it; for though the root cannot be found, yet it furely returns, it is thought, in fome part of the field where it has once begun to grow, whenever the plants on which it feeds, form the crop of the feafon. Sheep, in fome cafes, have been found ufeful in leffening it, by feeding upon it and breaking its runners, when they can be turned into the land where it prevails. See CUSCUTA *Europæa*.

Corn bind-weed is another troublefome parafitical weed in arable-land, often growing amongft wheat, and, when abundant, twining round the ftalks of the corn, and very much injuring the crop, when the wheat has been laid by heavy rain. It is faid not to be fo common in fome of the midland counties, as in fome of thofe nearer the metropolis, whence they are in the habit of procuring and being fupplied with feed-wheat; on which account it has fometimes been feared that it might be introduced more abundantly by fuch means: but as the feeds are fmall, they may eafily be dreffed out in cafe of fuch accidents. It is a perennial weed, and much addicted to running in the root. It has been proved by an experienced writer, that cutting it off, even below the furface of the ground, only tends to fpread it farther: it muft be reduced and deftroyed, if poffible, by means of fallowing, and ufing the fame procefs as for couch or fquitch. In fome diftricts this weed is moft frequently found in clays and deep loams, in which the roots ftrike fo down, that even trenching two fpits and an half deep will not, it is faid, reach their extremities; and that the fmalleft bit of a root left in the ground will fpring and rife to the furface. It entwines round and entangles all plants in fuch a manner, as either to bring them to the ground, or check their vegetation, by injuring their ftructure on the furface of it. See CONVOLVULUS *Arvenfis*.

Wild carrot is a common and fometimes a troublefome weed, in dry tillage-land. It is a biennial weed-plant, producing feed in a plentiful manner. Though fome, as Withering, affert that this, in its cultivated ftate, is the common well-known garden carrot; yet others, as Miller, contend that the wild carrot could never be improved fo as to render the roots in any degree comparable with the cultivated carrot. However this may be, where it is found in quantity, it fhould be prevented from feeding, in order to reduce it, and bring it properly under, which may be effected by cutting or pulling it up in its early growth. See DAUCUS *Carota*.

Shepherd's needle, or beggar's needle, is a weed fometimes abounding in hard tilled land, and the feeds of which are not wholly feparable with eafe from grain in dreffing. It is a fmall annual weed, that produces a plentiful crop of feeds, each feed being furnifhed with a fpike or beak of from one to two inches long, whence its name of needle. It feldom abounds much in well cultivated and managed land. See SCANDIX *Pecten*.

Chickweed is, in fome cafes, a troublefome weed in a crop on land which has been rendered fine by tillage, and from which it fhould, therefore, be rooted out. It has been remarked by the Rev. Mr. Shaw, it is faid, that this weed is an excellent out-of-door barometer:—that when the flower expands boldly and fully, no rain will happen for four hours or upwards; that if it continue in that open ftate, no rain will difturb the fummer's day; that when it half conceals its miniature flower, the day is generally fhowery; but that when it entirely fhuts up, or veils the white flower with its green mantle, let the traveller put on his great coat, and the ploughman with his beafts of draught reft and retire from their labour. In Gloucefterfhire it is ftated that it grows moft plentifully on the good and well cultivated lands. It there mats fo clofely round the plants, and covers the furface fo completely, as to keep out the influence of the fun and air; and confequently requires to be removed, which is moftly beft performed by the hoe. It may be thus kept under, if not wholly removed and deftroyed. See ALSINE *Media*.

Curled dock is a mifchievous weed in tillage-land, and fhould never be fuffered on any account to feed its feeds, and fpread them on any land, but be rooted up and carried off in time, to prevent injury. In arable ground, the roots are beft picked off with care during the time the land is in tillage, as they will otherwife produce vigorous luxuriant plants which will draw much nourifhment from the foil, to the great injury of the ground, and of the intended crop. It is a hardy perennial weed, which is very tenacious of growth by its roots, and producing a wonderful increafe of feeds: too much caution cannot, therefore, be ufed to avoid fowing it, nor too much pains be beftowed in its extirpation and deftruction. Withering afferts it to be the peft of clover-fields in Norfolk. See RUMEX *Crifpus*.

Arfmarts, or lake weeds, are plants of this kind, fometimes met with on the wetter forts of arable lands. They abound moft in wet feafons, on the heavier and more moift forts of ground; and as being hardy annuals, producing a plentiful fupply of feeds, are apt to fhew themfelves in the crops of grain. They are weeds which are to be deftroyed by proper fallowing, by the removing of the wetnefs of the land, and by the rooting out of the plants in proper time to prevent their feeding. See POLYGONUM *Perficaria*, and *Penfylvanicum*.

Knot grafs is fometimes a tillage-weed; trailing in its habit of growth; flourifhing moft by the way-fides: when out of the fmothering crops, it is very prolific in feeds. It fhould be got under by preventing its feeding, by rooting it out fufficiently early for the purpofe. See POLYGONUM *Aviculare*.

Bearbind, or black bindweed, is a parafitical weed that twines round any thing it can lay hold of, and which is fometimes found among field crops, to their great injury. It is very productive of feeds, which, being angular, are not eafily feparated from grain in dreffing or winnowing it. It is nearly allied, it is faid, to buck-wheat, and to which it is preferred by Dr. Withering, who afferts that the feeds are

are quite as good for ufe as thofe of that wheat, are produced in greater quantity, and the plant bears cold better. From its twining hurtful nature, when among crops, it fhould be early deftroyed, and prevented from feeding and multiplying itfelf. See POLYGONUM *Convolvulus*, and *Sagopyrum*.

Knawell is a diminutive weed, but prolific in feeds, and of vigorous growth; it is often found on pieces of poor thin foil, when in tillage, but is not believed to be very pernicious: it may probably, when neceffary, be weakened, reduced, or deftroyed, by an early fpring working of the land when in fallow. See SCLERANTHUS *Annuus*, and *Perennis*.

Bladder campion is a weed that is common in wheat and barley crops, growing in tufts, with many ftalks from each root; which, when the cafe, fhould be rooted out by the hand, or other convenient method. It is a perennial weed, and has the habit and property of increafing from the roots. See CUCUBALUS *Behen*.

Cockle is a luxuriant, vigorous, annual weed; perfecting many feeds, and drawing much from the foil or land: care fhould, therefore, be taken not to fow the feed of this injurious weed. The feeds are fo large, that they cannot all be dreffed out from the grain, it is faid: the plant fhould, therefore, be plucked out by hand, before the feeds ripen and fhed themfelves. It is a common weed among wheat and other crops, in many diftricts. See AGROSTEMMA *Githago*.

Red and white campion are weeds of the perennial kind, growing occafionally in hedges, corn-fields, and paftures. When they become abundant and injurious, they may be weakened, reduced, or deftroyed, by well-managed fallows, in moft cafes. See LYCHNIS *Dioica*.

Moufe-ear is a weed that has fomewhat the habit of chickweed, but is of a duller appearance: it is frequent amongft corn-crops, and in paftures, but perhaps not very injurious to the former. See CERASTIUM *Arvenfe*.

Corn fpurry, or yarr, is a frequent weed in corn-fields, though not very bulky or luxuriant, yet quick and tenacious of growth, and producing feeds in a plentiful manner. Dr. Anderfon has ftated, that in Aberdeenfhire it is a pernicious weed, growing in fuch abundance among the crops as to choke the grain: it has often been feen fo thick, that over a vaft extent of furface a pin could not have been put down, without touching a plant of it; and that the farmers there think it indeftructible: and it is added, that whenever any of the land had been poached, by being ufed as a road, efpecially in wet weather, none of this weed appeared there: that it was evident that this was occafioned by the clods, thus produced, not giving room for the fmall feeds to germinate freely; which fuggefted, that if, therefore, he could contrive to bring the ground into a cloddy ftate, when fown, he fhould be free of the weed for that crop. As a crop of bear or fix-rowed barley in one field was entirely loft, the foil or mould being in a loofe, mealy, incoherent ftate when fown; it was refolved to delay ploughing it the next feafon as long as poffible, and to plough it at laft when it was very wet. Fortunately it came a violent rain in the beginning of the month of March, and it was ploughed when nearly in the ftate of a puddle, turning over more like mud than foil or earth: dry weather fucceeding, this mud bound, it is faid, a little on the furface, and produced a kind of clod; the corn was then fown; it got a very flight harrowing, barely to cover the feeds, in an imperfect manner, and to leave the field as rough as poffible: none of the weed appeared, and the crop at harveft was one of the moft luxuriant that had ever been feen by the writer. The fuccefs of this cafe is not, however, fufficient to recommend it as a general practice.

It has been fuggefted, that as fmall birds are very fond of the feeds of this weed, it is probable that, by the furface of the ground being left undifturbed through the winter, a large portion of the feeds would be picked up and devoured by them. It is believed too, that in all cafes of a ftubble very full of fmall feeds, it is well to defer the ploughing as long as it conveniently can, on this account. In refpect to land rendered very fine by tillage, it is well underftood, it is faid, by the farmers of fome diftricts, as thofe of Staffordfhire, to be a fault, and that it is much better left only knappy, as they call it, that is, in fmall lumps. This is attained in fallows, by working the land early in fummer, and letting it lie to confolidate through the latter part of it; and in the turnip culture, by the treading of fheep and cattle: and it is one great reafon, it is fuppofed, why land fhould not have too many ploughings, but only a proper number judicioufly timed; however, that ploughing in general, particularly of broken land, is much beft done when the land is dry.

By fome means of this kind, this fmall weed may be kept under without much difficulty. See SPERGULA *Arvenfis*.

Bafe rocket is a weed of the annual kind, that does not abound very much, though it is met with in fome places. It has been obferved among corn in the county of Gloucefter. See RESEDA *Lutea*.

Dwarf fpurge is a weed that is common in corn-fields, and generally in fingle plants, but is not very injurious to the crops. See EUPHORBIA *Exigua*.

Corn-poppy is an annual weed that produces numerous feeds, and is fometimes very abundant in corn-fields, being a pretty fure indication of a light crop. It has been queftioned, whether the lightnefs of the crop be occafioned by the abundance of this weed, or the increafe of this weed encouraged by the lightnefs of the crop; and fuggefted, that probably both are the cafe. In a full crop it is fcarcely to be found; its flowers appear in July. In the Corrected Report on Agriculture for the County of Gloucefter, it is ftated to be common in all light and fandy foils, particularly in the neighbourhood of that town. But that fince the practice of hoeing has become more general, this weed has been much diminifhed in quantity. It abounds much, too, on chalky ftone-brafh poor foils, in fome cafes. And in fome parts of Berkfhire, it is faid, in the account of its agriculture, that the poppy almoft conceals the corn, when it is in bloffom. It is fuppofed that it might without doubt be weakened, reduced, or wholly deftroyed, in fallows, by promoting an early vegetation in common with other feedling plants. See PAPAVER *Rhœas*.

Corn crowfoot is a weed that is fometimes very abundant, and injurious to a wheat-crop, on ftrong moift land. It is an annual weed of early growth, which can only be brought into a full ftate of vegetation in the fallow by an early tillage; otherwife the growth of the feeds is, it is faid, deferred to the next fpring, to the great injury of the crop. In the Flora Ruftica it is noticed, that in fome countries it has the name of hunger-weed, whence it is fuppofed to indicate a barren foil. The orthography, however, is not, it is faid, derived from the nature of the foil, but from the hungry profpect it holds out to the farmer. In the county of Gloucefter, it is faid to grow moft abundantly in ftrong loamy or clayey foils; and that deep and frequent ftirrings with the hoe are to be had recourfe to, as the moft proper means for reducing it, and keeping it under. See RANUNCULUS *Arvenfis*.

Dee nettle, or dead nettle, is a weed that much abounds among

among tillage-crops, on ſome lands, eſpecially in moiſt ſeaſons. As the weeds are perennial, and produced both from ſeeds and the roots, great pains are neceſſary to be uſed in their extirpation and deſtruction. There are ſometimes different ſorts met with among crops. See LAMIUM *Album*, and *Purpureum*.

Calves' ſnout is a weed in tillage-lands, in different diſtricts. It has been obſerved not to be uncommon among the corn-crops in Hampſhire, in ſome ſummers. It would appear too from Withering, that ſeveral other ſpecies of this genus are common in corn-fields, which are annuals; but the nature of them, or how far they are injurious to cultivated corn-crops, has not yet been determined. See ANTIRRHINUM *Orontium*, *Elatine*, *Spurium*, *Arvenſe*, and *Minus*.

Shepherd's purſe, or pouch, which, with ſome others, are well-known weeds, are ſometimes troubleſome on arable land. They are annuals of early appearance, and continue a great part of the year. They are to be reduced and deſtroyed by early and well-directed fallowing, or by being rooted up from the ground at an early period. See THLASPI *Arvenſe*, *Campeſtre*, and *Burſa Paſtoris*.

Whitlow graſs is ſaid to be a weed among corn, in ſome caſes and ſorts of land, early in the ſpring; but how far injurious is not well aſcertained: it ſhould, however, when in quantity, be kept well under. It is but ſmall, though quick in growth, and exhauſted in a ſhort time. See DRABA *Verna*.

Codded mouſe-ear is another diminutive weed, that ſhews itſelf early ſometimes among corn in tillage-lands; but being rapid in its vegetation and decline, is not of much importance as a weed to farmers.

Smooth and rough-leaved and pale-flowered chadlocks, &c. are weeds that are extremely troubleſome and diſtreſſing to farmers on tillage-lands, in ſome places. The writer of the paper on weeds alluded to above has ſtated, that theſe three plants are ſometimes confounded together by farmers, under the general name of chadlock, pronounced in the diſtrict where he lives kedlock, and in ſome others ketlock, though they are as diſtinct to the inveſtigating inquirer as wheat, barley, and oats. That they are all extremely common, or nearly equally ſo, if a large range of country be examined; though the different ſorts are more or leſs abounding in different places; that in his neighbourhood he can generally gather the three kinds in the ſame field, but the muſtard is much the moſt abundant. In the vicinity of Litchfield, where chadlock is indeed very abundant, it is almoſt univerſally wild rape. Some years ago, the writer obſerved, in the common fields of the county of Rutland, that the whole ſurface was tinged over with the flowers of the wild radiſh. They are all great nuiſances, and, when ſuffered in abundance to ripen their ſeeds, muſt of neceſſity draw much from the ſoil, to the great injury of the crop among which they are; and that as they are very quick of growth, and perfect their ſeeds expeditiouſly, it is not uncommon for theſe weeds to ſhed their ſeeds at the rate of ſeveral buſhels on the acre; and as it is well known that the ſeeds are capable of vegetating, after lying many years in the ground, it is no wonder they ſhould produce a plentiful crop; yet, being ſimply annuals, they are not difficult of deſtruction, if due attention and proper means be uſed. In order to deſtroy theſe, as well as all other ſeedling weeds, the land in tillage ſhould, it is thought, be pulveriſed and reduced early in the ſpring by ploughing and harrowing, after which warm weather and rain will ſoon cauſe all the ſeeds that are near the ſurface to vegetate; they may then be permitted to grow until they begin to flower, when they are to be ploughed in, and the land again harrowed; and the next rain will then cauſe moſt of the remaining ſeeds to ſhoot, which are in due time to be ploughed under as before; and if any ſhould afterwards appear amongſt the crop, they ſhould be hoed or hand-weeded out: by this means, in one or two tillages, theſe weeds may be totally eradicated; but if they be permitted to ſhed their ſeeds, their increaſe cannot be wondered at, when their prolific nature is conſidered, as well as the extreme hardineſs of their ſeeds. The ſeeds, when dreſſed from grain, have, it is underſtood, been frequently manufactured into oil.

The weed called charlock, in many places, is ſaid to be the moſt common of any in the vale of the county of Glouceſter. It is moſt probably the ſame with the wild muſtard, juſt noticed. It is ſaid, that during the ſummer, both on the fallows and in the planted fields, its yellow bloſſoms predominate over every other plant, and that unleſs deſtroyed in this ſtate, leave an immenſe crop of ſeeds behind. In order to check the increaſe of this weed, the attentive farmer ſuffers it to come into bloſſom on the fallows, and then turns it in with the plough. This is not always, however, effectual; as frequently the plants being merely moved, but not from the roots, and two or three inches of the tops left above ground, ſoon recover the injury they have ſuſtained, and go on to feed before the next ploughing. Women and children ſhould, therefore, go over the ground with the hoe a few days after the ploughing, and cut up the reviving plants; or lambs ſhould be kept on ſuch fallows, which are ſaid to eat off the tops with avidity. In the planted fields they are hoed and weeded, but as ſome will unavoidably eſcape, women are put in among the corn, after it is grown to a conſiderable height, to pull out the weeds in bloſſom with the hand. Though the farmer will certainly diminiſh the quantity, and prevent any new acceſſion by this attention, yet many years of good huſbandry muſt elapſe, before the ill effects ariſing from the negligence of former cultivators can be conquered; for the ſeeds being ſtrongly charged with eſſential oil, will continue in the ground for an incalculable length of time uninjured; and as often as the ſoil is turned up, a quantity of them will be brought ſufficiently within the influence of the atmoſphere to vegetate. In 1804, in the pariſh of Brockthorpe, in the above county, a conſiderable portion of the land in the common field was ſeen completely covered with this weed, and the ſeeds perfectly ripe and ſcattering on the ground. The ploughing had been neglected until nearly the autumn, and as the land was not cropped, the charlock grew in great abundance, and left more ſeeds than the good huſbandry of half a century will be able to eradicate.

It has been ſtated, that what is vulgarly called charlock in the vale of the above diſtrict, is in reality the common wild muſtard grown in the north for its flour. That it is there often collected by the country-people for the ſame purpoſe; and before the ſimple mode of living among the ancient farmers fell into diſuſe, few farm-houſes were without a cannon-ball and bowl, in which the muſtard-ſeeds were bruiſed, and the flour ſaved for the table with the black huſks unſeparated from it.

The name charlock is not unuſually applied by farmers to different plants of the weed kind, that are equally noxious and hurtful in arable lands, and ſome of them perhaps more frequent in ſuch ſituations than ſome of the above, ſuch as wild muſtard and rape, &c. See BRASSICA *Napus*, SINAPIS *Arvenſis et Nigra*, RAPHANUS *Raphaniſtrum*, &c.

Wild rocket is a weed found in tillage-lands in ſome diſtricts. It is ſaid, that this weed has made great progreſs in the corn-fields in ſome places, and is conſidered as a very formidable

formidable and hurtful plant of that kind. All the parts of this are confiderably acrid, and have a rank difagreeable fmell; whence it is called by thofe farmers who have it in their lands *ftinkweed*. It may, it is fuppofed, doubtlefs, be reduced and deftroyed by the proceffes already recommended for the deftruction of chadlock. See BRASSICA *Muralis*.

Fumitory is an annual weed, that is not uncommon or unufual in corn-fields, though not very greatly pernicious in them. It fhould, however, be kept well under where it is in any quantity. See FUMARIA *Officinalis*.

Reft harrows are weeds fometimes met with in tillage-lands. They are chiefly two forts, the former of which is faid not to be uncommon in arable lands, where there are no very defirable plants. It is common in fome diftricts among corn-crops, and an hardy perennial weed. In its deftruction, if the root can be got rid of in the fallow, there is little danger, it is faid, from the feeds: the roots are fometimes fo ftrong as almoft to ftop the plough, unlefs the team be pretty ftrong. The latter is frequently met with in fome places, but is unknown in fome of the midland counties. See ONONIS *Arvenfis*, or *Spinofa*.

Tare, particularly in the wild ftate, is a weed very injurious to corn-crops. It is faid to be a terrible enemy to a wheat-crop, where it abounds in confiderable quantity. Withering fays, that in wet feafons whole fields of corn have been overpowered and wholly deftroyed by it. Care fhould be taken, that feed-wheat be perfectly free from the feeds of tares; and all land fubject to them fhould be got, if poffible, fo forward in the fallow, as to bring on the vegetation of this weed previoufly to the fowing of the wheat: the feeds of this weed are faid to be good food for pigeons, poultry, and many other forts of birds. See ERVUM *Tetrafpermum*, and *Hirfutum*.

Rape, in fome cafes, is a very injurious weed in arable land. It fhould, in all cafes where it prevails much, be prevented from ripening and fhedding its feeds, as when this is not the cafe, the farmer has long to regret the confequence of his neglect. See *Chadlock fupra*.

Melilot is a weed very troublefome in tillage-land. The writer of the paper already noticed fays, that it is a very injurious corn-weed in many parts of the kingdom. That Miller marks Cambridgefhire, and Gerard, Effex, as abounding in it. That it has been heard of in Bedfordfhire, and feen among corn in Gloucefterfhire and Rutlandfhire: that in the latter county, five or fix fhillings the acre have fometimes been faid to be expended in weeding it out, without fully effecting the purpofe. According to the Flora Ruftica, there cannot be a worfe weed among bread corn, for a few of the feeds ground with it fpoil the flour, by communicating their peculiarly ftrong tafte to it. That it flowers in June and the following month, and the feeds ripen with the corn; and that it is probably capable of propagating itfelf, both by its roots and feeds, but might doubtlefs be much weakened and reduced by proper fallowing: that horfes are very fond of it; cows, fheep, and fwine, eat it; and bees are very fond of the flowers: it is, therefore, though a corn-weed, a good pafture plant. It is faid to be common in the vale part of the county of Gloucefter, in the arable lands; and it has been fuggefted, that if the feeds did not afford an unpleafant tafte to the flour of wheat with which it may happen to be mixed, it might probably be cultivated with advantage, as all domeftic animals are fond of it in fome degree. See TRIFOLIUM *Melilotus officinalis*.

Sow-thiftle is a very common and troublefome weed in tillage-land: it is a perennial, and common among corn-crops in fome diftricts; which, in all cafes, when it happens to be fo abundant, fhould be drawn up by the hand or other proper means before it ripens and fpreads its feeds; which, as being furnifhed with a feathery down, would otherwife fly over the whole country and diftrict, as has already been feen. See SONCHUS *Arvenfis*, and THISTLE.

Common thiftle, curfed thiftle, or fow-wort, is, in many cafes, a troublefome and difagreeable weed in and about corn-lands and crops. It is commonly called thiftle, growing almoft every where: when injurious in corn-crops, it may, it is faid, be weakened and reduced by good tillage and weeding, but not totally deftroyed, in perhaps thefe or any other ways, otherwife than by univerfal agreement to root it up, before its feeds ripen and become fpread, or by fome regulation of police enforcing the fame. This mifchievous weed is produced by its numerous fibrous roots, which are hardy and ftrictly perennial, and which if feparated in parts or pieces in ploughing, digging, or working the land, each part will, when left frefh in the foil, often grow or vegetate, and produce a new plant; and by its ftill more numerous feeds which are feathered, will fly and be carried to a great diftance by the wind; and when it becomes calm alighting upon cultivated land, will there vegetate and rife luxuriantly, fo that it would be in vain for any perfon to attempt clearing his land of this weed, unlefs his neighbours did the fame likewife: however, the roots of this weed may, it is faid, be pretty effectually deftroyed by a well-managed fummer-fallow, as they will not furvive repeated ploughings up in hot weather; and if due attention were beftowed to prevent the feeding of the weed, its numbers might be diminifhed very greatly: it is found very hurtful to all field-crops. Some think it eafily conquered, however, by proper management and attention in tillage-lands, and that it may either be drawn by the tool for that purpofe, or be cut off deep by the hoe or fpeed-hook.

It is fuppofed, on the authority of the Flora Ruftica, that the goat and the afs will eat it; that horfes will fometimes crop the heads while young and tender; but that no other fort of cattle touch it growing. That when burnt, it is faid to yield a very pure vegetable alkali. See SERRATULA and THISTLE.

Spear, *bur*, or *boar thiftles*, are weeds of a very pernicious nature in corn-lands, in many inftances and parts of the kingdom. They are faid to be called by the laft of thefe names in Staffordfhire, to diftinguifh them from the above weeds, which are likewife termed thiftles. There are feveral forts of them, and they often abound about the hedge-fides and borders of corn-fields, whence they fhould be rooted up after rain as much as poffible, before their feeds ripen and are ready to fpread, otherwife fuch feeds are liable to fly all over the country, as has been feen: thefe are weeds that grow very luxuriantly, drawing much from the ground or foil, when among the crops, as is frequently the cafe in many places. They fhould always be drawn out as much as can be done in fuch cafes in hot weather: they are moftly weeds of the annual or biennial kinds. It is faid by Withering, in fpeaking of the ufes of them, that fhould a heap of clay be thrown up, nothing would grow upon it for feveral years, did not the feeds of the fpear thiftle, wafted by the wind, fix and vegetate thereon; that under the fhelter of thefe, other vegetables appear, and the whole foon becomes fertile.

They are never to be trufted among crops, but be kept well cut or pulled up in their early growth. See CARDUUS *Lanceolatus*, *Pratenfis*, and *Acaulis*. Alfo THISTLE.

Colt's-foot is a weed that is very apt to abound in hard tilled land. It has been faid that the only time to deftroy this weed, is by cutting it up in thofe months when it begins to throw out its flower, at which time, if fo cut, it will

will bleed to death; these months are February and March, at which time all land in fallow, which is subject to this weed, should undoubtedly be ploughed and harrowed down, which would, without doubt, check the growth of, and very much weaken the weed; but when neglected at this period, it will soon afterwards ripen its seeds, which furnished by nature with feathers, fly all over the country, and establish themselves very quickly on cultivated land, and banks of earth newly thrown up. This weed may, it is said, be considerably weakened by repeated summer ploughing, and be afterwards, for the most part, weeded out by hand, as the ground is thus rendered light. It is a weed which in Gloucestershire is not found, except on soils that are poor in their nature, and subject to moisture. The obvious remedies are consequently fertilization by manure and the removal of wetness by draining. See Tussilago *Farfara*.

Groundsel is a mischievous and troublesome disgusting weed, not unfrequently found in fallows, on good free soils rendered fine by cultivation, as its seeds ripen quickly in such cases, and fly over the country with the wind: it is a weed that should be got quit of in time by being pulled out, or turned under by the plough, and the seed of it be by no means permitted to ripen and disperse. See Senecio *Vulgaris*.

Corn marigold, goulans, goul, or buddle in Norfolk, is an extremely troublesome weed in some soils: it is an annual, producing seeds plentifully, which vegetate whenever the land is cultivated, and very commonly in the crops of corn: it would, without doubt, it is supposed, be destroyed, as other annual seedling weeds, by early and complete fallowing to bring the seeds into vegetation in due time, and afterwards ploughing them under. According to Withering, in Denmark, there is a law to oblige the farmers to root it up: and it is said to be stated in the second volume of the "Statistical Account of Scotland," that the late sir William Grierson, of Lag, held *goul* courts as long as he lived, for the purpose of fining such farmers on whose growing crop three heads or upwards of this weed were found; and it has been observed, that some regulation of police for fining those who harbour weeds, the seeds of which may be blown into their neighbour's grounds, has no injustice in the principle of it.

It is stated in the Berkshire Corrected Report on its Agriculture, that it may be destroyed by the application of chalk as a manure, as well as by extirpation.

On the authority of the Flora Rustica it is noticed, that if this weed be cut when young in flower, and dried, horses will eat it. See Chrysanthemum *Segetum*.

Corn mint is a weed that is said by the writer of the Corrected Report of the Agriculture of the County of Gloucester, to be common on damp soils; and that it increases fast by the root, where, for want of frequent ploughing, dragging, and other tillage, it is neglected. See Mentha *Arvensis*.

Corn camomocle is a weed that is sometimes prevalent in corn-fields: it is very prolific in seeds, which should never be suffered to shed, as in that case it would be multiplied to an almost endless degree. See Anthemis *Arvensis*.

Stinking May-weed is a plant of this kind that is common in corn-fields among the crops, but which is often confounded with the above and other weeds of that sort, from which it is to be distinguished by its disagreeable smell: it is very injurious to corn-crops, and should be prevented or destroyed by good fallowing, or by being timely rooted out of the land. The Gloucester Report on its Agriculture states, that maithe or mathern there often overruns a whole field, particularly when planted with peas, so that only the white blossom of the weed is to be seen. The only chance of destroying this stinking weed is, it is supposed, by the drill husbandry, where room is left for the free use of the hoe. In the broadcast mode the weeds must be pulled out by the hand, which is not only tedious, but, in some measure, dangerous, as there is a noxious quality in the plant which is liable to injure the hands of the weeders, if they happen to have sores on them. See Anthemis *Cotula* and Matricaria *Chamomilla*.

Blue bottle is a weed that is common in corn where the tillage of the land has been imperfect, or too long carried on, and continued without cleaning by means of turnips or fallow: it is an annual weed with a somewhat elegant blue flower. It is very common in the corn-fields of Shropshire and Lancashire, as well as in some other counties. It is said that, in Gloucestershire, blue bonnet, knapweed, or corn flower, is a weed common in some fields, principally where the soil is loamy and mixed with pebbles. It is advised to be extirpated at first by the hoe, and, when grown to blossom, by the hand. See Centaurea *Cyanus*.

Great knapweed is a perennial corn weed, growing in tufts of many stems or stalks from the same root; and which is to be destroyed in the fallow, or by being weeded out of the crop. See Centaurea *Scabiosa*.

Pansy is an annual flower weed that is often found among corn-crops in different districts, where it is produced by seeds that have not been destroyed in the preparation for the corn-crop. It is seldom very hurtful, but when abundant should be weeded out in some way or other. The beauty of the colours of its flowers has gained it a place as an ornamental plant. See Viola *Tricolor*.

Corn horse-tail is a weed often met with in corn-land, the fertile stem of which appearing early in the spring, with that of colt's-foot, and decaying before the other part of the plant appears. The author of the paper already noticed states, that Loesel says, if ewes in lamb eat it, abortion is the consequence; but it is believed that sheep or cows will not eat it, unless compelled by hunger. It is to be destroyed by the same kind of tillage and extirpation, as that recommended for colt's-foot. In the Gloucester Report on Agriculture, it is stated to be found only on moist soils, and cannot be easily overcome, but by draining and completely removing the wetness. See Equisetum *Arvensis*.

Fern is a weed not uncommon in corn-fields on dry sandy land: it is a hardy perennial plant, tenacious of growth, and striking a long tap root into the ground, beneath the reach of the plough, which shoots up vigorously when the sun becomes powerful: it prevails largely and strongly on some deep dry hazel loamy soils. In order to destroy it, after soaking rain, it should be drawn or deeply ploughed up; though, in some cases, it will require much pains and attention to get quit of it, especially on land where it has been established for a great length of time. See Pteris *Aquilina*.

There are different other weeds which are occasionally met with in lands of this sort, but which, as their nature, habits, and effects, have not been well or fully ascertained, they have not been noticed here.

Weeds injurious in Meadow and Pasture Lands.—From its not having yet been fully and exactly decided which are to be considered as noxious and hurtful, and which beneficial and useful plants, in the herbage of grass-lands, it may be proper and of utility to consider them under the heads of such as are really found prejudicial in such situations, and such as have not been discovered to be actually so, and the particular qualities of which are not well known.

Of the firft fort are thofe which are defcribed below, on the authority of the writer of the paper on weeds mentioned above, and that of fome others.

Cotton grafs, hare's-tail, or mofs crops, are weeds that grow in bogs or boggy meadows; and with the down of which poor people ftuff their pillows, and make the wicks of candles. This weed is a certain indication that drainage has been neglected, and that it is of courfe neceffary to be attended to and practifed, in order to reftore the meadow or other fuch land to the proper ftate for the growth of good herbage. See ERIOPHORUM *Vaginatum*, and *Polyftachion.*

Hog weed, or cow parfnip, is a weed often found in meadows, but which is too coarfe and of too weedy a nature and appearance to be fuffered to abound in well cultivated and managed grafs-land, though, it is believed, that cattle will eat it either green or in the ftate of hay: it is thought that it may probably be weakened or deftroyed, by annually cutting up in its early growth. See HERACLEUM *Anguftifolium*, and *Sphondylium.*

The latter is frequently met with, efpecially in moift meadows in Chefhire.

Wild cicely, or cow-weed, is a common weed in orchards, hedges, meadows, and paftures. Cattle are faid to be fond of it in the fpring, but it is too coarfe to be permitted or encouraged among good herbage of the grafs kind; and as it flowers, and ripens its feeds before the graffes, it is a bad and improper addition to the grafs-plants of both meadow and pafture lands: it is frequent in the meadows of Chefhire. It has been fuggefted, that this and the laft noticed plant may probably be worthy of a trial in cultivation by themfelves, as being of luxuriant growth, they would yield a large produce: their value has not, however, yet been fully afcertained; nor efpecially in this method of culture and management. See CHÆROPHYLLUM *Sylveftre.*

Garlick, in the wild ftate, is a weed that is frequently found in meadows and pafture lands, and which is confidered as greatly injuring the latter when ufed for cows. It is faid to give a difagreeable flavour to the produce of the dairy, as butter and cheefe, but it does not feem that cows much diflike or refufe to eat it. It is fuppofed, however, that this may probably happen on account of its being fo much blended and intermixed with the other graffes, that they cannot avoid cropping it a little. This weed is frequent in the cow paftures of fome parts of Lancafhire, Gloucefterfhire, and moft probably many others. See ALLIUM *Ampeloprafum.*

Ramfon is a weed that is found in fome meadows and other grafs-lands, but more commonly in the hedges; other plants will not, it is faid, flourifh near it: cows eat it, but it, like the above weed, gives their milk and its produce a garlic flavour: it fhould, of courfe, be weeded out of grafslands as foon as difcovered and be deftroyed. See ALLIUM *Urfinum.*

Rufhes of different forts are a fort of weed-plants which are not unfrequently met with in meadows and paftures, efpecially when of the cold clayey kind, and which are a fure indication that the land, in fuch cafes, wants the fuperfluous wetnefs removed; which, when it has been effected, always gives way to better herbage, though their extirpation and deftruction afterwards will be promoted and accelerated by top dreffings of afhes and other matters. In the Gloucefter Report on its Agriculture, it is ftated, that the common rufh is an inhabitant of foils that are moift and ftrong, that it abounds in the furrows of pafture-lands, and on the *meers* or ftrips of grafs-land left between the grounds in the vale of that county, as the dividing mark of different properties, and that it is deftroyed in the manner above. See JUNCUS, different forts. Alfo RUSH.

Docks are weeds that are found in ftrong four heavy land of the meadow and pafture kind. As thefe weeds are refufed by moft forts of domeftic animals, they fhould be rooted up after rain, and every pains be taken to deftroy and remove them from grafs-land, which they injure greatly by their fhade, and by caufing the herbage about them to become rank. They are faid to be eaten only by fallow-deer, by which their flourifhing in parks and pleafure-grounds is prevented. It is remarked that in Gloucefterfhire docks are extremely injurious to the herbage of pafture-lands, but that if taken in time they may be eafily conquered. If, however, they are permitted to ripen, they leave an immenfe quantity of feed for future crops; and, that being perennial, the evil is increafing in fuch a multiplied proportion, as almoft to exclude the growth of all other plants. In a large meadow adjoining the county-town, thefe weeds have matured and fhed their feeds, it is faid, fo often, and for fo many years, that, at the time of mowing, the whole appears like a crop of docks. Where thefe weeds are not got up by the roots, it is ufeful, in fome cafes, to cut through the ftalks under the ground; and to repeat the practice as fhoots are again thrown up. See RUMEX *Crifpus*, *Acutus*, *Obtufifolius*, &c. Alfo WEEDING *Dock-Spit*, &c.

Biftort is a weed that, in fome places, occupies large portions or patches in meadows, to the injury and deftruction of better herbage: it is a perennial, but may without doubt be weakened or deftroyed by rooting up repeatedly. The root is one of the ftrongeft vegetable aftringents, and may probably be applied to many purpofes in the arts with benefit. It is the inhabitant of moift meadows in Chefhire. See POLYGONUM *Biftorta.*

Wild campions are weeds often found abundantly in paftures formed from ploughed lands: there are two forts, as thofe with white and red flowers. Care fhould be taken to exterminate them from fuch paftures by proper fallowing the land when in the broken up ftate. See LYCHNIS *Dioica*, &c.

Goofe-tanfy, filver-weed, or feathered cinquefoil, is a weed common in many paftures laid down from the arable ftate, but generally untouched by cattle: it fhould therefore be deftroyed and got rid of in the tillage ftate of the land, and by keeping it free of ftagnant wetnefs. See POTENTILLA *Anferina.*

Tanfey is a weed that is found in Gloucefterfhire, in fome paftures by the fide of the Severn, and in a few other places in that county, but not in abundance, as well perhaps as in fome others, efpecially in the northern parts of the kingdom. It is an unpleafant weed, it is faid, which fhould be eradicated by the fpade, or fome other proper means. See TANACETUM *Vulgare.*

Pilewort is a weed that flowers very early in the fpring, and abounds in fhady or moift pafture ground; it fometimes occupies much room in fome meadows, and chokes other plants which grow near it; and not being eaten by cattle, it fhould certainly be extirpated: nothing difcourages its increafe more than coal and wood-afhes, the writers of the Flora Ruftica fuppofe. See FICARIA *Verna*, and RANUNCULUS *Ficaria.*

Loufewort, or red-rattle, is a weed found in moift meadows and paftures, and, it is thought, rarely but where the land is in want of being rendered dry: it is faid to be very difagreeable to cattle, and injurious to fheep, giving them the fcab, and occafioning them to be overrun with vermin: it is believed, however, that thefe injuries are principally caufed

caufed by the unwholefome nature or ftate of the land on which it grows: it may be deftroyed, it is fuppofed, by removing the wetnefs and top dreffing. See PEDICULARIS *Sylvatica*.

Yellow-rattle is a weed that is faid to grow generally in moift meadows in the county of Gloucefter, and which ripens its feeds, and fheds them before the time of mowing, when the dry hufks make a rattling noife under the fcythe: at this time, it contains no nutritious juice at all, though, when green, oxen and horfes will fometimes eat it rather eagerly, and at other times refufe it. Having, however, no defirable quality to recommend its cultivation, and oftentimes overrunning large patches of ground, it fhould be eradicated and deftroyed; and being a biennial, this, it is thought, may eafily be done, by grazing the land for three or four years in fucceffion, and taking care that the ftalks that are left by the cattle be fkimmed off by the fcythe before they are ripe enough to fhed their feeds, or while they are in full bloffom. In regard to its removal, it is ftated, that a farmer near the northern borders of the fame county, fhewed the writer a floping piece of grafs-land which had been overrun with rattle: without any view to the deftruction of that he conducted the water of an adjoining ftream, as well as he could, over the piece which was not, however, wholly watered; but it proved that on the watered part, the rattle was deftroyed, while it continued to grow on the portion which had efcaped. No plant is more frequently found mixed with the graffes in the meadows of Chefhire than this; but as it has nothing to recommend it, and the farmers diflike it, the removal of it fhould be effected to make way for better herbage. See RHINANTHUS *Crifta-galli*.

Dyer's-broom is a weed that is feen very abundant in fome paftures on ftrong and moift land, whence, as it is often troublefome, it fhould be grubbed up, and be got quit of. Wood waxen, dyer's-weed, or bafe broom, grows abundantly, it is faid, in many parts of the vale of Gloucefterfhire, but generally on dry paftures: it is refufed by no cattle but fheep; yet, being inferior to good graffes, fhould be rooted out, except in places where, as in the neighbourhood of Briftol, it is collected and carried while in full bloffom to the manufacturers, who, by boiling and other means, extract a fine yellow colour from it. See GENISTA *Tinctoria*.

Reft-harrow, or commock, is faid to be a weed often found in paftures, where it is eaten by cattle, efpecially the younger fhoots of it; but that it is too coarfe and rubbifhy to be fuffered to increafe, and fhould confequently be rooted out or grubbed up as foon as poffible. In Gloucefterfhire it is faid, too, to be a moft troublefome weed, and a pretty fure proof of want of attention, culture, and manure; as by the two former it may be eafily cleared from arable land, as has been feen, and by well-rotted horfe-dung even pafture-lands may be affifted; but that rather than fuch a difgufting plant fhould continue to grow, where its place might be fupplied with good herbage, neither labour nor expence fhould be fpared. The little advantage it gives to fheep, which will eat the young fhoots before the prickles are formed, is not, it is fuppofed, a fufficient inducement in the calculation of a good farmer to leave it undifturbed. In the parifh of Elmore, in that county, there is, it is faid, a pafture-ground almoft covered with it, which lies too far from the farm-houfe to have manure eafily conveyed to it. In this cafe, the occupier tried the experiment of drawing it out by the roots, but difcontinued it from the idea that it came up with greater ftrength, and in more abundance the fucceeding year. The fact is, that the bufinefs is but half done, if the roots are not entirely removed, as every broken piece will throw out fhoots; and from long continuance of the plant on the fpot, and the annual fhedding of the feeds of it, it is probable that a new crop will arife in the following fpring: but the farmer fhould not be difcouraged, it is faid, on his firft attempt; fince, by continually watching the weeds in their early growth, and cutting them off with the hoe, they would gradually be deftroyed; and the procefs would be much affifted by well dreffing the places with rotten horfe-dung, as fuggefted above. See ONONIS *Spinofa*, and *Arvenfis*.

Common thiftle is a moft noxious weed among grafs herbage: it has ftrong roots which fhoot out in a lateral manner, and is a perennial plant of vigorous growth in fome foils. It may be got quit of by cutting it off within the ground, or by being rooted up; for the former fort of work the beft time is when the plants are coming into full bloffom, as they then become fooneft rotten and deftroyed in their hollow root parts; and for the latter in pafture-lands when the ground is well foaked with rain, and they can be drawn eafily. They are fometimes very hurtful to the hay lands in the vicinity of the metropolis, where the management is bad. See SERRATULA *Arvenfis*, and THISTLE.

Rough large thiftles, or boar-thiftles, are weeds of a very troublefome nature among grafs-crops, and which are always to be got rid of without delay. They are generally mown or otherwife cut over, but are much better rooted or drawn up. It is remarked by the writer of the Corrected Account of the Agriculture of the County of Gloucefter, that thiftles of all kinds are very unpleafant weeds in grafs-lands; either when green or dried with the hay, they annoy the cattle in feeding, and confequently fhould never be permitted to grow long on any fuch land; to prevent their growing at all, is, it is thought, perhaps impoffible, but the increafe of them may be checked by early attention: while, however, they are left to be mown with the grafs, or to remain undifturbed in the highways during the fummer, the feeds will be difperfed by the wind in various directions over the country: until a method be therefore adopted to correct the evil in its infancy, the labour beftowed by good farmers for the extirpation of this weed will not, it is faid, produce a complete effect, although it will prevent the plant from being carried to the mow in a ftate of equal maturity with the hay, and its feeds afterwards from being difperfed with the dung in the fields. Was every farmer to do the fame, the encouragement to perfevere in the practice would be powerful; but that it is not probable, that a farmer will expend much in doing what the negligence of a neighbour will render ineffectual. Some of thefe thiftle-weeds are annual, others biennial and perennial; confequently, where the diftinction is not known, the fafe method is, it is faid, to cut the root with a paddle, deep in the ground, or to draw up the root; and that this fhould be done for the firft time in the fpring, and again on the lattermath in autumn. See CARDUUS *Lanceolatus*, &c. Alfo THISTLE.

Cudweed, or chafeweed, is a weed faid not to be uncommon in paftures from arable land. It has been feen abundantly in an upland pafture after barley, where the clover had failed of fuccefs; cattle refufe it, but it has been fuppofed to be fuccefsful in the bloody flux of cattle and of the human fpecies: it feldom appears much in a grafs-crop, or efpecially when the artificial graffes fucceed well. See GNAPHALIUM *Germanicum*.

Ox-eye, white marigold, or great daify, is a weed common in fome paftures, and not grateful, but which feldom abounds fo as to be much injurious to the grafs, and which is eafily drawn out by the hand or other fuch means. See CHRYSANTHEMUM *Leucanthemum*.

Black

Black knap-weed is a common and abundant weed in ſome moiſt and cold meadows and paſtures, where it is a very bad plant, being coarſe, hard, and ſtubborn, ſeldom touched by cattle, either in the green or dry ſtate, and not extirpated from the ground without much difficulty: it is a perennial weed, which increaſes much by the root, according to the Flora Ruſtica. It is ſuppoſed that it might probably be much weakened and reduced, and be extirpated by degrees by drawing up after rain. It is ſtated too, that in Glouceſterſhire the common black knap or knob-weed, provincially hard heads, is a vile and worthleſs weed, which cattle of no kind will touch, in any ſtate; and yet it is ſuffered, on ſome paſtures, to grow and increaſe to ſuch a degree, as to exclude the appearance of almoſt every other plant, and, though uſeleſs, is mowed with the other herbage, and preſerved for winter fodder. That it is a weed which indicates poor land, though probably, by the uſe of ſoaper's aſhes, it might be conquered, otherwiſe the ground ſhould be ploughed up and converted to a better purpoſe. The writer of this article lately ſaw it wholly covering a poor paſture field in the north of Lancaſhire, to the excluſion of all uſeful graſſes. See CENTAUREA *Nigra*.

Sedge-graſſes, various ſorts, are weeds that are moſt common in cold, old, ſour, moiſt clayey lands of the meadow and paſture kind, undrained and unimproved; in which they are ſaid, in ſome places, to occupy the whole ſurface: they are extremely hardy, and flouriſh where ſcarcely any thing elſe will grow: ſeem produced by nature from this principle in her economy, that a bad plant is better than none, for theſe plants are not eaten by any ſort of cattle which can get any thing better; yet, upon getting quit of the ſuperfluous moiſture or wetneſs, and top-dreſſing the land, it will commonly give way to a finer and more valuable herbage. See CAREX.

They have provincially the titles of hard-graſs, iron-graſs, and carnation-graſs, ſometimes applied to them.

Common nettle is a weed ſometimes growing in tufts on paſture-land, where it ſhould always be rooted up, as it will prevent the growth of good herbage, and render the graſs rank near it: aſſes are ſaid to be fond of it, and cows eat it in the ſtate of hay. See URTICA *Dioica*.

Moſſes, various ſorts, are weeds that are ſometimes ſaid to ſpread on paſture and other graſs lands, and, it is believed, indicate that the herbage is ſtarving and torpid, and ſtands in need of a ſtimulus to quicken its growth: proper top-dreſſing ſhould be uſed, and the wetneſs be removed, if neceſſary. Treading by ſheep, and ſcratching the ſurface by means of fine-teethed implements, have likewiſe been found of great utility. See MUSCI, and MOSS.

Such plants as the above muſt be conſidered as proper and neceſſary to be extirpated from graſs-lands of moſt kinds; but there are various others which are of leſs importance, and the characters of which are more doubtful, and their uſes not ſo well determined and decided upon.

Of this latter ſort or claſs, the following may be noticed as being moſtly improper in ſuch ſituations.

Crowfoots, butter-flower, butter-cup, king-cup, or gold-cup, are plants almoſt every where found in meadow and paſture lands. The pile-wort is common in ſome places, and the bulbous-rooted ſort, it is obſerved, has knotty roots, riſes little above the ground, bloſſoms early in the ſpring, and is chiefly found in meadows that are rather moiſt, being eaten only by ſheep. The other ſorts are common in the meadows and paſtures everywhere, being very abundant in the hay-grounds near the metropolis. Their good qualities in ſuch lands have been much queſtioned and diſputed by many; but the writer of the paper already noticed is inclined to think favourably of them, eſpecially as promoting the digeſtion of the live-ſtock that feed in ſuch paſtures; and as not having been diſcovered to be injurious in ſuch ſituations by farmers in their long experience. The writer of the Glouceſter report, however, ſtates, that the ſeveral ſorts of crowfoot, provincially termed crazys, which in the ſpring throw a yellow veil over the meadows, are to be reckoned among the uſeleſs weeds, having little to recommend them to notice but their gaudy appearance. That the three latter ſorts are acrid and biting to the taſte, and are therefore rejected by cattle nearly alike. It is indeed ſaid, that the creeping crazy is more mild and palatable to ſome cattle, though it is to be ſuſpected that cattle eat it rather from neceſſity than liking; as from its ſpreading along the ſurface, it becomes ſo matted with the herbage, that it muſt be taken up, in ſome degree, with it. The ſtalks of the two others are left ſtanding when the ground is quite bare about them; yet, when made with the hay, they are ſaid to loſe the pungent quality; and the brightneſs of the bloſſom in the rick, is always a ſign of the whole having been well harveſted.

All the ſorts of this tribe of plants, though pleaſant to the eye in meadows and paſtures, in conſequence of their diſplay of yellow flowers, are, it is ſaid in the Berkſhire report, injurious to the herbage, and little reliſhed by animals of any kind. Although difficult to be eradicated, ſome of the larger ſorts of them may be reduced greatly by proper care and attention. See RANUNCULUS *Ficaria*, *Bulboſus*, *Repens*, and *Acris*.

Wild mint is a plant found in moiſt paſtures, and which prevents the coagulation of milk; ſo that when cows have eaten it, as they are apt to do largely at the end of ſummer when the paſtures get bare, their milk can hardly be made to yield cheeſe; a circumſtance which occaſionally puzzles the dairy-maids. It is a plant that ſhould be removed from paſtures, and which, it is ſuppoſed, may be weakened by effectually removing the wetneſs of the land. See MENTHA *Arvenſis*.

Marſh marigold is a plant that occupies much ſpace, and which is dangerous to cows. It ſhould conſequently be removed from paſtures and other graſs-lands. See CALTHA *Paluſtris*.

Water hemlock is a plant ſuppoſed poiſonous to horſes, and ſhould therefore be eradicated from paſture-lands. See THELLANDRIUM *Aquaticum*.

Water cowbane, meadow-ſaffron, and treacle-muſtard, are plants in paſture and graſs lands, that are ſaid to communicate an unpleaſant odour to the milk of cows, and to be ſometimes fatal to them. When abundant they ought to be removed from ſuch lands. See CICUTA *Viroſa*, COLCHICUM *Autumnale*, and THLASPI *Arvenſis*.

Mouſe-ear ſcorpion-graſs is a plant that often proves fatal to ſheep, it is ſaid, and ſhould of courſe be extirpated from ſheep-walks. See MYOSOTIS *Scorpoides*.

Rag-wort is a plant in graſs-land which cows and horſes refuſe, and which ſheep will only eat when very young: it is a plant that is ſtated, in the Cheſhire Report on Agriculture, to be regarded as worſe than uſeleſs both in meadows and paſtures. That it frequents rich ſoils only; and that the farmer there often exhibits the keddle-dock, as it is provincially termed, as a proof of the goodneſs of his land. That while his vanity is flattered by its preſence, he not only neglects to extirpate it, but frequently ſuffers it to ſpread over one of his beſt pieces of land, to the injury of himſelf and the annoyance of his neighbour. It is ſaid that by mowing it is prevented from propagating its ſeeds; but that the roots are not deſtroyed. That this is beſt effected

either

either by eating it down while young with ſheep, or pulling it up by the hand. This laſt ſhould be done when the ground is moiſt, in order that no conſiderable fibres may be loſt or left in the land, as if there are the roots will ſtrike again. See SENECIO *Jacobæa.*

Meadow ſorrel is a plant common in meadows, and eſpecially where the ſoil is ſtrong and rather wet: it is a coarſe plant that is injurious by its ſhade, and ſeeds in good graſs-lands. See RUMEX *Acetoſa.*

Wood or *meadow anemone* is a plant common in meadows, though diſregarded by farmers; the whole plant is ſaid to be acrid. Withering aſſerts, that when ſheep that are unaccuſtomed to it eat it, it brings on a bloody-flux. See ANEMONE *Nemoroſa.*

Eye-bright is a plant common in paſtures, and refuſed by cattle in general; conſequently occupying the place of a better plant. See EUPHRASIA *Officinalis* and *Odontitis.*

Dandelion is a diſagreeable plant, though common in graſs-lands in moſt diſtricts: it is ſaid to be conſiderably diuretic, and on that account may probably have a good effect on cattle at firſt going to graſs: it is coarſe, but good in hay with graſſes. See LEONTODON *Taraxacum.*

Yarrow, and ſneeze-wort, are plants common in paſtures, but indifferent to cattle-ſtock. The former has been recommended for poor land. The common yarrow has been found plentifully intermixed with the herbage in the vale part of the county of Glouceſter, where much fed with horſes. Some have, it is ſaid, ſuppoſed, that cattle are not averſe to it; but it has been obſerved, that this weed has remained uneaten until every blade of graſs has been cropped cloſe to the ground, and therefore that it ſhould be extirpated by the ſpade or ſome other means, ſuch as the three-pronged fork, at the expence of manual labour. See ACHILLEA *Millefolium* and *Ptarmica.*

Orchiſes of ſeveral ſorts are plants that are common in moſt meadows, having broad, entire, ſpotted leaves in general, and large bunches of pale or purple flowers. They generally remain untouched by moſt, or all ſorts of cattle-ſtock. See ORCHIS *Maculata*, *Biſolia*, &c.

Plants of this ſort have hitherto been much too little examined and inquired into, in ſo far as relates to their utility and importance, or the contrary, for the uſes of the farmer, to afford any thing ſatisfactory on the ſubject; but that a great many ſuch plants ſhould be rooted out of graſs-lands of different kinds there can be no ſort of doubt. This would render the meadows and paſtures much better for the purpoſes of hay, and the paſturing and feeding of live-ſtock of every ſort, and be greatly beneficial to the farmer in many ways.

Weeds injurious in waſte and uninclofed Lands.—It is ſtated by the writer of the paper on weeds, that thoſe conſidered as particularly hurtful to ſuch land, are not very numerous; for though many ſorts of plants, uſeleſs as the food of domeſtic animals, grow there, yet, as there is no poſſibility of introducing any thing better until ſuch lands are appropriated and improved by cultivation, they can hardly be conceived as noxious, ſo long as nothing better can be put in their ſtead. That, as ſuch lands in their preſent condition are uſeful only as ſheep-walks, or for producing fuel, the bettering of them, in the former reſpect, is an object deſerving of attention, particularly as ſuch amelioration would render them of greater value in caſe of incloſure, and would much ſhorten the buſineſs of bringing them into the ſtate of improvement. See WASTE *Land.*

The weeds that encumber ſuch lands, and reduce their value as ſheep-walks, are conſidered as of two kinds; the common upland rubbiſh, and the bog produce of plants: the former ſmothers the land, ſo as to prevent the growth of better herbage; and the latter are generally hurtful to animals that feed on them, either from their own nature, or becauſe the land on which they grow is uncomfortable for and unwholeſome to the health of them, eſpecially to ſheep.

Upland weeds are all thoſe that riſe in high barren ſituations, and which chiefly conſiſt of heaths of different ſorts; furze or gorſe, the petty whin, or hen-gorſe, and broom, but which is more commonly met with in neglected dry lands of the arable kind: theſe ſhould all, it is ſaid, where the ground is of tolerable ſtaple, or depth of mould, be burnt off, or grubbed up, early in the ſpring; and if the land be afterwards ſown with graſs-ſeeds of the hay kind in moiſt weather, it will much improve the herbage: the fern ſhould alſo be mown, and carried off in the ſummer, the value of it as litter being well worth the labour and trouble. See ERICA, ULEX *Curopæus*, GENISTA *Anglica*, SPARTIUM *Scoparium*, and PTERIS *Aquilina.*

Bog weeds are thoſe that ariſe in ſwampy places, and are cauſed by ſtagnant moiſture or wetneſs, being principally cotton graſſes, matt-graſs, ruſhes of ſeveral ſorts, red-rattle or louſe-wort, marſh, St. Peter's-wort, kingſpear, which laſt two are of but little conſequence in themſelves: they, however, indicate boggy land; and in their company are often found purple-flowered money-wort, ſedge graſſes of ſeveral ſorts, &c.: all which would give way to better herbage, upon the ſtagnant wetneſs of ſuch bogs being removed, which ſhould, it is ſaid, be done by a rate, levied on the inhabitants of the neighbourhood, having right of common upon ſuch waſtes. See ERIOPHORUM *Polyſtachion* and *Vaginatum*, NARDUS *Stricta*, JUNCUS, PEDICULARIS *Sylvatica*, HYPERICUM *Clodes*, NARTHECIUM *Oſſifragum*, ANAGALLIS *Tenetla*, and CAREX.

The diſeaſe, termed the rot, in ſheep, which ſo commonly ariſes in theſe ſituations, has been often attributed by ſtock-farmers and others to the ſun-dew, marſh penny-wort, and common butter-wort, weeds found in ſuch lands; but it is more probably cauſed by the flat inſect known by the name of flake, *faſciola hepatica*, which is not unfrequently met with in ſuch watery grounds, ſticking to different parts of the plants, and which has been diſcovered in the diſeaſed livers and bile ducts of ſheep thus affected. See DROSERA *Anglica*, HYDROCOTYLE *Inundata*, *&c.*

The writer juſt noticed ſuggeſts, that if the country ſhould not yet be ripe or ready for incloſing all the commons and waſte lands, the improvement of their ſtaple by meaſures of this kind, by deſtroying weeds and introducing better herbage, by removing the wetneſs of the bogs, and deſtroying the aquatic weeds growing thereon, would better their preſent ſtate, and improve their value to the public, would render them capable of maintaining a greater number of better ſheep, and preſerve the ſtock in better health, as well as render the land more ſuſceptible of a rapid and eaſy improvement by cultivation, whenever the time may arrive for their incloſure, and for ſuch full amendment of their condition.

Weeds injurious in Hedges and other ſuch Fences.—It is remarked in the paper on weeds and weeding, that all kinds of them are hurtful to young hedges, which conſtantly require to be well cleaned and freed from them for three or more years after planting, as otherwiſe the young quick or other plants would be choked and deſtroyed; and that there are alſo ſome kinds of weed-plants which very much injure old full-grown hedge-fences. That many kinds of weeds growing in hedges are a great nuiſance if the ſeeds be ſuffered to ripen, becauſe ſuch ſeeds are liable to be carried into cultivated

cultivated land by the wind; that there are fome kinds of hedge-weeds, too, which bear the character of being injurious to live-ftock; thefe, if the obfervation be well founded, ought, it is faid, to be well cleared from the hedges that fuch ftock frequent; and that, laftly, the improper fpecies of the vegetable kingdom, compofing or growing in hedges, may be termed hedge-weeds, becaufe they prevent the main object and end of fuch hedges, that of dividing, fencing out, and defending the land in a proper manner.

The moft hurtful weeds and plants of this fort are,

Catch-weed, or cleavers, a weed that has a tendency to choke and injure young hedges, by means of its numerous creeping and twining rough branches: it fhould, of courfe, be well cleaned out in due time, before it fpreads itfelf much in the bottom of the fence. See GALIUM *Aparine*.

Great bind-weed is a plant of this fort that is injurious in fome hedges, by twining round the growing quick or other plants, and reftricting their growth: its roots fhould confequently be extirpated from fuch fituations, which may probably be worth collecting for medicinal ufes, as the infpiffated juice of them compofe fcammony, a powerful purgative remedy. It is eaten greedily, too, by hogs without injury. See CONVOLVULUS *Sepium*.

Great wild climber is a weed-plant common in hedges, and which, in the chalk counties, is faid provincially to be called old man's beard, from the hoary appearance of the plant after flowering, the feeds being furnifhed with numerous grey hoary tails. It is very injurious to hedge-fences, as the leaf-ftalks twine about any thing they can lay hold of, and thus fupport the plant, which is large, luxuriant, and heavy, without any ftrength to fupport itfelf, and by its weight hauling down, obftructing the proper growth, and deforming the fences of this kind. Withering remarks, that the fine hairs that give the cottony appearance are, he apprehends, too fhort to be employed in manufacture, though, it is probable, they may be ufed to advantage for the ftuffing of chairs. See CLEMATIS *Vitalba*.

Wild hop, ladies' feal, or black bryony, and wild vine or bryony, are all weed-plants common in hedges, where they are fuppofed to be fomewhat injurious to the hedge-fences. They do mifchief in thefe fituations, by crowding and fmothering up the hedge-plants, and preventing their healthy and vigorous growth, as well as by taking away the proper nourifhment from their roots. See HUMULUS *Cupulus*, TAMUS *Communis*, and BRYONIA *Dioica*.

There are other fpreading, twining, and climbing weed-plants, which are occafionally very injurious and troublefome in hedges; fuch as the common ivy, which fpreads and creeps on the banks, and runs up and winds round the ftems of the plants, greatly injuring and impeding their growth and ftrength; the honey-fuckle, which binds itfelf clofely about the ftalks and branches of the hedge-woods, doing them much injury in different ways; and the briar, which extends its rampant fhoots in various directions, to the great annoyance and mifchief of the hedge-plants in many cafes. All thefe fhould be eradicated and cleared out from hedges in moft cafes, as they conftantly tend to weaken and render them in bad condition. See HEDERA *Helix*, LONICERA *Periclymenum*, and ROSA *Canina*.

Sow-thiftles, large rough thiftles, knap-weeds, and ragwort, are weeds that have been already noticed, and are great nuifances in hedges, if their feeds be fuffered to ripen in fuch fituations. The common nettle, too, is fometimes found in hedges to their great injury. They fhould all, therefore, be extirpated and cleared out from hedges in their early growth, to prevent future increafe.

In addition to thefe, the writer of the above paper has given the following, the feeds of which are furnifhed with feathers too, and they are capable of being carried to a great diftance.

Yellow devil's bit, wild lettuce, yellow hawk-weed, bufhy hawk-weed, and fmooth hawk's-beard, are weeds often troublefome in hedges, and which fhould be kept well weeded out at an early period. See LEONTODON *Autumnale*, LACTUCA *Virofa*, HIERACIUM *Murorum et Umbellatum*, and CREPIS *Tectorum*.

Burdock is a well-known plant of the weed kind, that fhould not be fuffered to perfect its feed in hedges, as it is of very luxuriant growth, and of courfe very injurious and difagreeable in fuch fituations. Withering afferts, that before the flowers appear, the ftems, ftripped of their rind, may be boiled and eat as afparagus; and that when raw, they are good with oil and vinegar. See ARCTIUM *Lappa*.

Dog's mercury is a weed faid to be noxious to fheep, and which is very common and abundant in fome hedges, appearing very early in the fpring, when fheep-food is the moft fcarce; on which account it is thought ftill more dangerous, if it be fo at all. When in very large quantity it may be hurtful to hedges, and fhould be kept under. See MERCURIALIS *Perennis*.

Barberry is a frequent plant in fome hedges; if found to really poffefs a blighting quality, it fhould be removed from the hedges of corn-fields. See BERBERRIS *Vulgaris*.

It is advifed by the author of the above paper, that thefe, as well as other plants of a fimilar nature, together with all luxuriant weeds and fhoots of the bramble kind, and whatever elfe grows beyond the bounds of the hedge-fence, fhould be brufhed out of fuch hedges about the middle of the fummer, as is very often done in fome counties, as Staffordfhire, for the fake of their afhes, which are worth all the labour and expence incurred in burning them, &c.

Weeds injurious in Woods and Plantations of different Kinds.—The weed-plants which are neceffary to be confidered under this head, are not very numerous: thofe which are given below are the chief of fuch as are peculiar to or commonly found in fituations of this nature, where no art has been ufed. They are the moft common herbs and plants which are fpontaneoufly produced in woods and plantations without attending to the timber and underwood forts; but many other kinds are to be met with, which are lefs common, and which have been lefs noticed and confidered.

Enchanters' night-fhade is a weed found in the woods of Bedfordfhire, and fome other counties, and by no means uncommon. See CIRCÆ *Lutetiana*.

Wood-reed is a weed met with in many woods. See ARUNDO *Arenaria*.

Woodroffe is a weed common in many woods about Enfield, in Staffordfhire, and Berkfhire. Sometimes very plentiful. See ASPERULA *Odorata*.

Wild angelica is a weed common both in woods and hedges, in many places. See ANGELICA *Sylveftris*.

Solomon's feal, or wood lily, is a weed found in woods in many different parts of the kingdom. See CONVALLARIA.

Englifh hyacinth, or hare-bell, and willow herbs, are weeds in fome woods. See HYACINTHUS *non Scriptus*, and EPILOBIUM.

Bilberry is a weed met with in moift woods in many parts of the country. See VACCINIUM *Myrtillus*.

Wintergreen is a weed-plant met with in the moor-land woods

woods in Staffordſhire, and ſome other counties. See PYROLA.

Wood-ſorrel is a weed very common in woods. See OXALIS *Acetoſella.*

Wood-ſpurge is a weed frequently met in woods, ſituated in a clayey ſoil. Plentifully in Needwood-foreſt, in Staffordſhire. See EUPHORBIA *Amygdaloides.*

Raſpberry, dewberry, and common bramble, are weeds common in moſt woods, in ſome of the ſorts. See RUBUS.

Wild Strawberry is a weed common in ſome woods. See FRAGARIA *Veſca.*

Tormentill is very common as a weed in ſome woods. See TORMENTILLA *Reptans.*

Herb bennet, and wood anemone, are common weeds in ſuch ſituations. See GEUM *Urbanum*, and ANEMONE *Nemoroſa.*

Wood crowfoot is a common weed in woods on a clayey ſoil. See RANUNCULUS *Auricomus.*

Stinking Hellebore is a weed in woods, in many parts of the kingdom. See HELLEBORUS *Fœtidus.*

Wood ſage, betony, hedge-nettle, and baſtard baum, are weeds of the common wood kind. See TEUCRIUM *Scorodonia*, BETONICA *Officinalis*, STACHYS *Sylvatica*, and MELITTIS *Meliſſophyllum.*

Cow-graſs, or cow-wheat, is very common in many woods, and ſaid to be an excellent cow-herbage; but little found in paſtures, in any ſituation. See MELAMPYRUM *Pratenſe.*

Fig-wort, and coral-wort, are weeds in ſome woods. See CROPHULARIA *Nodoſa*, and DENTARIA *Bulbifera.*

Pea-everlaſting is a luxuriant weed-plant, that has been ſeen with the ſtem five or ſix feet long, in a wood in Rutlandſhire. See LATHYRUS *Sylveſtris.*

Wood-vetch, wood-peaſling, St. John's wort, ſhrubby hawk-weed, ſow-wort, hoary groundſel, golden-rod, butterfly-orchis, friary-blade, ſedge-graſſes, and ſpurge-olive, or ſpurge-laurel, are all plants of the weed kind in woods in different places. See VICIA *Sylvatica*, OROBUS *Sylvatica*, HYPERICUM *Perforatum*, HIERACIUM *Sabaudum*, SERRATULA *Tinctoria*, SENECIO *Crucifolius*, SOLIDAGO *Virgaurea*, ORCHIS *Bifolia*, OPHRYIS *Ovata*, CAREX and DAPHNE *Mezereum* and *Laureola.*

It has been remarked, that as no ſort of cattle can be properly introduced into theſe ſituations, in the early growth of the woods, there appears no particular room for the choice of the under herbage; but all large coarſe growing weeds of theſe and other kinds, ſhould be removed or kept well under, and that briars and brambles, if they appear, ſhould on ſeveral accounts be grubbed up and deſtroyed. Ivy, too, as claſping, confining, fretting, and injuring the plants on which it riſes, ſhould be early cleared away to prevent the miſchief of its after removal.

It is hardly neceſſary to obſerve, as it muſt be evident, that this account is far from comprehending all the plants which have been conſidered as weeds by writers, and thoſe engaged in the cultivation of land; as ſuch as are known to be prejudicial or hurtful, in ſome way or other, to ſome ſorts of cultivation or other, have, for the moſt part, been only introduced.

Thoſe who may wiſh for further information on the ſubject, may conſult the paper on weeds, by Mr. Pitt, inſerted in the fifth volume of "Communications to the Board of Agriculture;" and alſo the new edition of Miller's Dictionary, by Martyn, in which a very large catalogue of weed-plants is given; as well as many of the Corrected Reports on the Agriculture of different Counties.

It is remarked by the writer of the above paper, that the plants we term weeds, conſidered as reſpecting mankind, are not totally uſeleſs; many of them have valuable medicinal, and, perhaps, other qualities and properties, and ſome of them may be applied to uſes ſo as to pay ſomething towards the expence of clearing them from the ground: thus, ſow-thiſtles are good for rabbits or hogs, the hog-weed is uſeful for either pigs or cattle: horſes are ſaid to be fond of young thiſtles when partially dried, and the ſeed may be prevented from ſpreading by gathering the down, which makes good pillows; however, there is ſome danger in truſting them to this ſtage of growth, as a high wind would and frequently does diſperſe them over a whole country, as has been ſeen already. Chadlock, when drawn, may be given to cows, who are very fond of it; and it is ſaid in the Oxford Report on Agriculture, that it can be converted into good hay. Further, that nettles, fern, and the more bulky hedge-weeds, may be collected and annually burnt, as has been ſeen above; their aſhes being afterwards formed into balls, which are of conſiderable value, as being uſed in compoſing a ley for ſcouring and cleaning linen and other cloths.

It is ſtated, too, that pigeons are of uſe in picking up the ſeeds of many weeds that would otherwiſe vegetate; and the writer has no doubt but that a prodigious quantity of the ſeeds of weeds are eaten by different ſorts of ſmall birds, particularly of thoſe of moſt of the lake-weeds, of ſpurry, and in ſevere weather, of the different ſorts of chadlocks, as well as of many other kinds. But that it has been obſerved, that bees have not thriven or done ſo well in this country ſince the extirpation of weeds has been more attended to, and become more general.

It is noticed, that in Japan, and in China, not a weed, it is ſaid, is to be ſeen; and that they make uſe of night-ſoil only as a manure, partly with the view of preventing any riſk of weeds being produced in that way.

In concluding, it may be noticed, too, that the ſame writer has remarked, that the vegetables we term weeds are more hardy and tenacious of growth than any others; nor can it indeed be otherwiſe than that thoſe plants, which ſucceed in ſpite of oppoſition, muſt be of the moſt hardy kind. But that the production or growth of weeds is equally conſiſtent with the divine goodneſs with that of the moſt valuable plant, for myriads of diminutive creatures, enjoying life and animation, are fed and ſupported by them, and to whom they are a more natural prey than the dietetic plants of mankind: and that man, poſſeſſed of reaſon, reflection, and intelligence, has powers and abilities to ſelect and cultivate ſuch vegetables as are adapted to his uſe, and proper for his ſuſtenance, and to deſtroy and extirpate others; and thus to appropriate to himſelf what proportion he may think proper of the earth's ſurface; which if he ſhould neglect to dreſs and cultivate properly, it will, in ſome degree, revert to its natural ſtate, producing the hardier and more coarſe and acrid plants for the ſuſtenance of numberleſs tribes of inſects and other little animals, and for an infinity of other known and unknown uſes and purpoſes; and that indeed were it otherwiſe, the indolence of the human race might, in ſome meaſure, ſuſpend the bounty of providence, and the fertile parts of the ſurface of the earth, inſtead of being covered with an univerſal verdure, would, by inexer ton or neglect, be rendered little different to the ſterile and barren deſert.

WEED, *Dyer's*. See DYER'*s Weed*, *Baſtard* ROCKET, and WELD.

WEED, *Fuller's*. See TEAZEL.

WEED-*Hook*, in *Agriculture*, a very uſeful implement for cutting up thiſtles, and other ſtrong plants of the ſame nature;

ture; but as thiftles, when cut either at an early period of the feafon, or before much rain falls, are apt to fpring up afresh, and produce four or five ftems in place of one; they fhould, perhaps in every inftance, be pulled up by the roots, or, if they be cut, the operation fhould be done with a chifel within the ground, which is formed with a divifion in the mouth of it, fo as to feize the ftem part of the plant, and cut it deep down. See WEEDING *Dock-Spit*.

WEED, *Sea*. See FUCUS.

WEED, *Silver*. See CINQUEFOIL.

WEEDA, in *Geography*, a town on the E. coaft of the ifle of Gilolo. N. lat. 0° 15′. E. long. 127° 45′.

WEEDEL, a town of the duchy of Holftein; 7 miles S.S.W. of Pinneburg.

WEEDING, in *Agriculture* and *Gardening*, the operation of freeing crops of any kind from noxious weeds. On the indifpenfible neceffity, and great utility of this practice, it is altogether needlefs to enlarge. See WEED.

There are obvioufly two different methods to be principally employed in the removal and deftruction of weeds; one of which occurs in the preparation of the land, and the other during the growth of the crop. In the former method it is neceffary that fuch weeds as are of the root kind fhould be diftinguifhed from thofe of the feedling defcription, as the deftruction and removal of them muft be effected in different ways, and upon different principles.

Weeding in garden-grounds is always a bufinefs that fhould be regularly and well performed in both the circumftances above-mentioned. Much may be frequently done in the former cafe by properly ridging or laying up the ground before the fevere winter-feafon fets in, and in reducing and breaking it down in the early fpring or other time, for levelling it, and making it ready for putting in the neceffary crop, as the root as well as the feedling weeds may be greatly extirpated and deftroyed in thefe different operations; the former affording the ready means of taking out the firft fort, and the latter by putting them in the fprouting ftate, giving the opportunity of deftroying the other. In the latter cafe, a great deal will be effected by the fteady and repeated application of the hoe while the crops are upon the ground; and by good and careful hand-weeding, before the weeds have had time to ripen and fhed their feeds.

It has been remarked with great truth, in regard to the extirpation and prevention of garden-weeds, that many will almoft conftantly appear, from the feeds being brought by the wind; as well as by being introduced by ufing raw dung, particularly of hogs and horfes, which often contains feeds poffeffing their vegetative power, and the litter intermixed therewith not unfrequently containing more; which ftrongly fhew that raw dung is very improper for gardens, though often ufed, particularly for early and other potatoe-crops, as it caufes much trouble and expence in weeding.

Much labour in weeding muft neceffarily be faved, too, by drawing up all feedling weeds in time, as they appear, and before they have fown their feeds.

The extirpation and removal of weeds from garden-grounds are fomewhat differently effected in various places: in fome they principally ufe the fpade, and the three-pronged or fanged fork, for cleaning out root-weeds; but the different kinds of hoes are employed for other purpofes, of which the common ones are moftly made ufe of for fcuffling over the furface, and thofe of the triangular and parallelogramic form, for cutting up weeds, moulding up and clearing growing plants, and loofening the furface of the ground for promoting the fprouting of any feeds that may be prefent, and other fuch ufes. With thefe the fcuffle or fcuffler is fometimes had recourfe to for cutting the weeds, and working the furface of the land over in large gardens. In the fmall planted broad-caft fown crops, the weeding can only be well accomplifhed by performing the work by the hand. See HOE, FORK, SPADE, SCUFFLE, &c.

In regard to deftroying and removing weeds in tillage-lands, it has been well obferved by Naifmith, in his "Elements of Agriculture," that when the ground is greatly overrun with weeds, a complete winter and fummer fallow will, for the moft part, be found unavoidable, in order to get entirely quit of them. Rib-fallowing, before the winter fets in, will, it is faid, prepare the foil for parting freely with the vivacious roots, the ploughing and harrowing requifite to tear them up when the fpring drought commences, will pulverife and reduce it, and provoke the dormant and inactive feeds to vegetate with the firft moifture; by repeated turnings, during the fummer, the greateft part may be made to vegetate, and be deftroyed as they rife; and the vivacious roots, which lie beyond the reach of the plough, by being long prevented from exercifing their vegetating powers, will be impared in vigour. When winter-wheat, or any crop which is to ftand through that feafon, is intended to be put in on fuch ground, it would be proper that the feed fhould be fown in drills, that by ftirring the intervals in the enfuing fummer, the tendency which moft foils have to condenfe or confolidate too much when greatly pulverifed or reduced in their parts, may be counteracted. If fpring-feed be intended, the laft ploughing fhould be given to the land before the winter's rain commences, and the field be accurately and fully furface or furrow-drained, and laid dry. The influence of the atmofphere during the winter will, by thefe means, communicate the happy medium of confiftence, on which fo much depends; and the foil, as foon as it gets dry in the early fpring, will be in the beft order for the reception of the feed at that time, and the weeds the moft fully and effectually deftroyed and removed.

But where ground has been under any tolerable management, drill culture will, it is faid, for the moft part, fuit all the purpofes of a clean fallow, or be the means of rendering the land wholly free of weeds. In repeatedly turning the intervals, moft of the annual weeds may be attacked in the group, and be expeditioufly deftroyed as often as they fpring up; and the roots of the perennial ones be turned up and expofed to the heat and drought, which, if not altogether extirpated, will have their progrefs checked and prevented. But the rows fhould alfo be hand-weeded, and the hand-hoe will not unfrequently be found an important implement in this work. Drill culture may thus be partially exercifed, in this intention, it is thought, every where with great advantage, adapting the application to any particular fituation or circumftances. For example, where alternate courfes of tillage and grafs crops are adopted, in a courfe of three years' tillage, the fecond might always be in the drill manner; or if there were manure to fpare, to keep a field in good condition in tillage-crops for four years, both the fecond and third might be in the drill method: the firft on account of the tough turf or fward; and the laft for the fake of fowing the land down with grafs-feeds would be more convenient in the broad-caft ftate: but the weeding in thefe cafes fhould not be neglected; the larger weeds efpecially; and all thofe which are moft prevalent, and moft productive of feed, fhould be taken out by hand labour, or fome fuch means, when they begin to flower. By fuch ftrict care and attention to weeding tillage-land and crops and ftocking the ground with proper perennial graffes when laid to reft, weeds would at length be fo much fubdued, it is fuppofed, as to be feldom injurious to the farmer.

The

The writer of the paper on weeding has ftated, that it is remarked by the author of the Effays on Rural Affairs, that there is only one mode of extirpating annual weeds, the feeds of which are indeftructible ; which is to put the ground into fuch a ftate as to induce them to fprout or germinate, and then to deftroy the young plants by harrowing them up, or ploughing them under. This, it is believed, is ftrictly true ; but the author of the paper juft noticed does not exactly agree with the writer of the effays in the procefs to be purfued for the purpofe ; the ground, in this intention, in his opinion, fhould be ploughed before winter, but not harrowed, it being better to lie rough through that feafon, fo as to have the greateft extent of furface poffible expofed to the action and mellowing effects and influence of frofts ; that, as foon as it becomes dry, in or about March, it fhould be crofs-ploughed and harrowed well down ; many of the feeds and roots will then vegetate, which fhould in due time be ploughed under, and the land harrowed again, and this fort of procefs be repeated as often as neceffary : this, it is faid, is the true ufe and manner of fummer-fallow in this view, which, to have its full and proper effect, fhould always, it is thought, be attended to early in the feafon, when the powers of vegetation are the greateft, and the heat of the fun is powerful ; as under fuch circumftances the greater number of weeds will be brought into a ftate of growth.

It is thought that the great defect in the management of fummer-fallows in the intention of deftroying weeds would feem to be the neglect of working them early in the feafon, by which omiffion the vigorous annual feedling-weeds are not brought into vegetation in due time ; as, after which, they will not grow until the fpring following, when they appear in fuch abundance among the wheat or other crop, as fometimes to choke it up : this is the reafon, it is faid, why the field poppy, the corn-crowfoot, the tare, and many other annual weeds, make fuch havoc among wheat, when by a proper and judicious early working of the fallow, they might have been brought to exhauft themfelves in the following fummer : this appears very clear from the effect, for if no wheat were fown, the feeds of thefe weed-plants would often fill the ground with a full crop ; but feeds can vegetate but once, confequently had this vegetation been brought on in the fallow, and the plants afterwards been ploughed under in due time, none could have appeared in the wheat-crop.

It is fuppofed, too, that the turnip-culture is peculiarly adapted to the deftruction of weeds, as for this fort of crop the ground muft of neceffity be in early and fine preparation, by which weeds of early growth are conveniently brought into vegetation, and deftroyed ; and thofe which remain in the living ftate in the foil may be exterminated by hoeing. It has been obferved by the writer, that wet weather is as neceffary as dry to give a fummer-fallow its whole effect ; for without a foaking of rain after the land is pretty well pulverifed, numbers of the feeds of weeds will not vegetate, but remain and grow amongft the crop ; the root-weeds are therefore to be deftroyed in dry weather, and the feedling ones after rain ; and though the land fhould, after a dry feafon, be apparently in excellent order for fowing, it will be better to wait the effect of rain, and even give time for the feedling weeds to vegetate, before the feed for the crop be actually fown.

It is, therefore, fuggefted, that the deftruction of root weeds, and thofe of the feedling kind, on corn-land, muft be effected upon different principles, and in different manners ; the former, by working them out of the foil in dry weather only ; the latter, by pulverifing and reducing the particles of the foil, fo as to induce the feed to germinate and fpring up fully after rain, and afterwards ploughing under the young plants : alfo that frequent ploughings and harrowings are neceffary, to expofe all the feedlings contained in the foil to the powers of vegetation. But it is conceived, that the ploughings and harrowings of fallow ground fhould not, however, immediately fucceed each other ; time fhould be given for the confolidation of the foil, which, after well harrowing, will undergo a flight fermentation, and fettle, as it were, into a mafs ; after which it will turn up mellow, and the deftruction of weeds will go on apace. It is thought, that the frequent ploughings, which have been recommended by fome, are not only unneceffary, but injurious. It has always been obferved, that one ploughing of a fallow too foon fucceeding another has no other effect, when ufed in this intention, than that of rooting about the clods, and preventing the general effect of confolidation and fermentation in the land. The fuffering of the weeds to fpread their leaves a little between the feveral ploughings of a fallow, for this purpofe, is not, it is fuppofed, injurious : care, however, muft be taken not to carry this notion too far, particularly in the cafe of fquitch or couch grafs, or fo as to fuffer any of the quick growing weeds to ripen their feeds, or the luxuriant ones to become too large for being buried with the plough. As thefe remarks are judicious, and perfectly practical, they deferve the particular attention and confideration of the farmer, wherever the weeding and proper cleaning of his ground is concerned.

It is ftated too, that in this view, if a fallow for turnips be crofs-ploughed and harrowed down in the month of March, it will generally lie very well to the beginning of May ; and that in general no fallow will want ploughing oftener, in fuch intention, than once in fix weeks, if fufficient harrowings be given between the ploughings. The particular time moft proper for thefe operations muft, however, be determined not by any general rule, but by local circumftances, experience, and obfervation.

In cafes where lands have not undergone proper improvement, or been under a bad ftate of management, weeds cannot be deftroyed without much labour and expence. (See Weed.) But where lands are already improved, and have been for fome length of time under a good fyftem of management, the bufinefs is in part performed, and the evil much leffened ; as in fuch cafes, as well as all others, every rotation or courfe of cropping fhould render the land cleaner and freer from weeds, which will certainly be the cafe, where there is a proper and correct attention beftowed on the bufinefs. The means which are neceffary to be ufed in this intention are commonly, it is faid, thefe : complete and well-managed fallows, as above, when fallows are neceffary or proper ; the ufe of manures, which are free from the feeds or quick roots of weeds ; the careful choice of fuch feed grain as is clean ; the practice of fhort tillages, or that of not taking too many crops in rotation ; the having recourfe to attentive weeding and a fpirited ufe of the hoe, in which view the drill hufbandry doubtlefsly, it is fuppofed, affords fuperior advantages to the broad-caft, in keeping land clean from weeds ; but that land muft be well cleaned before the drill hufbandry is applicable ; the plentiful ufe of the clean feeds of the beft graffes and trefoils at the end of the tillage, in each cafe ; the weeding of the land, when in or at grafs, fo as not to fuffer the feeds of any noxious or injurious plants to fpread themfelves ; and that when upon again breaking up the land, to purfue fuch a fyftem or plan of cropping as will not increafe or encourage weeds. But though much might be faid on each of thefe points, it is thought unneceffary, as the intelligent farmer will readily

adopt

adopt every neceſſary regulation and precaution from his own obſervation and experience. It will, therefore, only be needful to ſlightly touch upon the different particulars or objects. As the ſubject of fallows has been already conſidered and explained, it is unneceſſary to be further noticed in this place. In regard to fold-yard manure, it ſhould always, it is ſuppoſed, in this intention, undergo a fermentation before it is laid upon the land, ſufficient to prevent the future vegetation of any ſeeds that may be contained in it: but it ſhould likewiſe be kept as free as poſſible from the ſeeds of weeds; and perhaps it is beſt laid on graſs-land, applying only lime, or other manures certain of being clean, to fallows; or if dung not certainly clean from ſeeds be laid on fallows, it ſhould be applied on them early enough to give time to have the ſeeds to vegetate and ſpend themſelves before ſowing for the crop. It is ſaid, that every one knows the neceſſity of clean ſeed-corn to the producing of a clean crop, but ſometimes neglects to apply ſuch knowledge; and indeed clean ſeed-grain is not always to be procured. If weed-ſeeds be ſuſpected, they ſhould, as often as poſſible and practicable, be dreſſed out before ſowing the corn. The weeding of crops is generally imperfectly performed, and is likely to continue ſo, it is thought, in many places, on account of the difficulty of procuring hands enough for work which is only ſo temporary in its nature. Thiſtles are generally only cut off, but they ſhould always, it is ſaid, by drawn up by tongs, or other tools for the purpoſe, and the other ſorts of weeds by the hand. The hoe has yet been only of general uſe in turnip crops, nor is it likely to extend further, unleſs the drill huſbandry ſhould be more eſtabliſhed; nor even, in its preſent application, can proper hands enough be always, it is ſaid, procured at ſufficiently reaſonable rates. As much, however, ſhould conſtantly be done in all theſe ways as circumſtances will allow. In the laying down of land to graſs, the importance of clean graſs-feed is well underſtood; yet the ſeeds of docks are not unfrequently ſown with clover, and thoſe of other pernicious weed-plants with ray-graſs. In all caſes, the utmoſt attention ſhould be paid to the ſowing of clean ſeed of this ſmall kind. And in the weeding of graſs-land, docks and thiſtles are often mown, or only cut off, but they ſhould always be rooted up; for which purpoſe, docking irons formed upon ſufficiently good principles are moſtly had recourſe to. They are, it is ſuppoſed, every where well underſtood, conſiſting ſimply of a forked or clefted ſpike of iron, which is jogged within the cleft, and fixed to the end of a wooden lever: this being forced down by the hand or foot, ſo as to incloſe the root of a dock, or large thiſtle, will eaſily bring it up, particularly after rain; but mowing them off, being done with more expedition, is often practiſed; and they are ſometimes left undiſturbed, and ſuffered to ſcatter their ſeeds without any effort being made to prevent it, which is very injurious, and always to be avoided as much as poſſible. It is ſtated too, that upon breaking up a turf or ſward, it is underſtood in the writer's neighbourhood, that unleſs a wheat fallow or a turnip crop compoſe a part of the tillage, the land will be injured, and rendered fouler, and more addicted to produce weeds: this notion is, it is believed, a juſt one, though often deviated from in practice, for the ſake of preſent profit, and under the deluſive idea of cleaning the land again next tillage. It is, however, well aſcertained, that land well cleaned by former good management will beſt bear this deviation; for the fewer weeds it contains at breaking up, the leſs will be the increaſe of them during the tillage or after-culture of the ground.

The writer of the Elements of Agriculture noticed above has obſerved, that it is not enough to attend to weeding in the time of tillage-culture only: it is proper that graſs-fields and lands ſhould likewiſe be kept free of all noxious, hurtful, and unprofitable herbage. The negligence which may be ſeen in this reſpect, in many diſtricts and places, is, it is ſaid, ſhameful. Paſtures and other graſs-lands are ſometimes ſo cloſe covered with large weeds, that the paſturing animals have ſcarcely room to pick up a mouthful; and thus the vegetable food and other matters, which ſhould nouriſh good and wholeſome paſture and other graſs-land herbage, is conſumed by uſeleſs weeds. And ſpeaking of different coarſe and diſguſting weed-plants, ſuch as the dock, ragweed, bur, corn, and ſow-thiſtles, and ſome others, it is remarked, that the two laſt are of the ſort which extend their vivacious roots below the reach of the plough, when the land is in tillage. It is not, it is ſaid, uncommon with thoſe who affect to pay a little more attention than ordinary to their paſtures and graſs-lands, to cut down theſe plants in the flower. If this be done in a rainy time, or if ſuch rain falls ſoon after, the water deſcending into the freſh cut wound of the ſtem, debilitates the roots, and diſcourages the growth of the plants for a time, though they are ſeldom wholly deſtroyed by it; but that if ſuch critical rains do not occur, freſh leaves immediately ariſe to ſupport the roots, and the cutting over has very little or no effect. They ſhould conſequently be annually pulled up by the roots as ſoon as poſſible, after the flower begins to form and ſhew itſelf, taking advantage of the firſt ſhower which happens to fall, to ſoften the ground and make them draw up more freely. By purſuing this practice regularly and ſteadily for a number of years, the deep lying perennial roots are, it is ſaid, gradually weakened, and fall into decay. Nor is cutting down the ragweed of much avail. Some of the plants die, but many ſurvive, and branch out more copiouſly the enſuing year. But this plant not being deep-rooted, is eaſily pulled up when in flower, if the ground be ſoft at the time. The bur-thiſtle being a biennial plant, may be killed at any time by cutting it under the firſt leaves. The common dock is the moſt troubleſome plant in graſs-land, eſpecially in clayey ſoils, where it is always the moſt frequent. Every bit of its long tap-root left in the ground will continue to vegetate and grow, and at length form a new ſtem and plant. It ſhould, in all caſes, be fully turned out with the dock-iron, in the manner already noticed, as ſoon as the flowering-ſtem is formed; and as the plants of this kind riſe at two ſeaſons, the paſture or graſs fields ſhould be weeded twice in the ſummer, that no ſeeds may be allowed to ripen. The roots ſhould be fully expoſed to the heat and drought; for if they be in a moiſt place, they will continue to vegetate on the ſurface, as they lie and ſtrike out ſide-roots into the ground. All other ineſculent herbage on paſtures and other ſorts of graſs grounds, and all weeds bearing ſeeds by the ſides of roads, ditches, brooks, and other ſuch places, ſhould be cut down too, when they begin to flower, in order to prevent their increaſe by their ſeeds being diſperſed over the graſs fields and grounds.

The writer of the Glouceſterſhire Report on Agriculture, in reprobating the practice of confining the buſineſs of weeding almoſt ſolely to the tillage-lands, while the meadows and paſtures are almoſt wholly neglected, and overrun with docks, thiſtles, nettles, hemlock, and many other ſuch weed-plants, remarks, that it is ſuppoſed by the farmers, that the ſcythe will be early enough to cut them off: the ſeeds, however, are generally ripened and diſperſed before mowing time; and if not, they are carried with the hay to the ſtall, and mixed with the dung, or into the paſture

ture for fodder during the winter; in either of which cafes they cannot fail, it is fuppofed, of increafing greatly. Befides, the mere cutting off this kind of weeds rather improves than diminifhes their growth, by forcing them to throw out new fhoots from the roots, and that in greater abundance than before. Thus, a thiftle, which rifes at firft with a fingle ftem, if cut off above the furface of the ground, fpreads with feveral lateral branches, and covers a large fpace of ground. The moft likely method of deftroying them is to draw them up by the roots, as already feen, which may eafily be done when the ground is moift, and is done by thofe farmers there, it is faid, who are anxious for their credit, nice in their herbage, and proud of feeing their paftures rivalling the neatnefs of a lawn. The negligence, indeed, of a neighbour often operates as a difcouragement, and it is an evil not eafily to be prevented: it is, however, furprifing in another inftance, it is faid, to obferve an almoft unanimous encouragement given to the multiplication of noxious weeds. In the highways they are left to grow to maturity, and their feeds are difperfed in immenfe quantities in every direction, and all over the country, by the wind, or by being carried by birds. Under thefe circumftances, it is faid to be certainly of little ufe for one, or even all the occupiers of ground, to clear their lands of weeds, while this plentiful fource of them remains unmolefted. One fhould fuppofe, the writer obferves, that the evident mifchief refulting from this neglect would excite a general combination againft thefe deftructive enemies to the interefts of agriculture: that, however, not being the cafe, might it not, it is afked, be convenient to incorporate with the duty of the furveyors, or overlookers of the roads, the bufinefs of cutting up, and otherwife deftroying, fuch kinds of weeds within their diftricts or boundaries? Should the fact of the thoufand-fold increafe of fuch felf-fown feeds be doubted or difputed, let, it is faid, any one but obferve a patch on a common, from which the turf or fward has been pared, how completely it will be covered with thiftles in the following fummer; and the arable fields adjoining are not much better, where this negligence prevails.

And the writer of the paper on the fubject of weeding ftates, that there is another caufe of the increafe and propagation of weeds, which may be termed a *public* caufe, and which it is not in the power of any individual to prevent; but which a flovenly, neglectful, or ill-difpofed perfon may promote and increafe, and which can only be effectually prevented by a *political* regulation, and for which, it is believed, no provifion has yet been made in our political code: thus are the numbers of vigorous and luxuriant weeds which are fuffered to ripen their feeds in our hedges, paftures, woods, and other lands, and the feeds of which being provided with feathery matters, are difperfed over the whole territory of the kingdom, and propagate themfelves far and near, growing in whatever places they alight and fettle, and producing a moft abundant crop: the moft common and pernicious of which are fuppofed to be the different forts of fow-thiftles, fow-worts, common thiftles, colt's-foot, groundfels, knap-weeds, &c. For as the feeding and fcattering of the feeds of all thefe forts of plants is clearly a public nuifance, and as they are fubject to be carried to a great diftance by the above means, and to do harm to the lands of all occupiers indifcriminately, they fhould, it is thought, be under the controul of our political regulations. This would be the effectual means of preventing much labour and expence to the farmer and the occupier, in the weeding of different kinds of lands and crops, and at the fame time go a great way in rendering the territory of the country ultimately clear of a great proportion of its moft noxious and hurtful weeds. Befides, regulations of the above kind have been applied in different countries and places to weed-plants, which are much lefs injurious and hurtful than thefe. See WEED, and the above paper in the fifth volume of Communications to the Board of Agriculture.

In fome cafes and parts of the country, the weeds in the lefs heavy tillage-lands are deftroyed, by an entire and perfect fummer-fallow every third year, which is an effectual but expenfive method of proceeding; but on the ftrong loams and other heavy foils by good hoeing and hand-weeding the drilled or fet crops of beans, peas, and fome other kinds. On the fandy and other light loams, by well hoeing and weeding by hand the crops of peas, potatoes, turnips, and fome others. As foon as the peas or tares are off the land, the ground is ploughed and well harrowed, and the root-weeds picked or raked together, and burned or otherwife difpofed of, as noticed above; which is moftly repeated after the crofs-ploughing and harrowing have been performed. The ground being then in a great meafure free from root-weeds, the turnips are fown, and the feed-weeds that may arife deftroyed by twice or oftener hand-hoeing and weeding. This fort of practice being repeated or put in execution once in three or four years, is capable of keeping light land tolerably clean and free from weeds. However, in the cafe of a hot dry fummer, the labour and expence of raking, collecting, picking, and burning the weeds, may not unfrequently be faved, and the roots deftroyed, by only harrowing them to the furface after every ploughing; and by that means expofing them well to the heat of the fun for a fufficient length of time to kill them, which is fometimes effectually done in the courfe of a week. Care muft, however, always be taken that they are fully and completely deftroyed, otherwife much mifchief may be the confequence, as they are extremely tenacious of life.

In all cafes, where the ftaple or vegetable mould of the foil is of a fufficient depth to admit of trench-ploughing, that fort of ploughing, with the affiftance of heavy rolling, and other proper means, will in fome circumftances completely deftroy root-weeds. In fome cafes, it is even more effectual for that purpofe, it is faid, than any greater number of ploughings, and is an excellent method, where it can be accomplifhed without turning up a poor barren fubfoil. The great utility and importance of it in cleaning garden-grounds have been already feen, and it is fuppofed to be equally beneficial in deftroying weeds, and preferving the foil moift in the moft drying weather of the fummer feafon. See TRENCH-*Ploughing*, and TRENCHING. Alfo RIDGING-*up*.

The work of weeding in all cafes fhould be begun fufficiently early in the fpring, that the weeds may not be in too forward a ftate, and the bufinefs, in whatever way it is undertaken, be effectually and completely performed, without any fort of omiffion or neglect. In the meadows and pafture-lands it fhould be equally attended to as in the corn-fields, as in all fituations weeds are a very great drawback upon the farmer's profit, and of vaft inconvenience in many different ways.

It is prefumed by the writer of the paper on weeding, that if the above propofed regulations, precautions, and methods of deftroying injurious plants were generally adopted in practice, they would render the Britifh empire as free from weeds as thofe of China and Japan.

It may be concluded that, on the whole, by great, unremitted, and proper attention, with fome fuch regulations as the above, to the extermination and deftruction of all forts of ufelefs and hurtful weeds in cultivated grounds, and from meadows and paftures, the growth of injurious and worthlefs plants may be prevented, and the arable crops be rendered

dered much more abundant and productive than they uſually are, and thoſe of the graſs kind be provided with a better and more uſeful herbage for the ſupport of live-ſtock of all kinds, which would greatly contribute to the farmer's profit and advantage.

Weeding-*Chiſel*, in *Agriculture*, an uſeful tool with a divided chiſel point for cutting the roots of large weeds within the ground. See Weed-*Hook*.

Weeding *Dock-Spit*, the tool uſed in extirpating weeds of the dock, thiſtle, and other ſuch large kinds which are to be got up by the roots. It is a ſort of crow or lever, with a claw at the bottom end of it, a little curved forward, and divided into two ſide parts, in ſomewhat the manner of the thin end of a common hammer uſed for drawing nails: it has an arm or tread which projects at about eight or ten inches from the lower end, for the foot to reſt firmly upon in forcing it into the ground, and at a little diſtance above it, on the back ſide, a curve of iron, projecting about three inches; on the upper or top end, a handle is fixed, and faſtened as in the common ſpade: in uſing it the claw ſeizes the root of the plant, and, by a gentle preſſure of the handle end downwards, in the manner of the lever, eaſily and readily draws or forces it out of the ground: by means of this ſimple implement or contrivance, many hundreds of ſuch weed-plants may be eradicated or drawn out in the courſe of a day. It has ſometimes the names of weeding-ſpud or ſpade, and dock-ſpit or ſpud given it. See Weeding.

Weeding-*Forceps*, or *Tongs*, the tool of the nipper kind, which is made uſe of for taking up ſome ſorts of plants in weeding corn and other crops, ſuch as ſmall thiſtles of different kinds, ſmall docks, and various other ſuch weeds. It ſeizes them by the mouth part, which is fixed upon them by means of the long handles in uſing it, and readily forces them up. See Thistle-*Drawer*.

Weeding-*Fork*, a ſtrong three-pronged fork of the fork ſort employed for working root-weeds in tillage-lands, and forking out the weeds of the ſame kind in garden-grounds; in both which caſes it is a very uſeful and effective tool. It is ſometimes made with flat prongs, and termed a ſpud in plantation-grounds. See Fork.

Weeding-*Shim*, an implement which is conſtructed differently to ſuit different purpoſes, but that which is made with a frame ſomewhat like that of the common wheel-barrow, is conſidered the beſt in the county of Kent, where tools of this ſort are much uſed in the plantation-grounds for different crops. It is a very uſeful and convenient tool for the purpoſe of tearing up weeds on ſummer-fallows, and in many other caſes. Its cheapneſs too is a great recommendation of it, as it is capable of being well conſtructed for about two pounds. See Harrow, &c.

Weeding-*Spud*. See Weeding *Dock-Spit ſupra*.

WEEDS, in *Mining*, a term uſed by our Engliſh diggers to expreſs any ſort of unprofitable ſubſtance found among the ores of metals. They ſeem to have borrowed the phraſe from the gardeners; and as every thing with them is a weed, except what they have planted, and expect to gather, ſo every thing is a weed with the miners, except the thing they are ſinking for. See Digging.

The principal ſubſtances known in our mines under the name of weeds, are mundic or marcaſite; this is of three ſorts, white, yellow, and green; daze, a kind of glittering talcky ſtone, of the telaugium kind, which endures the fire, and is of various colours and hardneſſes; iron-moulds, or pyritæ; caul, which is browniſh and ſpongy; and gliſter, which is a ſort of talc. Phil. Tranſ. N° 69.

Weeds alſo denote a peculiar habit, worn by the relicts of perſons deceaſed, by way of mourning. See Mourning.

WEEK, *Septimana*, *hebdomada*, in *Chronology*, a diviſion of time, compriſing ſeven days.

The origin of this diviſion of weeks, or of computing time by ſevenths, is greatly controverted. Some will have it to take its riſe from the four quarters or intervals of the moon, between her changes of phaſes, which, being about ſeven days diſtant, gave occaſion to the diviſion. Be this as it will, the diviſion is certainly very ancient. The Syrians, Egyptians, and moſt of the oriental nations, appear to have uſed it from all antiquity: though it did not get footing in the Weſt till Chriſtianity brought it in: the Romans reckoned their days not by ſevenths, but by ninths; and the ancient Greeks by decads, or tenths.

Indeed, the Jews divided their time by weeks, but it was upon a different principle from the other eaſtern nations. God himſelf having appointed them to work ſix days, and to reſt the ſeventh, in order to keep up the ſenſe and remembrance of the creation; which, being effected in ſix days, he reſted the ſeventh.

Some authors will even have the uſe of weeks, among the other eaſtern nations, to have proceeded from the Jews; but with little appearance of probability. It is with better reaſon that others ſuppoſe the uſe of weeks, among the heathens of the Eaſt, to be a remain of the tradition of the creation, which they had ſtill retained with divers others.

This is the opinion of Grotius, De Veritat. Relig. Chriſt. lib. i., who likewiſe proves, that not only throughout the Eaſt, but even among the Greeks, Italians, Celtæ, Sclavi, and even the Romans themſelves, the days were divided into weeks; and that the ſeventh day was in extraordinary veneration. This appears from Joſeph. adv. Apion. II. Philo. de Creatione. Clem. Alexand. Strom. lib. v. Though Helmoldus, lib. i. cap. 84. Philoſtratus, lib. iii. cap. 13. Dion. lib. xxxviii. Tibullus, Lucian, Homer, Callimachus, Suetonius, Herodotus, &c. who mention the ſeptenary diviſion of days as very ancient, ſuppoſe it to have been derived from the Egyptians.

The *days of the week* were denominated by the Jews, from the order of their ſucceſſion from the ſabbath. Thus, the day next after the ſabbath, they called the *firſt* of the ſabbath; the next, the *ſecond* of the ſabbath; and ſo of the reſt; except the ſixth, which they call *paraſceve*, or preparation of the ſabbath.

The like method is ſtill kept up by the Chriſtian Arabs, Perſians, Ethiopians, &c. The ancient heathens denominated the days of the week from the ſeven planets; which names are ſtill generally retained among the Chriſtians of the Weſt. Thus the firſt day was called *Sun-day*, *dies ſolis*; the ſecond *Moon-day*, *dies lunæ*, &c. a practice the more natural on Dion's principle, who ſays, the Egyptians took the diviſion of the week itſelf from the ſeven planets.

In effect, the true reaſon of theſe denominations ſeems to be founded in aſtrology. For the aſtrologers diſtributing the government and direction of all the hours in the week among the ſeven planets, ♄ ♃ ♂ ☉ ♀ ☿ ☽, ſo as that the government of the firſt hour of the firſt day fell to Saturn, that of the ſecond day to Jupiter, &c. they gave each day the name of the planet, which, according to their doctrine, preſided over the firſt hour thereof; and that, according to the order ſpecified above; and which is included in the following technical verſe.

Poſt SIM SUM *ſequitur, pallida* Luna *ſubeſt.*

Wherein, the capital letters SIM SUM, and L, are the initial letters of the planets. So that the order of the planets

planets in the week, bears little relation to that in which they follow in the heavens: the former being founded on an imaginary power each planet has, in its turn, on the firſt hour of each day.

Dion. Caſſius gives another reaſon of the denomination, fetched from the celeſtial harmony. For it being obſerved that the harmony of the diateſſaron, which conſiſts in the ratio of 4 to 3, is of great force and effect in muſic; it was judged meet to proceed directly from Saturn to the Sun; becauſe, according to the old ſyſtem, there are three planets between Saturn and the Sun, and four from the Sun to the Moon.

Our anceſtors the Saxons, before their converſion to the Chriſtian faith, named the ſeven days of the week from the Sun and Moon and ſome of their deified heroes, to whom they were peculiarly conſecrated, which names we received and ſtill retain: thus Sunday was devoted to the Sun; Monday to the Moon; Tueſday, according to ſome, to Tuiſto or Tuiſco, mentioned by Tacitus; but, according to others, to Thyſa or Dyſa, the wife of Thor, and the goddeſs of juſtice; or, according to others, to Tyr; Wedneſday to Woden, the god of war; Thurſday to Thor, who preſided over the air, and was ſuppoſed to govern the winds and clouds; this is the ſame with Lucan's Taranis, ſimilar to the Welſh word for thunder; Friday to Friga or Fræa, the wife of Thor, and the goddeſs of peace and plenty; and Saturday to Seater, called alſo Orodo, to whom they prayed for protection, freedom, and concord, and for the fruits of the earth. The origin of the laſt appellation, however, is doubtful; as ſome have obſerved, that the name *Seater* is not mentioned by any writer before Verſtegan. See Verſtegan's Reſtitution of decayed Intelligence, p. 68. Junii Etym. Angl. and Mallet's North. Ant. vol. i. p. 91, &c.

To find the accompliſhment of Daniel's prophecy of the Meſſiah, the deſtruction, rebuilding, &c. of the temple, chap. ix. ver. 24, &c. the critics generally agree to underſtand *weeks of years*, inſtead of *weeks of days*.

Accordingly, Dr. Prideaux, fixing the end of theſe weeks at the death of Chriſt, in the year of the Julian period 4746, and in the Jewiſh month Niſan, dates their commencement in the month Niſan, in the year of the Julian period 4256, which was the very year and month in which Ezra had his commiſſion from Artaxerxes Longimanus, king of Perſia, for his return to Jeruſalem, there to reſtore the church and ſtate of the Jews. And thus he finds, that from the one period to the other, there were exactly 70 weeks of years, or 490 years. Connect. vol. ii. p. 381, &c.

WEEKS, *Ember*. See EMBER.

WEEKS, *Feaſt of*. See PENTECOST.

WEEK, *Paſſion*, or the *Holy Week*, is the laſt week in Lent, in which the church celebrates the myſtery of our Saviour's death and paſſion.

This is alſo ſometimes called the *great week*. Its inſtitution is generally referred, both by Proteſtants and Papiſts, to the times of the apoſtles. All the days of that week were held as faſts: no work was done on them; no juſtice was diſtributed; but the priſoners were ordinarily ſet at liberty, &c. even pleaſures, otherwiſe allowed, were at this time prohibited. The oſculum charitatis was now forborn: and divers mortifications practiſed by all ſorts of people, and even the emperors themſelves.

WEEK, *Rogation*. See ROGATION.

WEEK, or *Wick of a Candle*, &c. the cotton match in a candle or lamp. See CANDLE, LAMP, &c.

WEEK-*Fiſh*, in *Ichthyology*, a name given by ſome to a very delicate fiſh, caught on the Eaſt Indian ſhores, and called by the Dutch there the *wit-viſch*. See WIT-*Fiſh*.

WEEKLY *Markets and Fairs*, in *Agriculture*, are of conſiderable uſe and convenience to the farmer and land-owner, as affording the ready means of purchaſing, providing, and furniſhing them with the different articles they are continually in need of, as well as the various ſorts and deſcriptions of cattle and other live-ſtock, which are always wanted in ſuch caſes; as they are common in moſt large towns, the former once or oftener in the courſe of the week, and the latter in ſome inſtances in that time, and at more diſtant periods. They give the means, too, of readily diſpoſing of all ſorts of produce and ſtock of the farm kind, which is often a very great accommodation and advantage to the farmer and ſtore-maſter, as is fully ſeen in the weekly market of Smithfield in the metropolis, as well as in many particular markets and fairs in the country, as at Liverpool, Lancaſter, Garſtang, and many other towns in the north; and at Uxbridge, Reading, Chelmsford, Petworth, and a variety of other towns in the ſouth. See Owen's Book of Fairs, &c.

WEELING, ANSELM, in *Biography*, born at Bois-le-Duc in 1675, was an imitator of Godfrey Schalken and Adrian Vanderwerf; but particularly of the former; and many of his productions have been taken for pictures by that maſter. He died in 1749.

WEELS, in *Geography*, a river of Germany, which riſes in the duchy of Oldenburg, and joining the Ochte, in the county of Delmenhorſt, falls into the Weſer, 8 miles N.W. of Bremen.

WEEN. See HWEN.

WEENINX, JOHN BAPTIST, in *Biography*, an excellent artiſt, was born at Amſterdam in 1621, the ſon of John Weeninx, an artiſt of conſiderable celebrity. He loſt his father when he was very young, and was placed by his mother with a bookſeller; but his taſte for painting manifeſting itſelf decidedly, he was allowed to indulge it, and was placed as a diſciple with John Micker, and afterwards with Ab. Bloemart. He made a rapid progreſs, and drew with ſuperior power the principal buildings in Amſterdam and its vicinity. Animals, birds, huntings, &c. he was ſkilled in repreſenting, and he ſoon began to paint his ſubjects with ſucceſs. He left Bloemart, and ſtudied a ſhort time with Moojaert; but when he was 18, he found himſelf ſufficiently eſtabliſhed to truſt to himſelf, and his pictures were favourably received.

A deſire to improve led him to Rome, where his talents recommended him to many of the principal perſonages; among others, the cardinal Pamphili gave him a penſion, and honoured him with many commiſſions: he would fain, indeed, have retained him at Rome, but the ſolicitations of his family, and his natural deſire of exhibiting his power among his countrymen, induced him to return to Holland, after an abſence of four years. On his return, he found abundant admiration and employment, which, indeed, he very well merited, as his extraordinary facility in painting a vaſt variety of ſubjects has rarely been equalled. He painted hiſtory, portraits, landſcapes, ſea-ports, animals, and dead-game; but he particularly excelled in Italian ſea-ports, enriched with noble architecture, and decorated with figures. There is a very beautiful ſpecimen of his power in the gallery of Cleveland-houſe, which in Britton's Catalogue is numbered 243. He unfortunately died very young, in 1660, being only 39 years old.

WEENINX, JOHN, ſon of Baptiſt, mentioned above, was born at Amſterdam in 1644, and was inſtructed in painting by his father until he was 16 years of age, when he he had the misfortune to lofe that able inftructor. His talent was not of fo general a nature as that of his father; but in birds, flowers, animals, and fruit, he has feldom been furpaffed for the boldnefs, animation, and correctnefs of touch, or the brilliancy and clearnefs of colour, as well as of chiaro-ofcuro. The elector John William invited him to his court, and many of his moft confiderable productions are at the gallery of Duffeldorf. He decorated a hunting feat of the electors, the chateau of Benfberg, with a feries of hunting of the boar and the ftag, in which he difplayed his fkill and tafte with brilliant effect. His fmaller works are exquifitely finifhed, yet with great breadth, and defervedly efteemed. He died in 1719, at the age of 75.

WEEPER, in *Zoology*. See Simia *Capucina*.

WEEPING, in *Phyfiology*. See Lungs and Tears.

Weeping-*Rock*, in *Agriculture*, that fort of laminated, or porous, open rock, through which water paffes in a flow, gradual, weeping manner. Strata of this kind are not unfrequently very troublefome in the practice of draining. See Wall-*Spring* and Spring-*Draining*.

Weeping-*Spring*, that fort of difcharge of water from the internal parts of the earth which is produced in a very flow weeping manner. The draining of fprings of this fort is fometimes not attended with much difficulty, while in other cafes they are often very troublefome. See Spring and Spring-*Draining*.

WEER. See Weir.

WEERAWAU, in *Geography*, a town of Hindooftan, on the borders of the defert of Cutch; 40 miles W. of Buddakano.

WEERDT, or Werdt, a town of Germany, in the bifhopric of Munfter, on the Old Iffel; 40 miles W. of Munfter. N. lat. 51° 52′. E. long. 6° 33′.

WEERT, or Wert, a town of France, in the department of the Lower Meufe; 10 miles W. of Ruremond. N. lat. 51° 17′. E. long. 5° 43′.

Weert, *Nieder*, a town of France, in the department of the Lower Meufe; 10 miles S.W. of Venlo.

WEESDALE, a town of the ifland of Shetland; 6 miles N.W. of Lerwick.

WEESENSTEIN, or Wesenstein, a town of Saxony, in the margraviate of Meiffen; 5 miles S.W. of Pirna.

WEEVER. See Wever.

Weever, in *Ichthyology*, the Englifh name for the fifh called by Willughby and other authors the *draco-marinus*, or fea-dragon.

Belon fays, that this name is a corruption of the French *la vive*, becaufe this fifh is capable of living long out of the water.

Mr. Pennant defcribes another fpecies, under the name of the *great weever*, the *draco major*, or *araneus* of Salvian, which inhabits the fea near Scarborough. Brit. Zool. vol. iii. p. 171.

WEEVIL, in *Natural Hiftory*, the name of a fmall infect which does great damage in magazines of corn, by eating into the feveral grains, and deftroying their whole fubftance.

This creature is fomewhat bigger than a large loufe, and is of the fcarab or beetle kind, having two pretty, jointed, tufted horns, and a trunk or piercer, projecting from the fore part of its head: at the end of this trunk, which is very long in proportion to its body, there is a fort of forceps or fharp teeth, with which it gnaws its way into the heart of the grain, either to feek its food, or to depofit its eggs there.

By keeping thefe creatures alive in glafs tubes, with a few grains of wheat, their copulation and manner of generation have been difcovered. The female perforates a grain of wheat, and in it depofits a fingle egg, or, at the utmoft, two eggs; and this fhe does to five or fix grains every day, for feveral days together. Thefe eggs, which are not larger than a grain of fand, in about a week produce as odd a fort of white maggot, which wriggles its body very much about, but is very little able to move from place to place: this, in about a fortnight, turns to an aurelia, from which is produced the perfect *weevil*. This deftructive creature is itfelf very fubject to be deftroyed, and when in the egg or aurelia ftate, it is very fubject to be eaten by mites. Baker's Microf. p. 221. Leewenhoeck, tom. iv. ep. 76.

It is ftated in a feries of communications which contain different interefting particulars, inferted in the appendix to the Corrected Report on the Agriculture of the County of Middlefex, that J. L. Banger, efq. of the ifland of Madeira, has found that fteaming fuch grain as is infefted with the weevil has the effect of preferving it. In comparing the method ufed by another perfon with his, on portions of the fame cargo of grain, the quantity or weight was greater in the latter; but the moft effential difference was in the quality, which in the former was almoft unfaleable, while in the latter, or that of fteaming, it was better and fweeter than when firft received. The produce of grain from the ifland of St. Michael it is found cannot be preferved fo long a time as that which is imported from any other country, though the manner of keeping it there, which might throw fome light upon the fubject, is not known: of this the writer has recently obtained fufficient experience, it is faid, by having ordered a part of a cargo of grain to be placed in a ftore which had lately been ufed with that ifland wheat; and from this caufe, in a very fhort time, had become badly infected with the weevil. Another purchafer of a part of the fame cargo, too, is, from a fimilar caufe, a fufferer. The writer has not, however, much anxiety about it, as the grain he purchafed and fteamed once on the firft of January, and again on the firft of June, is now, (the time of writing,) in perfect prefervation, and free from the weevil. The Indian corn too, that was purchafed then in March laft, at which time it was very full of the infect, is at prefent free and perfect, it is faid, without a fecond heating. It is intended paffing it again through the fteam, however, it is faid, as foon as the apparatus is properly fixed, when no doubt is made of its keeping through the year. In examining the particular tendency that the grain lately arrived has to the generation of the infect, the writer has imagined it in fome meafure to proceed from the embargo laid upon American veffels having obliged the merchants in the different fea-ports to keep their granaries fo full as to have heated the grain; though he has fome reafon to think that the months of March and September are attended with peculiar circumftances refpecting the increafe of the weevil.

It is found that by the confumption of one hundred pounds weight of coals in a kitchen portable fteam apparatus, three *moys*, or feventy-two Englifh bufhels of grain can be fteamed in the common hours of work of one day.

The writer had then lately fteamed a granary of fixty moys, or one thoufand four hundred and forty Englifh bufhels, in about three weeks. The wafte of grain, not badly infected with the weevil, is found to be one *per cent.* in weight in one month, and the increafe fo rapid, that if proper precautions be not taken, in lefs than fix it will be rendered totally unfit for ufe; and that in the Weft Indies the writer is fatisfied from his own experience, that three months will be equal, in deftruction to the grain, to that

that of fix months in the temperate climate in which he writes. Perhaps, it is faid, no part of the globe would experience fo much benefit from the ufe of fteam as a rice country.

The writer having, by fubftituting copper tubes for thofe of tin, which were at firft employed, but tinned to prevent mifchief, at laft fucceeded in getting them fufficiently tight, proceeded better in his trials: the fteamed rice remained free from duft, and it is fuppofed that fteam may be rendered very ferviceable in feparating the hufk from the grain in that cafe, as well as in barley, &c.; nay, that it may be extended to flax, and many other articles.

The attention of the writer more lately has been particularly attracted, by finding fome grain that had been fteamed to grow, when fown, in repeated trials; and from the very flourifhing ftate of what is come up, and his own obfervations, he is led to think that the blight in wheat might be materially prevented by having it fteamed before it is fown. It was afterwards difcovered that the flourifhing condition of the wheat fown after fteaming furprifed every one who faw it; and it is thought to be an object worthy of confideration.

It was found, on taking a certain quantity of wheat that had been fteamed, and of fuch as had not, and fending them to the mill, that there was an increafe of nearly five *per cent.* in the bread produced from the wheat that was fteamed: but it is not certainly known if this difference would have arifen, if the latter had been dried in the fun or an oven, as fometimes practifed there, but which is troublefome. The beft bread made there is, it is faid, from a mixture of fine American flour and ifland wheat; and the writer has no doubt, that if a baker was to make ufe of fteam, he might, in the proportion of wheat in the quartern loaf, fave from five to ten *per cent.*

The writer intends to try the advantages to be gained by fteaming feeds to be fent to foreign countries. Bifcuit, he is convinced, may be kept any length of time by it; but from its fize, the operation of fteaming it is confiderably more difficult than grain. Wheat provided in any way, in general, it is faid, gets better and more free from the weevil by fteaming. See the Paper.

The weevil, too, is faid to be very injurious and deftructive to the wheat and Indian corn in America, fo that the means of preventing it muft be of great utility and confequence.

WEFERLINGEN, in *Geography*, a town of Weftphalia, in the principality of Halberftadt, infulated in the duchy of Magdeburg; 25 miles N. of Halberftadt.

WEFT, a kind of web, or thing woven; as, a *weft* or trefs of hair. See WEB, HAIR, TISSUE, &c.

WEFT, or *Woof*, the crofs-threads of cloth. See WEAVING.

WEGELEBEN, in *Geography*, a town of Weftphalia, in the principality of Halberftadt; 5 miles N. of Quedlingburg.

WEGERSDORF, a town of Pruffia, in Oberland; 3 miles S. of Salfeldt.

WEGG'S ISLAND, a fmall ifland in Hudfon's Bay. N. lat. 63° 20′. W. long. 90° 25′.

WEGG'*s Lake*, a lake of North America. N. lat. 50° 25′. W. long. 92° 25′.

WEGGIS, a town of Switzerland, in the canton of Lucerne, and capital of a bailiwick, fituated on the north fide of the Lake of Lucerne; 7 miles E. of Lucerne.

WEGSTADEL, a town of Bohemia, in the circle of Leitmeritz; 10 miles S.E. of Leitmeritz.

WEGSTAID, or VEGESTAID, a town of the bifhopric of Paffau, infulated in Auftria; 12 miles E. of Paffau.

WEHAX, LILL, and STOR, two fmall iflands on the E. fide of the Gulf of Bothnia. N. lat. 60° 45′. E. long. 21° 7′.

WEHEN, a town of the principality of Naffau Saarbruck Ufingen; 10 miles N.N.W. of Mentz.

WEHLEN, or WEHLAU, or *Wehl-Städtel*, a town of Saxony; 5 miles S. of Pirna.

WEHMALAIS, a town of Sweden, in the government of Abo; 20 miles N. of Abo.

WEHNER, a town of Eaft Friefland; 13 miles S. of Emden.

WEHR, a river of the duchy of Baden, which runs into the Rhine, 4 miles W. of Seckingen.

WEHRENDORF, a town of Weftphalia, in the county of Ravenfburg; 5 miles W.S.W. of Vlothow.

WEHRENSEE, a town of the duchy of Stiria; 6 miles N. of Luttenberg.

WEHRHEIM, a town of Germany, in the principality of Naffau Dillenburg; 18 miles S.S.W. of Dillenburg.

WEIBSTADT, a town of the duchy of Baden; 28 miles E.S.E. of Manheim. N. lat. 49° 17′. E. long. 8° 59′.

WEICHOLTZHAUSEN, a town of the duchy of Wurzburg; 6 miles N.N.E. of Schweinfurt.

WEICHSEL. See VISTULA.

WEICHSELBURG, a town of Saxony, in the lordfhip of Schonburg; 14 miles N.N.W. of Waldenburg.

WEICHSELBURG, or *Weixelburg*, a town of the duchy of Carniola; 28 miles W. of Landftrafs. N. lat. 46° 5′. E. long. 14° 15′.

WEICHSELMUNDE, a fort built to defend the city of Dantzic, on the Viftula. In 1734 it was taken by the Ruffians; 4 miles N. of Dantzic.

WEICHTERSBACH, or WECHTERBACH, a town of Germany, in the county of Ifenburg, on the Kinzig; 23 miles E. of Francfort on the Maine.

WEICKERSBERG, or WEIKERSPERG, a town of Auftria; 5 miles W. of Efferding.

WEICKERSHEIM, a town of Germany, in the principality of Hohenlohe, on the Tauber; 23 miles N.N.E. of Ohringen. N. lat. 49° 30′. E. long. 9° 58′.

WEIDA, a river of Silefia, which rifes on the confines of Poland, and joins the Oder, near Breflau.

WEIDELBACH, a town of the principality of Anfpach; 5 miles S.W. of Feuchtwang.

WEIDEMBERG, a town of Germany, in the principality of Culmbach; 7 miles E.S.E. of Bayreuth.

WEIDEN, a town of Bavaria, in the principality of Sulfbach, on the Nab; 17 miles N.E. of Sulfbach. N. lat. 49° 40′. E. long. 12° 3′.—Alfo, a town of the bifhopric of Bamberg; 4 miles E. of Weifmain.

WEIDENBACH, a town of Germany, in the marggravate of Anfpach; 5 miles S.S.E. of Anfpach.

WEIDENBERG, a town of Germany, in the principality of Culmbach; 7 miles E.S.E. of Bayreuth. N. lat. 49° 55′. E. long. 11° 46′.

WEIDERAU, a town of Saxony, in the lordfhip of Schonburg; 4 miles N.E. of Penig.

WEIERN, a town of Bavaria; 23 miles S.S.E. of Munich.

WEIF. See WAIF.

WEIGEL, ERHARD, in *Biography*, a German mathematician, was born at Weida, in Nordgau, in 1625, and educated at Wenfiedel, whither his parents were obliged to remove, on account of perfecution, when he was three years old; and afterwards at the Gymnafium of Halle, where he enjoyed the advantage of being inftructed in mathematics by Bartho-

Bartholomew Schimpfer, a celebrated aftronomer. The circumftances of his parents obliging him to return to Wenfiedel, he there purfued his ftudies under an able tutor. Afterwards, encouraged by Schimpfer, he fettled at Halle, where his reputation drew to him many pupils, by whom he was enabled to remove to Leipfic for farther improvement; fo that in 1653 he was invited to be profeffor of mathematics at Jena. By favour of William, duke of Saxony, he was appointed mathematician to the court, and chief director of buildings; and thus the latter years of his life were chiefly employed in travelling. In the progrefs of his years he made many improvements in globes, and other inftruments for facilitating the ftudy of aftronomy. This ingenious mathematician died in 1699. For a lift of his works, which were many, we refer to his article in Gen. Biog.

WEIGELIA, in *Botany*, a Japanefe genus, dedicated by Thunberg to the honour of Dr. Chriftian Ehrenfried Weigel, profeffor of Chemiftry in the univerfity of Gripfwald, in Upper Saxony, who publifhed at Berlin, in 1769, when he was only 21 years of age, a *Flora Pomerano-Rugica;* but whofe fame, as a deep and learned practical botanift, chiefly refts on his *Obfervationes Botanicæ*, publifhed as an inaugural differtation, under his prefidency, in 1772, in quarto, with three plates. This work, from its rarity, is not fo well known as it deferves to be. The author correfponded with Linnæus, and communicated fpecimens of his new or doubtful plants.—Thunb. Jap. 6. Nov. Gen. 5. Schreb. Gen. 113. Willd. Sp. Pl. v. 1. 836. Mart. Mill. Dict. v. 4. Juff. 421. Lamarck Illuftr. t. 105.—Clafs and order, *Pentandria Monogynia*. Nat. Ord. uncertain. Juffieu fufpects it may belong to his *Apocineæ*, the *Contortæ* of Linnæus; an opinion which the infertion of the ftyle at the bafe of the germen feems to favour; but the ferrated leaves are a great, perhaps infuperable, objection. If we might fufpect an error as to the fituation of the germen, the genus would readily range itfelf among Juffieu's *Caprifolia;* but the fecond fpecies has more the character of his *Bignoniæ*, and renders it probable that Thunberg is merely miftaken in his idea of the fimple nature of the germen.

Gen. Ch. *Cal.* Perianth fuperior, of five awl-fhaped, erect, equal leaves. *Cor.* of one petal, funnel-fhaped; tube the length of the calyx, internally hairy: limb bell-fhaped, cloven half way down into five ovate, obtufe, flightly fpreading fegments. *Stam.* Filaments five, inferted into the tube, thread-fhaped, erect, nearly as long as the corolla; anthers erect, linear, obtufe, cloven at the bafe. *Pift.* Germen fuperior, quadrangular, abrupt, fmooth; ftyle from the bafe of the germen, thread-fhaped, rather longer than the corolla; ftigma peltate, flat. *Fruit* unknown. Thunberg fufpected there was a folitary naked *feed*.

Eff. Ch. Corolla funnel-fhaped. Style from the bafe of the germen. Stigma peltate. Calyx fuperior, of five leaves.

1. W. *japonica*. Seffile-leaved Weigelia. Willd. n. 1. Thunb. Jap. 90. t. 16. Tr. of Linn. Soc. v. 2. 331. (Nippon Utfúgi; Kæmpf. Am. Exot. 855.)—Leaves feffile, ovato-lanceolate.—Native of hilly fituations in Japan, flowering in April and May. The *ftem* is fhrubby, with oppofite, round, fmooth branches, flightly quadrangular when young. *Leaves* oppofite, feffile, pointed, copioufly ferrated, an inch, or rather more, in length, veiny, fmooth on both fides, except the veins, which are hairy; paler beneath. *Flower-ftalks* axillary, compreffed, three-flowered, longer than the leaves, with two awl-fhaped *bracteas* at the bafe of each partial ftalk, and two more about half way up. *Flowers* about an inch long, reddifh-purple. Thunberg's defcription, in the *Flora Japonica*, confounds both fpecies together, and is therefore here neceffarily corrected.

2. W. *coræenfis*. Large-flowered Weigelia. Thunb. Tr. of Linn. Soc. v. 2. 331. Willd. n. 2. (Koreï Utfúgi; Kæmpf. Amoen. Exot. 855. Ic. Select. t. 45.)—Leaves ftalked, obovate.—Native of Corea, from whence Kæmpfer fuppofes it was brought to Japan. He defcribes it as a *fhrub* with beautiful *flowers*, fmelling like cloves, and changeable in colour, being fnow-white, flefh-coloured, and red, on the fame plant. His excellent drawing, among thofe engraved and diftributed through the munificence of fir Jofeph Banks, throws more light upon this fpecies, and indeed upon its genus, than any thing elfe we have met with. It appears to be a climbing or trailing *fhrub*, with round branches, and oppofite ftalked *leaves*, very like thofe of the *Hydrangea hortenfis* in fize and figure, being thrice the length of the firft fpecies, and obovate with a point. *Flower-ftalks* axillary and terminal, three-flowered, an inch and a half long, with awl-fhaped *bracteas*. *Tube* of the *corolla* flender, above half an inch long, twice the length of the *calyx;* limb bell-fhaped, twice the length of its tube, divided half way down into five broad, obtufe, horizontally fpreading fegments. *Stamens* projecting beyond the mouth. *Anthers* incumbent. *Stigma* large, peltate, flat. Nothing appears refpecting the *germen*, or its fituation. We do not clearly underftand the fecond of Kæmpfer's feparate figures, which is perhaps an under view of the *corolla*.

WEIGELSDORF, in *Geography*, a town of Bohemia, in the circle of Konigingratz; 2 miles W. of Trautenau.

WEIGELSHAUSEN, a town of the duchy of Wurzburg; 5 miles W.S.W. of Schweinfurt.

WEIGENHEIM, a town of Germany, in the lordfhip of Schwarzenburg; 10 miles S.S.W. of Schainfeld.

WEIGERSTORFF, a town of Auftria; 6 miles S. of Wells.

WEIGH, Way, or Wey, *Waga*, a weight of cheefe, wool, &c. containing two hundred and fifty-fix pounds avoirdupois. Of corn, the weigh contains forty bufhels; of barley or malt, fix quarters.

In fome places, as Effex, the weigh of cheefe is three hundred pounds. See Measure.

"Et decimam cafei fui de Herting, præter unam peifam, quæ pertinet ad ecclefiam de A. Mon. Angl." where *peifa* feems to be ufed for a weigh.

Coke alfo fpeaks of weighs of bay-falt.

Weigh-*Beams* are fteel-yards for the weighing of goods upon wharfs, &c.

WEIGHER, an officer in divers cities, appointed to weigh the commodities bought and fold, in a public balance, &c. Thefe weighers are generally obliged by oath to do juftice to both parties; and to keep a regifter of the things they weigh.

In Amfterdam there are twelve weighers, eftablifhed into a kind of office. As it was formerly allowed them to touch the ftrings of the balance in weighing, it was eafy for them to favour either the buyer or feller, according as the one gave them more money than the other. To prevent which abufe, it was charged on them, by an ordinance of the burgomafters in 1719, not to touch the balance in any manner whatever.

WEIGHGATT, in *Geography*, a name given to the ftrait called Waygatt, (which fee,) from the wind which blows through this ftrait (*waikan*, to blow,) becaufe a ftrong S.W. wind blows out of it. It is alfo called Hindelopen. See Martens's Voyage, p. 27.

WEIGHING,

WEIGHING, the act of examining a body in the balance, to find its weight.

The diftillers in London weigh their veffels when full; and for a half hogfhead, which is thirty-one gallons and a half, allow two hundred one quarter and eleven pounds for the cafk and liquor. For a puncheon, they allow fix hundred one quarter and two pounds; for a Canary pipe, eight hundred a half and feventeen pounds.

Weighing-*Cage*, in *Agriculture*, a fort of machine or contrivance which is made in fomewhat the form or manner of an open box or cage, by means of which any fmall animal, fuch as a pig, fheep, calf, or any other of a fimilar kind, may be very eafily and expeditioufly weighed, and with fufficient accuracy and correctnefs for the purpofes of the farmer, ftore-mafter, and grazier. It is conftructed on the principle of the common fteel-yard. It has a ftrong wooden frame, on which there are fteel centres, in which the pivots of the lever are hung. Upon the fhort fide of the lever is fufpended a fort of coop, furrounded by ftrong net-work, in which the animal intended to be weighed is put and fecured; the point of fufpenfion is connected with the coop by means of two curved iron-rods, which at the fame time form the head of it. A common fcale, in which the weights are to be put, is hung on the longer fide of the lever. See Steel-*Yard*.

Weighing-*Chair*, a machine contrived by Sanctorius, to determine the quantity of matter carried off from the body, and that of food taken at a meal; and to warn the feeder when he had eat his quantum.

That ingenious author, having obferved, with many others, that a great part of our diforders arifes from the excefs in the quantity of our foods, more than in the quality thereof; as alfo how much a fixed portion, once well adjufted, would, if kept to regularly, contribute to health; bethought himfelf of an expedient to that purpofe. The refult was the weighing-chair: which was a chair fixed at one arm of a fort of balance, wherein a perfon being feated at meat, as foon as he had ate his allowance, the increafe of weight made his feat preponderate: fo that, defcending to the ground, he left his table, victuals, and all, out of reach.

Weighing-*Houfe*, a building furnifhed with a dock, and conveniences for gauging or afcertaining the tonnage of boats that are to be ufed on a canal.

Weighing-*Machine for Turnpike Roads*, in *Mechanics*, a machine for weighing heavy bodies, and particularly wheel-carriages. This is commonly done in order to afcertain if a carriage is within the weight allowed by law to be carried by fuch carriage on the turnpike-roads; a weighing-machine, or weigh-bridge, being fixed at every turnpike-gate. See Turnpike.

Formerly immenfe machines were ufed for this purpofe: the machine was erected in an open building, beneath which the road paffed, fo that a cart, waggon, or other carriage, could be drawn under it; ftrong chains were then paffed beneath the body of the carriage, to attach it to the extremity of an immenfe fteel-yard. The fulcrum of the fteel-yard was fufpended by a lever, or by pulleys and crane-work, from the top of the building; and when the carriage was properly fecured, the fteel-yard was hoifted up by the crane-work, fo as to fufpend the waggon, and it could then be weighed by applying the fliding-weight of the fteel-yard to different parts of the divided bar. Several curious machines of this kind are defcribed by Leopold, in his Theatrum Staticum, 1724.

This method was tedious and dangerous; but when turnpike-roads became more common, a very fuperior machine was introduced, and we now find one at almoft every turnpike-gate. It is called a weigh-bridge, becaufe the carriage is drawn upon a wooden platform or bridge, which is placed over a pit, made in the line of the road, to contain the machinery. The pit is walled withinfide, and the platform is exactly fitted to the walls of the pit; but as it does not touch the walls, it is at liberty to move freely up and down. The platform is fupported by levers, placed beneath it, and is exactly level with the furface of the road, fo that the carriage is eafily drawn on to it. This is done without any difficulty or lofs of time, becaufe the platform is in the direct line of the road, and the carriage is only required to ftop for a minute whilft its wheels ftand fairly upon the platform, and the horfes ftand upon the folid ground beyond the platform. A few fmall weights put into a fcale, like that of a common balance, determine the weight of the carriage and its load. If the weight of the carriage is previoufly known, the weight of the load may be found, by deducting the weight of the carriage from the total.

This weigh-bridge is placed at the fide of a fmall houfe, which ufually ferves as a lodgement for the gate-keeper, and the fcale is fituated within the houfe. The platform is fupported by two double levers contained in the pit; the ends of thefe levers are borne up by a long horizontal lever, which paffes through one of the fide-walls of the pit, and enters into the houfe: from the end of this lever, a fmall iron rod is carried up to one end of a common fcale-beam or balance, from the other end of which the fcale is fufpended. All the levers are of the nature of fteel-yards, that is, the weight or load of the bridge is applied upon the levers which fupport it, at points very near to their refpective fulcrums, or centres of motion; whilft the ends of thefe levers are fupported, at a very confiderable diftance from their fulcrums, by the long lever, and they bear upon this lever at a point very near to its fulcrum; but the counterbalancing force, that is, the effort of the weights in the fcale, is applied to the extreme end of the long lever, very far diftant from the fulcrum. For this reafon, a fmall weight, as one pound for inftance, placed in the fcale, will bear up a large weight, for inftance, 60 pounds, or one hundred weight placed upon the platform, according as the machine is conftructed. This has an advantage, befides the convenience of fmall weights, *viz.* that the platform with the carriage does not fink down any perceptible quantity during the action of weighing; for when the weight in the fcale is brought to equilibrium with the load, any motion or fpace which the fmall weight paffes through, when the fcale-beam vibrates, muft be to the fpace which the platform and carriage pafs through at the fame inftant, in the ratio of the load to the weight. Sometimes, inftead of ufing a fcale-board and detached weights, a long fteel-yard is employed, with a weight to flide along upon it to different diftances from the centre, until it will counterbalance the load on the platform; in that cafe, the lever is graduated to fhew the weight upon the platform.

Salmon's Patent Weighing Machine.—This is very generally ufed in the vicinity of London; it points out the weight on a dial.

Plate II., *Engines*, contains figures of a weighing machine of the beft kind. *Fig.* 1. is a horizontal plan of the levers contained in the pit, the platform being taken off to expofe them. The under fide of the platform is fhewn at *fig.* 2, and *fig.* 3. is a vertical fection of the whole machine.

E E (*fig.* 3.) is the platform; its upper furface is exactly level with the ground, and the edge of the planking of the platform is fitted into a border or frame which furmounts the fide walls of the pit, leaving a fmall crevice all round its edges, fo that the platform does not touch the fixed frame,

 although

although it is very near to it. The platform is compofed of a ftrong frame of wood (as fhewn in *fig.* 2.), and the upper fide is covered with wood planking. It is likewife defended from wear, by iron-bars and large-headed nails, which are faftened on the upper fide. Near each of the four angles of the platform a piece of iron is fixed, as fhewn by *b*; and it is on thefe four points that the platform is borne. When the platform is put in its place, thefe pieces of iron apply to the pins *b b* (*fig.* 1.), which are fixed in four ftrong iron levers, marked A A, B B. Each of thefe levers is fupported at the extreme end *c*, on a fulcrum or centre-pin refting on a metal fupport, as fhewn in *fig.* 4, which is borne by a piece of timber *o o*, worked into the walls of the pit at the angle. At the oppofite ends the levers A A are brought together, and B B the fame, fo that all four meet in two points *a a*, and by means of links, fhewn in *fig.* 5, are all connected with a long lever C C. This refts on a fupport or fulcrum D, borne by a pillar erected from the bottom of the pit. The end of the lever at I is received between two uprights to guide it, but do not any way confine its motion. In the common machine, it is from the extreme end of the lever C D that the iron rod before mentioned is carried up to the fcale-beam, or fteel-yard, as before defcribed; but the patent machine in the figure is differently conftructed in that part.

The fixed centres *c*, of the levers A A and B B, are at the ends of thofe levers, and the points *b b*, on which the platform bears, are very near to the centre *c*; but the diftance of the points *a* from *c* is nine times as great as from *c* to *b*, confequently a force of one pound applied to lift up the levers at the point *a* would balance nine pounds laid upon the platform. In like manner the diftance from the point *a* to the fulcrum D is only one-feventh part of the diftance from the fulcrum to the end of the lever C; hence, one pound applied to lift up the end of the lever C would raife feven pounds applied at the point *a*, and feven pounds applied at *a* would balance fixty-three pounds placed on the platform. To weigh with a machine of this kind, if we ufe a fcale and balance connected with the end of the long lever, we muft ufe weights which are only one fixty-third part of the marks which they bear.

Mr. Salmon's machine operates in a much more perfect manner, by the help of a felf-adjufting balance-wheel, which will weigh every different body, without employing any loofe weights; and it fhews the weight by means of an index and dial, like that of a clock. To effect this, another lever or fteel-yard F G is applied, whereof F is the fulcrum, and *f* the point from which a link C defcends to the end of the long lever C D. At the extreme end G, a ftrap is attached to afcend to the balance-wheel *i i*.

Now, as the diftance F *f* is only one-tenth of the diftance F G, one pound applied to lift up the end G would raife ten pounds at *f*, or $10 \times 63 = 630$ pounds placed on the platform.

To draw the end G of the lever upwards, a thin leather ftrap *g* is attached to it, and the upper end of this is coiled round a fmall roller *h*, which is fixed upon an horizontal axis, as is fhewn on a larger fcale in *fig.* 7, where the axis is marked *b b*. This is reduced to fmall pivots at the extremities, which are borne by friction-wheels *a a*, to render its motion as free as poffible. On the fame axis *b* is fixed a wheel *i i*, (fee alfo *fig.* 6.), and againft the arms of this wheel a fpiral ledge is fixed, with a fufficient projection to admit a fine filk line to wind upon the fpiral, when the wheel is turned round. A weight *k*, which is fufpended to the line, forms the counterbalance to the load placed upon the weigh-bridge (fee *fig.* 3.), and the weight of the load is determined by the diftance which the roller and wheel *i* are turned round. This diftance is fhewn by an index *c* fixed on the extreme end of the axis *b*, and pointing to different divifions engraved round a dial, as fhewn in *fig.* 6.

This fingle weight *k* can counterbalance all the different weights which may be placed on the platform, becaufe the line by which the weight *k* is fufpended, when it winds upon the circumference of the fpiral, continually applies itfelf at a different diftance from the centre of the axis, fo as to operate with greater force. Hence, when any weight is placed upon the platform E, it preffes down the levers A A and B B; thefe deprefs the long lever C D, and this again actuates the lever F G, and draws down the ftrap *g*, which unwinds from the roller on the axis *b b*, fo as to turn it round, together with the wheel and fpiral. The weight *k* winds upon the fpiral, but the fufpending line foon arrives at that part of the fpiral where its radius is fufficiently increafed, to enable the weight *k* to counterbalance the load upon the platform; the balance-wheel being then come to an equilibrium, will move no farther, and the index points out upon the dial the weight of the load upon the platform.

The fpiral originates in the central part, at a circle which is of the fame diameter as the roller, upon which the ftrap *g*, *fig.* 3. winds; and the weight *k* muft be equal to the fix-hundred-and-thirtieth part of the weight of the platform and levers A A, B B, when there is no weight upon it. When the weight *k* hangs from this commencement of the fpiral, the index *c* ftands at zero, as fhewn in *fig.* 6. The fpiral is fo made, that to turn it round fixty degrees will require one ton weight to be laid on the platform, and every additional ton will turn the wheel and index round another fixty degrees, fo that the machine will bear fix tons before the index makes a complete revolution. Each fpace of fixty degrees is divided into twenty parts, which reprefent hundred weights; and each one is fubdivided into halves or quarters, which divifions are very apparent on a large dial.

In conftructing a machine of this kind, every attention muft be paid to accuracy in the centres of motion of the different levers; all thefe points fhould be made of fteel, and hardened. The form of the centres fhould be that of a fharp edge, like a blunt knife, with the edge refting on a furface of hard fteel, made rather concave, (fee *fig.* 4.) Centres, or bearing points of this kind, made fharp, will move with very little friction; and if the fteel is good, and perfectly hard, the edges will not become blunt in many years' ufe. In all cafes, the bearing-pins with the fharp edges muft be fixed in the levers; becaufe if the levers were made with plain furfaces, and to have fharp pins to bear upon them, there would be no certainty as to the effective lengths of the different levers, and they would vary in their power whenever the fharp edge changed its place upon the fupporting furface.

The four principal levers, A A, B B, are made double, or with open loops at the ends, as fhewn in *figs.* 1 and 4; two fteel pins are put through the double part, one of them marked *c*, being made with a fharp edge at the lower fide, but the other, *b*, is fharpened on the upper fide. The former bears upon a fixed fupport faced with hard fteel, and the other receives the metal ftems, *b*, *fig.* 2. which are fixed to the underfide of the platform. The two levers, A A, are joined together at the point *a*; and the two levers, B B, are alfo joined in a fimilar manner. Each pair of levers are connected by a crofs-bar, as fhewn in *fig.* 1, fo as to make two triangles.

The ends *p* or *s*, *fig.* 5. of the compound levers A A or B B, where they join together, have a fcrew fitted through them, as fhewn in *fig.* 5; the ends of thefe fcrews are made

of

of ſteel, and ſharp-pointed, in order to reſt in a cup or ſocket, *r*, of ſteel, formed in the lower part of a loop or link I. The upper end of the loop is ſuſpended upon a ſharp-edged pin fixed in the lever C D, *fig.* 1, which lever is marked K and H in *fig.* 5. The link belonging to the lever A A is ſuſpended on one end of this pin, and the other loop upon the other end of the ſame pin. The lever F G is made juſt the ſame as a common ſteel-yard.

The ſpiral, *fig.* 6, muſt be made very correctly in braſs, and the line which winds upon it ſhould be very flexible, and of equal thickneſs. After every care has been taken to make all parts of the machine very accurately, they muſt be put together; and known weights being laid upon the platform, the diviſions on the dial ſhould be laid down from the poſitions of the index. If the dial is thus divided by actual experiment, the machine will weigh very accurately; but its ſenſibility will depend upon the ſharpneſs of the centres of the levers, and the hardneſs of the ſteel. When it is in good order, the addition of a quarter of a hundred weight to three or four tons, on the weigh-bridge, ought to produce a motion of the index. In an average ſtate of the machine, it may be depended upon to within half a hundred weight.

Mr. Salmon had a patent for this machine in 1796, but his invention is confined to the balance-wheel and ſpiral, as ſhewn in *figs.* 6. and 7. Theſe parts, ſeparated from the great machine, make a very accurate and complete weighing machine by themſelves, when incloſed in a box; a common ſcale, to contain the goods which are to be weighed, being ſuſpended from the lower end of the ſtrap which winds round the roller.

The introduction of theſe index weighing-machines for turnpike-roads is of great utility, to diminiſh thoſe inceſſant diſputes between the gate-keeper and the carriers reſpecting the weight of their loads. In the common weighing-machines, the weights, being looſe and of an arbitrary weight, may be changed or diminiſhed by the gate-keeper to make the loads appear greater; and the carrier has no means of detecting this fraud, except by unloading and weighing his cargo in ſmall quantities, which is ſcarcely practicable; neither can he be aſſured of the manner of weighing, even if the weights are juſt. Another ſource of uncertainty is, whether the machine be in exact balance when there is no load on the platform; for as the wood imbibes wet and becomes dirty, it makes conſiderable variations in the balance of the machine. To put the machine in equilibrio, a heavy weight is hung on the end of the lever C D, *fig.* 3, and can be placed nearer to or farther from the centre. This ſhould always be adjuſted, but is frequently neglected, and is difficult of detection.

With the index-machine all theſe difficulties are avoided: it is conſtructed by a maker whoſe character is at ſtake, and when once truly made will continue in the ſame ſtate, for the whole is locked up, ſo that the gate-keeper cannot have acceſs to the index. The only defect ariſing from age and wear is, that the index becomes leſs ſenſible, and moves ſluggiſhly and by ſtarts. This the carrier can try at any time by preſſing his foot upon the platform; and he can always ſee if the index returns to zero when the load is removed; and if it does not, he can ſee how much the machine is out of balance.

The law reſpecting weighing carriages is an inducement to fraud in the gate-keepers; a certain weight is allowed by act of parliament to be carried by each deſcription of carriage, which weight is regulated according to the width of the carriage-wheels, the number of horſes, and the ſeaſon of the year, whether winter or ſummer.

If the load does not exceed the allowed weight, a certain toll is charged for the carriage; but for all exceſs of weight, a very heavy toll is charged on each hundred-weight as a penalty, the amount of which is increaſed in proportion to the quantity of over-weight. (See Turnpike.) It is a valuable prize for a gate-keeper to find a carriage overloaded.

Weighing-*Machines for ſmall Weights*. Theſe are of different conſtructions, according to the uſe for which they are intended.

In ſome the weight of any body is determined by putting looſe weights into an oppoſite ſcale, and theſe weights may be either equal weights to thoſe which they are to denote, as in the caſe of a balance with equal arms, or the weights may be ſmaller and applied to the longer arm of an unequal balance, as in the ſteel-yard. The former is by far the moſt accurate, and from the facility of proving its accuracy by placing the weights in either of the ſcales, it has become the legal mode of weighing. Steel-yards are accurate if carefully uſed, but afford many opportunities of fraud in the hands of diſhoneſt perſons.

Mr. Medhurſt's patent weighing-machine is very uſeful in ſhops and warehouſes, being more convenient than the common balance and ſcales, and having the ſame property of equal arms to the lever. The ſcale-boards, inſtead of being ſuſpended from the arms of the balance, are ſecurely poiſed between the arms of a double balance-beam, and are placed at ſuch a height as is moſt convenient to receive the goods which are to be weighed. The weights are to be put into the oppoſite ſcale, but can be put in either; and the load on the oppoſite one, if there is any doubt of the accuracy of the balance.

When more conſiderable weights are to be weighed, equal weights are ſo inconvenient, that ſmall machines, ſuch as are uſed for carriages, are to be preferred for convenience, as they require only ſmall weights in the ſcale.

There is another kind of weighing-machines which requires no looſe weights, but ſhews the weight by a pointer or index upon a divided arch, or on a dial-plate.

The index and balance-wheel of Mr. Salmon's machine, when detached, make a very complete weighing inſtrument of this kind, as before deſcribed.

Other index machines act with a pendulum: thus, the ſcale to receive the goods is ſuſpended from a lever, to which a pendulous arm is attached with a heavy weight at the extremity to form a pendulum. The application of any weight in the ſcale tends to remove the pendulum from its vertical poſition; and it is a property of a pendulum to increaſe in its effort to return to the perpendicular, in proportion to the diſtance which it is removed from it. The quantity of deviation from the perpendicular is indicated by an index or pointer to the diviſions on an arch, and theſe diviſions are numbered to denote the weight. The machine uſed for weighing hanks of cotton is of this kind, and apothecaries ſometimes uſe a ſimilar inſtrument.

Many of the index machines are made with ſprings, which are bent by the application of the weight; and the degree of their flexure, as determined by ſome indexes, is an indication of the weight applied. Several machines of this kind are deſcribed in our article Dynanometer; and although they are rather differently conſtructed, to fit them for meaſuring the ſtrength of horſes, &c. all of them may be converted to weighing-machines, by applying a proper ſuſpending hook, with a ſcale to receive the matter to be weighed.

A curious machine of this kind was made many years ago by M. Hanin of Paris, and preſented to the Society of Arts. The weight is determined by the degree to which a ſemia femicircular fteel fpring will be bent, when the weight is applied to force the ends of the fpring to recede from each other. The quantity is fhewn by an index, which turns round over a circular dial-plate, like a clock-hand. The principal curiofity of this machine is, that the dial contains thirteen concentric circles, each divided to fhew the weight in the denominations of different countries; *viz.* on the two external circles are divifions to fhew troy and avoirdupois weight in pounds; within this is a circle to fhew the correfponding number of Paris livres; next Portuguefe arrobas, and Spanifh arrobas; then Dutch, Swedifh, Danifh, and German pounds; fo that the inftrument becomes an univerfal table for the ratios of thefe different weights.

Weighing-*Machine*, in *Agriculture* and *Rural Economy*, a fort of machine or contrivance made ufe of for the purpofe of weighing neat cattle and fome other kinds of animals alive, as well as different other ufes. It is a machine which is perfectly fimple and eafy in its manner of conftruction. It has a beam of the fteel-yard kind, at the top of which is a pin, on which the fufpenfion of the beam is made. There is a counterpoife which is moveable along the beam by means of a fliding focket, on which is raifed an iron arm, fupporting a wooden box or fcale to receive the counterbalancing weights in the operation of weighing. There are different levers, which are hung on a projecting pin of the beam by one end, the other refting on an iron fupport. There is a lid or platform, on which is placed the fubject to be weighed; to the under fide of this, at each corner, are attached blocks, from which proceed iron pieces, fimilar in form to the fupporting piece, but reverfed in pofition: by means of thefe four pieces the lid or platform ftands with its whole weight entirely on the lever; other pieces applying themfelves to the levers at a fmall diftance nearer to the centre of the machine than to the fupporting piece.

In the operation of weighing, the fubject to be weighed being placed on the lid or platform, preffed by the different pieces on the levers, which by their fufpenfion on the beam determine it from its even pofition by a quantity proportioned to the weight of the fubject, which is expreffed by the counterbalancing weights required to be placed in the box or fcale. See Steel-*Yard*.

A machine of this nature is of vaft utility and importance in the different fyftems of grazing, feeding, and fattening various forts of live-ftock and domeftic animals, efpecially where they are carried on to any confiderable extent, not only in afcertaining and marking the progrefs which is made by the different animals, and in fhewing how they pay for the ufe of any particular kind of food, or what power and property it may have in promoting the fattening procefs, but in many other ways.

Weighing-machines, conftructed upon the fame plan as thofe ufed on the public roads, are applicable, too, in the above cafes, and many others of the rural kind, being ready and convenient for fuch ufes.

Weighing *of the Air*. See Weight *of Air*.

Weighing *Anchor*, in *Sea Language*. See Anchor.

WEIGHT, in *Phyfics*, a quality in bodies by which they tend towards the centre of the earth, or in a line perpendicular to its furface. Or, weight may be defined, more generally, a property inherent in all bodies, by which they tend to fome common point, called the centre of gravity; and that with a velocity in proportion as they are more or lefs denfe, or as the medium through which they pafs is more or lefs rare.

Weight and gravity are generally confidered as one and the fame thing. Some philofophers, however, diftinguifh gravity as the quality inherent in the body, and weight as the fame quality exerting itfelf according to its natural tendency. See Gravity, Gravitation, and Density.

Sir Ifaac Newton demonftrates, 1ft, That the weights of all bodies at equal diftances from the centre of the earth, are directly proportional to the quantity of matter that each contains: whence it follows, that the weights of bodies have no dependence on their fhapes or textures; and that all fpaces are not equally full of matter.

2dly, On different parts of the earth's furface, the weight of the fame body is different, owing to the fpheroidical figure of the earth, which caufes the body on the furface to be nearer the centre in going from the equator toward the poles: and the increafe in the weight is nearly in proportion to the verfed fine of double the latitude; or, which is the fame thing, to the fquare of the right fine of the latitude; the weight at the equator to that at the pole being as 229 to 230; or, the whole increafe of weight from the equator to the pole, is the 229th part of the former.

3dly, That the weights of the fame body at different diftances above the earth, are inverfely as the fquares of the diftances from the centre, fo that a body at the diftance of the moon, which is fixty femi-diameters from the earth's centre, would weigh only the 3600th part of what it weighs at the earth's furface.

4thly, That at different diftances within the earth or below the furface, the weights of the fame body are directly as the diftances from the earth's centre: fo that, at half way toward the centre, a body would weigh but half as much, and at the very centre it would have no weight at all.

5thly, A body immerfed in a fluid, which is fpecifically lighter than itfelf, lofes fo much of its weight, as is equal to the weight of a quantity of the fluid of the fame bulk with itfelf. Hence, a body lofes more of its weight in a heavier fluid than in a lighter one, and therefore it weighs more in a lighter fluid than in a heavier one.

The foregoing principles laid down by Newton are univerfally admitted as correct, with the exception of the proportional weight of bodies on different parts of the earth's furface; for it is important to obferve, that he founded his calculation of the earth's ellipticity on the hypothefis of its being homogeneous, which is not the cafe; and hence he makes the equatorial diameter greater than the polar axis, as 230 to 229. But from the numerous experiments fince made on the pendulum in different parts of the world, the ellipticity is found to be not fo great.

By the inveftigations on this fubject by the marquis de Laplace, (Mecanique Celefte, vol. ii.) the ellipticity is found to be $\frac{1}{336}$; and the calculations and experiments of other aftronomers concur nearly in this refult, making it on an average about $\frac{1}{308}$. In our article Standard, we have given tables of thofe determinations, and likewife of the principal experiments made on the pendulum in different latitudes; and we fhall here add fome further inveftigations and new calculations, as effentially connected with our fubject Weight, and of peculiar intereft at the prefent time.

The chevalier Delambre, in his "Aftronomie," vol. iii. p. 585, gives the following fimple and elegant expofition of the pendulum, with other ufeful formulæ for finding the earth's ellipticity, &c.

Let h be the height of the place of obfervation above the level of the fea; R, the radius of the earth; then the length of the pendulum is to be multiplied by

$$\left(\frac{R + h}{R}\right)^2 = \left(1 + \frac{2\,R\,h + h^2}{R^2}\right) = 1 + \frac{2\,h}{R}.$$

Let

Let L be the length of the pendulum at the equator; for another latitude, it will be $L + a$ fin.^{2} H, fo that a is the excefs of the polar pendulum above the equatorial pendulum, H being the latitude of the place.

Let m and n be the two pendulums obferved in two very different latitudes.

$$m = L + a \text{ fin.}^2 H,$$
$$n = L + a \text{ fin.}^2 H',$$

$m - n = a\,(\text{fin.}^2 H - \text{fin.}^2 H') = a \text{ fin. } (H - H') \text{ fin. } (H + H')$: hence $a = \dfrac{m - n}{\text{fin. } (H - H') \text{ fin. } (H + H')}$.

If there be a greater number of fimilar equations, put in each the numerical value of fin.^{2} H, and determine the two conftant quantities, L and a, by the fum of the obfervations, employing, if you think proper, the method of the fmaller fquares.

Now the ellipticity is proved to be $0.00865 - \dfrac{a}{L}$. We have then a value of the ellipticity, which may be compared with that of the degrees. It was in this manner that M. Mathieu found the ellipticity to be $\dfrac{1}{298.2}$, by the fix actual meafurements of the pendulum made on the meridian from Dunkirk to Formentera. So far Delambre.

From the above equations and formulæ it is manifeft, that if L, the length of the equatorial pendulum, and a, the difference between it and the polar pendulum, be known, all other queftions connected with the fubject may be accurately determined; and hence it is, that the important problem of meafuring the pendulum has long engaged, and ftill continues to command the attention of the firft aftronomers in Europe.

Laplace, in the Mecanique Celefte, gives the following values of L and a; *viz.* $0^m.990631631 + 0^m.005637$ fin.^{2} latitude, from which formula the lengths of the pendulum may be computed in all latitudes; but the fame learned author has recently publifhed another formula in the Connoiffance des Tems (1820, page 442), which is thus given.

" Mathieu, by a new difcuffion of all the obfervations of the pendulum, in ufing the refults of Borda's experiments reduced to the level of the fea, finds the following expreffion of the length of the pendulum,

$$0^m.990787 + 0^m.0053982 \text{ fin.}^2 \text{ latitude.}$$

" In this expreffion I have diminifhed by the two-thoufandth of a millimetre the refult of Borda upon this length, for the correction of the radius of the cylinder, which formed the knife edge; a radius which I value at eight thoufandths of a millimetre.

" The experiments now about to be made with particular care, in the two hemifpheres, will fhed new light on the coefficient of the fquare of the fine of the latitude, or on the variation of weight on the furface of the earth.".

From the above formula we have computed the following table, and have found the earth's ellipticity to be $\frac{1}{313}$. By this alfo the increafe of the weight of a body from the equator to the poles is $\frac{1}{180}$ of the whole, whereas that deduced from the Mecanique Celefte is $\frac{1}{178}$, which proportion has been adopted by Poiffon, Biot, and other writers on the fubject.

TABLE fhewing the comparative Weight of Bodies on different Parts of the Earth's Surface, with the proportional Length of the Seconds Pendulum, and alfo its daily Number of Vibrations in each Latitude: fuppofing it correct at the Greenwich Obfervatory, that is vibrating 86400 Seconds in 24 Hours.

	Degrees of Latitude.	Weight of 100lb. in different Latitudes.	Length of the Pendulum.		Number of Vibrations in each Latitude.
			Metres.	Englifh Inches.	
	0° 0′ 0″	100.0000	0.990787	39.0083	86256.3
	5 0 0	100.0042	0.990828	39.0090	86258.1
	10 0 0	100.0165	0.990950	39.0147	86263.4
	15 0 0	100.0366	0.991149	39.0226	86272.0
	20 0 0	100.0637	0.991418	39.0331	86284.0
	25 0 0	100.0973	0.991751	39.0462	86298.3
	30 0 0	100.1362	0.992136	39.0614	86315.0
	35 0 0	100.1793	0.992563	39.0782	86333.6
	40 0 0	100.2251	0.993017	39.0961	86353.3
	45 0 0	100.2724	0.993486	39.1145	86373.7
Paris obfervatory -	48 50 14	100.3088	0.993846	39.1287	86389.4
	50 0 0	100.3198	0.993955	39.1330	86394.1
Greenwich obfervatory -	51 28 40	100.3335	0.994091	39.1383	86400.0
London, St. Paul's -	51 30 49	100.3338	0.994094	39.1385	86400.2
	55 0 0	100.3656	0.994409	39.1509	86413.8
	60 0 0	100.4087	0.994836	39.1677	86432.4
	65 0 0	100.4476	0.995221	39.1829	86449.1
	70 0 0	100.4812	0.995554	39 1960	86463.5
	75 0 0	100.5083	0.995823	39.2065	86475.2
	80 0 0	100.5284	0.996022	39.2144	86483.9
	85 0 0	100.5407	0.996144	39.2192	86489.2
	90 0 0	100.5449	0.996185	39.2208	86491.0

In

In computing the foregoing table we have, as on former occafions in this work, reckoned the French metre at 39.371 Englifh inches, and the correctnefs of this meafure is of the greateft importance to fcience. It was that originally determined by M. Pictet, in the National Inftitute, by comparing the platina metre with the brafs yard made by Mr. Troughton, which was agreed upon by the Royal Society of London, as the beft medium among our different ftandards, and the moft accurate in its divifions. In making the neceffary deductions for the effects of temperature on the different metals, Borda's tables of expanfion were ufed; but from other tables and ftandards different lengths of the metre have been determined; particularly by Dr. Mafkelyne, who made it 39.370226, and lately by Capt. Kater, who comes ftill nearer to Pictet, making it 39.37071. But unlefs fuch meafurements are made from the fame ftandard yard, and with the fame tables of expanfion, perfect agreement cannot be expected; and then it will be neceffary to determine the important queftion, whether fuch tables and ftandards are quite correct? In fhort, an approximation to perfect accuracy is as much as can be hoped for. It is, however, fatisfactory to obferve, that the difference between the determinations of M. Pictet and Capt. Kater is fcarcely difcernible, even in the moft delicate operations of an obfervatory, as it does not amount, when applied in meafuring the pendulum, to more than one-third of a fecond in twenty-four hours. But for all general purpofes the difference is wholly imperceptible.

This near agreement, therefore, confirms the propriety of our continuing Pictet's meafure, which is fanctioned by general ufage both in England and France, and has the additional advantage of numerical fimplicity, which, for commercial purpofes, is no flight recommendation.

Before we enter upon the fubject of commercial weight, fome general view ought to be given of the operations now about to take place on the pendulum in the two hemifpheres, as alluded to in our quotation from Laplace.

The experiments intended by the French, in a voyage of difcovery to the fouthern hemifphere, are to be made with pendulums of an extremely fimple conftruction, the aftronomical rates of which are previoufly afcertained at the Paris obfervatory. In thefe pendulums no maintaining power is applied, nor any compenfation for temperature. The thermometer, therefore, and the magnitude of the arc of vibration, muft be continually obferved, and the neceffary corrections applied, as in the experiment of Borda explained in Delambre's Aftronomie, vol. iii. p. 579. Pendulums of a fimilar conftruction were employed by the French aftronomers, M. Biot and M. Arago, at the royal obfervatory of Greenwich, and in other parts of Great Britain during the laft year (1817); but the refult of their experiments has not yet reached us.

A very correct and beautiful apparatus has lately been erected at our royal obfervatory, for the purpofe of meafuring the length of the pendulum; and alfo with a view of determining, with extreme exactnefs, the difference of the force of gravity at Greenwich and Paris, or, in other words, the comparative weight of bodies in thefe two latitudes.

This apparatus does not very effentially differ from that of Borda, except that a cylindrical rod of a given length is affumed as a ftandard, and the difference between this cylinder and the whole vibrating fyftem is determined by a micrometer motion given to the fteel table. In the French apparatus the fteel table remains fixed, and the meafuring-rod is lengthened by means of a fcrew, till the lower furface comes in contact with the plane of the table.

We have likewife obferved, that in Mr. Pond's apparatus, the pendulum of the clock is, by an ingenious contrivance, brought almoft into contact with the experimental pendulum, by which the coincidences can be diftinctly obferved with a high optical power.

In the expedition which has been lately fent by the Britifh government to explore the arctic regions, experiments are to be made for fimilar purpofes, but with different apparatus. Two famous clocks, by Shelton, which were ufed by captain Cook, are fent. Each is furnifhed with a new brafs pendulum of an entire piece, which can only vary in length by change of temperature, and this is to be allowed for from conftant obfervation of the thermometer. The rates of the clocks in London have been accurately determined; and if the fame can be afcertained at or near the pole, the refult will be very important.

In concluding our view of the philofophy of weight, its varieties on the furfaces of the planets fhould be noticed; which are determined on the fame principles as on the furface of the earth. See PLANET, and SYSTEM.

The weight of bodies on the furface of the fun is computed by Laplace to be about twenty-five times greater than on that of the earth; without, however, allowing for the diminution of gravity by centrifugal force, which he calculates to be about $\frac{1}{7}$. See CENTRIFUGAL *Force*.

WEIGHT, in *Commerce*, denotes the quantity of any commodity or fubftance, which is determined by being placed in a fcale againft fome known ftandard or weight. The art of weighing is therefore of the utmoft importance, as it furnifhes the beft practical means of afcertaining the quantity of matter in any given body, and thence the value of moft of the neceffaries of life.

Weights are generally made of ftone, iron, lead, brafs, or mixed metal; and they are moftly ftamped by proper authorities, denoting that they have been fized or compared with fome known or legal ftandard. See STANDARD, and alfo MEASURE.

The weights of all nations differ from each other, and frequently in the fame country a great diverfity prevails. The common denomination is the pound, of which there are moftly two forts, one for weighing the precious metals, and the other for common articles; fuch are the troy and avoirdupois weights in England. The former is generally divided into twelve ounces, and the latter into fixteen. But their divifion and multiples, as well as relative proportions, are extremely various. We fhall confider them here under two diftinct heads, *viz.* *Ancient Weights*, and *Modern Weights*.

Ancient Weights. — From the great importance of weights and meafures, their adjuftments muft have been coeval with the firft regulations of civil fociety; and hence their origin is too remote to be traced by any authentic hiftory. The only ancient weights that are known with any degree of certainty are thofe of the Jews, Greeks, and Romans.

The ancient Jews, having no ftamped coin, weighed all their gold and filver in the following fimple manner, dividing their talent into 50 maneh, and their maneh into 60 fhekels.

TABLE I.—Jewifh Weights reduced to Englifh Troy Weight (from Arbuthnot).

			lb.	oz.	pwt.	gr.
Shekel			0	0	9	$2\frac{4}{7}$
60	Maneh		2	3	6	$10\frac{2}{7}$
3000	50	Talent	113	10	1	$10\frac{2}{7}$

Note.—In reckoning money, 50 fhekels made a maneh; but in weight, 60 fhekels.

TABLE II.—Grecian and Roman Weights reduced to Englifh Troy Weight (from Arbuthnot).

										lb.	oz.	pwt.	gr.
Lentes										0	0	0	$0\frac{85}{112}$
4	Siliquæ									0	0	0	$3\frac{1}{28}$
12	3	Obolus								0	0	0	$9\frac{3}{28}$
24	6	2	Scriptulum							0	0	0	$18\frac{3}{14}$
72	18	6	3	Drachma						0	0	2	$6\frac{9}{14}$
96	24	8	4	$1\frac{1}{3}$	Sextula					0	0	3	$0\frac{6}{7}$
144	36	12	6	2	$1\frac{1}{2}$	Sicilius				0	0	4	$13\frac{2}{7}$
192	48	16	8	$2\frac{2}{3}$	2	$1\frac{1}{3}$	Duella			0	0	6	$1\frac{5}{7}$
576	144	48	24	8	6	4	3	Uncia		0	0	18	$5\frac{1}{7}$
6912	1728	576	288	96	72	48	36	12	Libra	0	10	18	$13\frac{5}{7}$

For the fubdivifions of the Roman as, libra, or pound, fee As.

TABLE III.—Ancient Roman Weights reduced to Englifh Troy Weight (from Paucton).

												English Grains.
Siliqua Keration												3
3	Simplium											9
$3\frac{3}{7}$	$1\frac{1}{7}$	Sextans of Celfus										$10\frac{2}{7}$
6	2	$1\frac{3}{4}$	Scriptulum									18
18	6	$5\frac{1}{4}$	3	Denarius of Nero								54
$20\frac{4}{7}$	$6\frac{6}{7}$	6	$3\frac{5}{7}$	$1\frac{1}{7}$	Denarius of Papyrius							$61\frac{5}{7}$
24	8	7	4	$1\frac{1}{3}$	$1\frac{1}{6}$	Sextula						72
36	12	$10\frac{1}{2}$	6	2	$1\frac{3}{4}$	$1\frac{1}{2}$	Sicilicus					108
48	16	14	8	$2\frac{2}{3}$	$2\frac{1}{3}$	2	$1\frac{1}{3}$	Duella				144
144	48	42	24	8	7	6	4	3	Uncia			432
1728	576	504	288	96	84	72	48	36	12	Mina		5184
				9600	8400	7200	4800	3600	1200	100	Centumpondium.	

TABLE IV.—Other Divifions of the Roman Pound (from Paucton).

												English Grains.
Uncia												432
2	Sextans											864
3	$1\frac{1}{2}$	Quadrans, triunx, teruncium										1296
4	2	$1\frac{1}{3}$	Triens									1728
5	$2\frac{1}{2}$	$1\frac{2}{3}$	$1\frac{1}{4}$	Quincunx								2160
6	3	2	$1\frac{1}{2}$	$1\frac{1}{5}$	Sexunx, femis							2592
7	$3\frac{1}{2}$	$2\frac{1}{3}$	$1\frac{3}{4}$	$1\frac{2}{5}$	$1\frac{1}{6}$	Septunx						3024
8	4	$2\frac{2}{3}$	2	$1\frac{3}{5}$	$1\frac{1}{3}$	$1\frac{1}{7}$	Bes, beffis, des					3456
9	$4\frac{1}{2}$	3	$2\frac{1}{4}$	$1\frac{4}{5}$	$1\frac{1}{2}$	$1\frac{2}{7}$	$1\frac{1}{8}$	Dodrans, nonuncium				3888
10	5	$3\frac{1}{3}$	$2\frac{1}{2}$	2	$1\frac{2}{3}$	$1\frac{3}{7}$	$1\frac{1}{4}$	$1\frac{1}{9}$	Dextans			4320
11	$5\frac{1}{2}$	$3\frac{2}{3}$	$2\frac{3}{4}$	$2\frac{1}{5}$	$1\frac{5}{6}$	$1\frac{4}{7}$	$1\frac{3}{8}$	$1\frac{2}{9}$	$1\frac{1}{10}$	Deunx		4752
12	6	4	3	$2\frac{2}{5}$	2	$1\frac{5}{7}$	$1\frac{1}{2}$	$1\frac{1}{3}$	$1\frac{1}{5}$	$1\frac{1}{11}$	Libra, as, pondo	5184

The weight of the Roman denarius, ounce, and pound, is otherwife ftated as follows :

		English Grains.
By Arbuthnot,	the Denarius, (7th part of the Ounce)	62,4
	the Ounce	437,2
	the Pound	5246,4
By Chriftiani,	the Denarius, (8th part of the Ounce)	51,9
	the Ounce	415,1
	the Pound	4981,2

See DENARIUS.

Modern Weights, or rather weights ufed in modern times, are in general very remote in their origin. We fhall begin with Britifh weights, and follow with thofe of France, making accurate comparifons between both; after which the divifions of the weights of the principal trading places in Europe, and other parts of the world, will be given; with tables of their relative proportions, extracted, by permiffion, from the Univerfal Cambift.

Englifh Weights.—By the twenty-feventh chapter of *Magna Charta*, the weights are to be the fame all over England; but for different commodities there are two forts, *viz.* troy weight, and avoirdupois weight.

The origin from which they are both raifed is the grain of wheat, gathered in the middle of the ear: 32 of thefe well dried make one penny-weight, 20 penny-weights 1 oz., and 12 oz. 1 lb. troy. Stat. 51 Hen. III. 31 Edw. I. 12 Hen. VII.

By the laws of affife, from the reign of William the Conqueror to the reign of Henry VII., the legal pound weight contained a pound of 12 ounces, raifed from 32 grains of wheat; and the legal gallon meafure invariably contained 8 of thofe pounds of wheat, 8 gallons made a bufhel, and 8 bufhels a quarter.

Henry VII. altered the old Englifh weight, and introduced a pound, under the name of troy, which exceeded the old Saxon pound by $\frac{3}{4}$ of an ounce: in proof of this it is alleged, that Henry VIII. when he abolifhed the old pound in the eighteenth of his reign, and eftablifhed the troy, declares that the troy pound exceeded the old pound by $\frac{3}{4}$ of an ounce.

This troy pound now in ufe, confifting of 12 ounces, contains 5760 troy grains, and the ounce therefore contains 480 grains; confequently 360 grains, equal to $\frac{3}{4}$ of the ounce, deducted from 5760, leave 5400 troy grains, equal to the weight of the old Saxon pound which he abolifhed. It appears, therefore, that the old Saxon pound was $\frac{540}{576}$ of the prefent troy pound; and as the avoirdupois pound of 16 ounces contains 7000 troy grains, the old Saxon pound was $\frac{54}{70}$ of the prefent avoirdupois pound.

Although formerly 32 grains made a penny-weight, it has in later times been thought fufficient to divide the penny-weights into 24 equal parts called grains, being the leaft weights now in common ufe.

The firft ftatute that directs the ufe of the avoirdupois weight is that of 24 Henry VIII., which plainly implies that it was no legal weight till that ftatute gave it a legal fanction; and the particular ufe to which the faid weight is thus directed, is fimply for weighing butcher's meat in the market. How or when it came into private ufe is not clearly known. Phil. Tranf. vol. lxv. part i. art. 3.

TABLE V.—Of Troy Weight, as ufed by the Goldfmiths, &c.

Grains.			
24	Penny-weight.		
480	20	Ounce.	
5760	240	12	Pound.

The grain troy is divided into 20 mites, the mite into 24 doits,

doits, the doit into 20 periots, and the periot into 24 blanks. Thefe divifions are imaginary, but there are real weights of decimal divifions to the thoufandth part of a grain.

TABLE VI.—Of Troy Weight, as ufed by the Apothecaries.

Grains.				
20	Scruple. ℈			
60	3	Drachm. ʒ		
480	24	8	Ounce. ℥	
5760	288	96	12	Pound.

This weight is effentially the fame as troy weight, but differently divided. It is chiefly ufed for medical prefcriptions: but drugs are moftly bought and fold by avoirdupois weight.

TABLE VII.—Diamond Weight.

Diamonds and other precious ftones are weighed by carats, the carat being divided into 4 grains, and the grain into 16 parts. The diamond carat weighs $3\frac{1}{5}$ grains troy: thus,

Diamond Weight.				Troy Weight.
16 Parts	=	1 Grain	=	$0\frac{8}{10}$ Grain.
4 Grains	=	1 Carat	=	$3\frac{1}{5}$ Grains.

TABLE VIII.—Of Avoirdupois Weight.

Drachms.					
16	Ounce.				
256	16	Pound.			
7168	448	28	Quarter.		
28672	1792	112	4	Hundred.	
573440	35840	2240	80	20	Ton.

The drachm is fubdivided into three fcruples, and each fcruple into ten grains; the pound or 7680 grains avoirdupois = 7000 grains troy, and hence 1 grain troy = 1097 grains avoirdupois.

Hence alfo	-	144 lb. avoirdupois	=	175 lb. troy.
And	-	192 oz. ditto	-	175 oz. do.

The ftone is generally 14 lb. avoirdupois weight, but for butcher's meat or fifh it is 8 lb. Hence the hundred equals 8 ftone of 14 lb. or 14 ftone of 8 lb.

A ftone of glafs is 5 lb. A feam of glafs 24 ftone, or 120 lb.

The fother of lead is generally $19\frac{1}{2}$ cwt.
at Newcaftle, 21 cwt.
at Stockton, 22 cwt.

Hay and ftraw are fold by the load of 36 truffes.

The trufs of hay weighs 56 lb. and of ftraw 36 lb. The trufs of new hay is 60 lb. until the 1ft of September.

A view of local varieties of Englifh weights will follow the prefent article.

TABLE IX.—Wool Weight.

Wool, like other common articles, is weighed by the avoirdupois, but the divifions differ from the above table: thus,

7	Pounds	- -	=	1 Clove
2	Cloves	- -	-	1 Stone
2	Stone	- -	-	1 Tod
$6\frac{1}{2}$	Tods	- -	-	1 Wey
2	Weys	- -	-	1 Sack
12	Sacks	- -	-	1 Laft.

The Weights of Ireland are the fame as thofe of England; and they are ufed for corn inftead of meafures, which feems to be the moft correct method of dealing.

Weights of Scotland.—By the act of union paffed in 1707, the weights and meafures of England were to be adopted in Scotland, but their introduction there is by no means general.

The Englifh troy weight and apothecaries' weight, however, are ufed throughout Scotland, in the fame manner as in England, with the exception that the Scotch jewellers divide the troy ounce into 16 drops, each drop being 30 troy grains; whereas the Englifh divide it into 20 penny-weights, and a penny-weight into 24 grains, as before ftated.

The Englifh avoirdupois weight is ufed for the fale of leather, foap, fugar, tea, flour, candles, and other groceries; alfo for felling rofin, wax, pitch, wrought metals, fome Baltic goods, and all goods brought from England.

Scotch troy weight, alfo called *Amfterdam* and *French Weight*, is ufed for weighing iron, hemp, flax, Baltic and Dutch goods, meal, butcher's meat, unwrought pewter and lead, and likewife for fome more articles. The pound, 16 of which compofe a ftone, contains 7616 troy grains: it is confequently nearly 9 *per cent.* heavier than avoirdupois, or 100 lbs. are equal to $108\frac{4}{5}$ lbs. avoirdupois.

Trone Weight.—This weight was abolifhed by act in 1618. Its name is ftill retained in felling butter, cheefe, tallow, wool, lint, hemp, hay, and fome other home commodities; but the trone ftone and pound are generally denominated by avoirdupois pounds and ounces. The trone pound always contains the fame number of ounces avoirdupois, as the ftone contains pounds. The weight of the ftone, however, is variable. It appears from a recent publication (Kelly's Metrology), that there are about thirty different fyftems of weights and meafures in Scotland.

Weights of France.—In order fully to explain this important part of our article, three different weights muft be noticed; *viz.* the ancient fyftem, called the "Poids de Marc;" the "Metrical Syftem," begun in 1795; and the "Syfteme Ufuel," fanctioned by an Imperial decree of 1812.

The old French weight (poids de marc), the pound or livre, contains 2 marcs, 16 ounces, 128 gros, 384 deniers, and 9216 grains, and equals 7556 grains troy. The new or metrical fyftem, alfo called the decimal fyftem, has been already explained under our article STANDARD. The following are its divifions, with its proportion to the poids de marc and Englifh troy weight. The gramme is the element of all weights, and it is multiplied and divided by tens in the following terms:

The word *Deca* prefixed means	-	10 times.
Hecto - -	-	100 times.
Kilo - -	-	1000 times.
Myria - -	-	10000 times.

On the contrary, for divifors,

the word *Deci* expreffes the	10th part,
Centi - -	100th part, and
Milli -	1000th part.

TABLE

TABLE X.

	Poids de Marc.					Eng. Troy Weight.			
	livres.	on.	gros.	grs.		lb.	oz.	dwt.	grs.
Bar or Cubic Metre of Water.	2042	14	0	14	-	2681	3	6	2
Myriagramme	20	6	6	63.5	-	26	9	15	1.46
Kilogramme	-	2	0	5 35.15	-	2	8	3	12.146
Hectogramme	-	-	3	2 10.715	-		3	4	8.414
Decagramme	-	-		2 44.2715			-	6	10.441
Gramme	-	-		18.82715			-		15.4441
Decigramme	-	-		1.882715			-		1.54441
Centigramme	-	-		0.1882715				-	0.15444

The gramme weighs 5.648 drachms avoirdupois, and the kilogramme 35.3 oz. or 2 lb. 3 oz. 4.8 drachms avoirdupois. The *Quintal Metrique*, therefore, weighs 1 cwt. 3 qrs. 24 lb. avoirdupois.

The pound of the *Syſteme Uſuel*, is the half kilogramme; but the diviſions are binary, according to the ancient ſyſtem.

Weights of Spain.—The Caſtilian mark is uſed for the precious metals. In weighing gold, it is divided into 50 caſtellanos, 400 tomines, or 4800 grains; but for ſilver, the ſame mark is divided into eight ounces, 64 ochavos, 128 adarmes, 384 tomines, or 4608 grains. The commercial weight is alſo Caſtilian. The pound is divided into 2 marks, 16 ounces, 128 drachms, or 9216 grains.—25 pounds = 1 arroba; 4 arrobas = 1 quintal.

Weights of Portugal.—Gold and ſilver are weighed by the mark of 8 ounces; the ounce being ſubdivided into 8 outavas, 24 eſcrupulos, or 576 grains. The commercial pound is divided into 2 marks or 16 ounces, the ounce into 8 outavas or 576 grains.—32 lb. = 1 arroba; 4 arrobas = 1 quintal.

Weights of Holland.—Gold and ſilver are weighed by the mark of 8 ounces. The ounce is divided into 20 engels or eſterlins; the engel into 32 aas. Thus the mark weighs 5120 aas. The commercial pound is 40 aas heavier than the above pound troy. It is divided into 2 marks, 16 ounces, 32 loots, or 128 drachms.—8 lb. = 1 ſtone; 15 lb. = 1 liſpond; 100 lb. = 1 centner; and 300 lb. = 1 ſhippond.

A new ſyſtem of monies, weights, and meaſures, ſimilar to the decimal ſyſtem of France, has been lately decreed for Holland, Brabant, and Flanders, by the king of the Netherlands.

Weights of Germany.—The weight for gold and ſilver is not the ſame in all parts of Germany, but the Cologne mark is every where the ſtandard weight for coins. It is divided into 8 ounces, 16 loths, 256 pfenings, 512 hellers, 4352 eſchen, or 65536 richt-pfenings. The pound or pfund commercial weight is generally divided into 2 marks, 16 ounces, 32 loths, 128 quentins, 512 pfenings, 1024 hellers. The larger weights are the ſhippond, the centner or quintal, the liſpond, and the ſtein; but they do not in all places contain the ſame number of pounds, and their diviſions as well as relative proportions are extremely various throughout the empire.

Weights of Italy.—The weights of Italy are various both in their diviſions and relative proportions. Thus, at Rome, the pound for weighing gold and ſilver is divided into 12 ounces, the ounce into 12 drachms, 24 denari or ſcrupoli, 48 oboli, 144 ſilique or 576 grani. At Naples, the pound or libra is divided into 12 ounces, the ounce into 30 trapeſi, and the trapeſo into 20 acini. At Genoa, Florence, Leghorn, and Milan, it is divided into eight ounces, the ounce into 24 denari or 576 grani. At Venice, the marc is divided into 8 oncie, 32 quarti, 192 denari, 1152 carati, or 4608 grani. The commercial weight in moſt of the above places is the ſame for light goods as for gold and ſilver, and is called peſo ſottile; but a heavier weight is uſed for coarſe commodities, and is called peſo groſſo. Their cantaro or quintal varies from 100 to 250 lb., and in ſome places the great cantaro is 1000 lb.

Weights of Denmark.—The pound for gold and ſilver contains 2 marks, 16 ounces, 32 lots, 128 quentins, or 512 orts or pfenings. The pound commercial weight is divided like that for the precious metals. The ſhippond contains 320 lbs. 20 liſponds, or $3\frac{1}{5}$ centners.

Weights of Sweden.—The marck for the precious metals contains 4384 aas; but for commercial purpoſes there are four other weights, *viz.* the victualie-wigt, divided into 32 lods or 128 quentins; the bergs-wigt or miner's weight, the landſtads-wigt, and the metal-wigt. The pound of each of the three latter is divided into 16 lods, or 64 quintals.

Weights of Ruſſia.—The pound in Ruſſia uſed for all commodities is divided into 32 loths, or 96 ſolotnicks.—40 lb. = 1 pood, and 10 poods = 1 berquet.

Weights of Aſia.—The weights of Aſia are far too numerous and various in their diviſions for our limits; but it may be obſerved, that decimal diviſions are more general there than in Europe.

Weights of Africa.—Upon the Barbary coaſt and in Egypt, the weights are ſimilar to each other in their diviſions, but very different in their relative proportions. The principal weight is the cantaro, divided into 100 rottoli, which is likewiſe uſed in Italy, Conſtantinople, and ſeveral places in the Levant.

Weights of America.—The weights and meaſures generally uſed in America, are thoſe of the countries by which the different ſettlements were originally colonized. Thus the Spaniſh weights are retained in all parts of South America except Brazil, where thoſe of Portugal are uſed. In the United States of North America, the Engliſh ſyſtem of weights and meaſures is ſtill continued, although ſeveral plans have been propoſed for changing them.

Compariſon of Weights.—The following Tables ſhew the relation between Engliſh and foreign weights. Alſo the proportion of the latter to each other, which is found by a ſingle ſtating in the Rule of Three, as in the following examples:

Example 1.—How many marks of Berlin weight are equal to 560 kilogrammes of France?

Becauſe 159.29 marks of Berlin = 100 lb. Engliſh Troy (*per* Table XI.), and 37.31 kilogrammes, by the ſame Table, = 100 lb. Engliſh Troy; it follows that 37.31 kilogrammes = 159.26 marks of Berlin; therefore, ſay,

As 37.31 kilog. : 159.29 marks :: 560 kilog. : 2390.84 marks.

Example 2.—How many pounds commercial weight of Amſterdam are equal to 276 pounds of Leghorn?

Here, by Table XII., 91.81 lb. of Amſterdam = 133.56 lb. of Leghorn, both being equal to 100 lb. Avoirdupois; therefore,

As 133.56 lb. of Leghorn : 91.81 lb. of Amſterdam :: 276 lb. of Leghorn : 189.7 lb. of Amſterdam.

TROY

Troy Weight.

Table XI.—Containing a Comparifon of the Troy, or Gold and Silver Weights of different Countries; and fhewing the Number of Pounds, Marks, Ounces, &c. of each Place, that are equal to 100 Pounds Englifh Troy; and alfo the Weight of a fingle Pound, Mark, Ounce, &c. in Englifh Troy Grains.

		Weight of 100 lbs. Englifh Troy.	Weight of a fingle lb. Mark, &c.
			E. Grains.
Amfterdam	Marks	151.68	$3797\frac{1}{2}$
Antwerp	The fame		
Augfburg	Marks	158.11	3643
Bafil	(See *Cologne.*)		
Berlin	Marks	159.29	3616
Bern	Marks	151.18	3810
Bombay	Tolas	3232.32	$178\frac{1}{5}$
Bremen	(See *Cologne.*)		
Breflau	Marks	182.39	3158
Bruffels	(See *Amfterdam.*)		
Cadiz	(See *Spain.*)		
Cairo	Rottoli	86.56	6654
Calicut	Mifcals	8347.82	69
China	Tales	993.79	$579\frac{3}{4}$
Cologne	Marks	159.64	3608
Conftantinople	Chekies	117	$4922\frac{1}{2}$
	Drams	11700	$49\frac{1}{4}$
Cracow	Marks	187.68	3069
Damafcus	Metecals	8347.82	69
Dantzic	Marks	195.42	$2947\frac{1}{2}$
Denmark	Marks	158.89	3625
England	Pounds Troy	100	5760
	Ounces do.	1200	480
Florence	Pounds	109.90	5241
	Oncie	1318.83	$436\frac{3}{4}$
Frankfort	(See *Cologne.*)		
France	Marks	152.44	3780
	Ounces	1219.52	472
	Kilogrammes	37.31	15444
	Hectogrammes	3731.53	$1543\frac{3}{5}$
Geneva	Marks	152.15	$3785\frac{1}{2}$
	(Or like *France.*)		
Genoa	Libre	117.45	4904
	Oncie	1409.40	$408\frac{2}{3}$
Hamburgh and Hanover	(See *Cologne.*)		
Holland	(See *Amfterdam.*)		
Konigfberg	Marks	190.50	$3023\frac{1}{2}$
Leghorn	(See *Florence.*)		
Leipfic	(See *Cologne.*)		
Lifbon	Marks	162.62	3542
Lubec	(See *Cologne.*)		
Madras	Seers	134.17	4293
	Pagodas	10919.40	$52\frac{4}{5}$
	Rupees	3217.87	179
Madrid	(See *Spain.*)		
Malabar	(See *Madras.*)		
Malta	Libre	117.83	4888
Milan	Marks	158.75	3629
	Ounces	1270	$453\frac{1}{2}$
Naples	Libre	116.36	4950
	Oncie	1396.32	$412\frac{1}{2}$
Nuremberg	Marks	156.95	3670
Paris	(See *France.*)		
Pegu	Ticals	2426.82	$233\frac{1}{8}$
Perfia	Mifcals	8022.25	$71\frac{4}{5}$
Poland	Marks	185	3113
Portugal	(See *Lifbon.*)		
Prague	Marks	147.09	3916
Ratifbon	Marks	151.68	$3797\frac{1}{2}$
Riga	Marks	178.43	3228
Rome	Libre	110	5236
Ruffia	Pounds	91.23	6314
	Solotnicks	8758	$65\frac{3}{4}$
Sienna	Libre	111.22	$5178\frac{1}{2}$
Spain	Marks	161.87	3557
	Ounces	1294.96	$444\frac{5}{8}$
	Caftellanos	8093.50	71
Surat	Tolas	3066.55	$187\frac{1}{7}$
Sweden	Marks	177.12	3252
Tripoli	Metecals	7819	$73\frac{2}{3}$
Tunis	Ounces	1185.20	486
Turin	Marks	151.68	$3797\frac{1}{2}$
Venice	Marks	156.44	3682
Vienna	Marks	132.88	$4334\frac{1}{2}$
Zurich	Marks	159.27	$3616\frac{1}{5}$

Avoirdupois

Avoirdupois Weight.

Table XII.—Containing a Comparifon of the Commercial Weights of different Places; and fhewing the Number of Pounds, &c. of each Place that are equal to 100 Pounds Avoirdupois; and alfo the Weight of a fingle Pound, &c. in Englifh Troy Grains, 7000 of which weigh one Pound Avoirdupois.

		Weight of 100 lbs. Avoirdupois.	Weight of a fingle lb. Mark, &c.
			E. Grains.
Aix la Chapelle	Pounds - - - -	96.76	7234
Aleppo - -	Rottoli of 720 drs.	19.89	35190
	Do. of 700 drams	20.46	34212
	Do. of 680 drams	21.06	33235
	Do. of 600 drams	23.87	29325
	Okas of 400 drams	35.80	19550
Alexandria -	Rottoli Forfori -	107	6542
	Zaydini - - -	74.90	9345
	Zauri - - - -	48.32	14485
	Mine - - - -	59.92	11682
Algiers - -	Rottoli - - - -	84	8330
Alicant - -	Great pounds - -	87.48	8002
	Light pounds - -	131.20	5335
Altona - - -	(See *Hamburgh.*)		
Amfterdam -	Pounds - - - -	91.80	7625
Ancona - -	Pounds - - - -	136.05	5145
Antwerp - -	Pounds - - - -	96.75	7235
Apothecaries' Weight.			
	Englifh pounds -	121.52	5760
	Dutch pounds -	122.89	5696
	German pounds -	126.65	5527
	French pounds (of 12 ounces) -	123.50	5668
Archangel -	(See *Ruffia.*)		
Augfburg - -	Heavy pounds -	92.35	7580
	Light pounds - -	95.95	7295
Aurich - -	Heavy pounds -	83	8433
	Light pounds - -	91.10	7666
Bamberg - -	Pounds - - - -	93.42	7493
Barcelona - -	Pounds - - - -	112.60	6216
Bafil - - -	Pounds - - - -	92.64	7556
Baffano - -	Pounds - - - -	132.82	5270
Batavia - -	Catties - - - -	76.78	9117
Bengal - - -	Seers - - - -	53.57	13066
Bergamo - -	Light pounds - -	139	5032
	Heavy pounds -	55.64	12580
Bergen - -	Pounds - - - -	91	7700
Berlin - - -	Pounds - - - -	96.80	7231
Bern - - -	Pounds - - - -	86.85	8060
Betelfagui - -	Maunds - - -	49.04	14273
Bilboa - - -	Light pounds - -	92.59	7560
	Iron weight pounds	63.42	11037
Bologna - -	Pounds - - - -	125.31	5586
Bolfano - -	Pounds - - - -	90.61	7725
Bourdeaux -	Pounds - - - -	91.72	7632
Bremen - -	Pounds - - - -	90.93	7698
Brefcia - -	Pounds - - - -	138.62	5050
Breflau - -	Pounds - - - -	111.90	6255
Brunfwick -	Pounds - - - -	97.14	7206
Bruffels - -	(See *Antwerp.*)		
Cadiz - - -	(See *Spain.*)		
Cairo - - -	Rottoli - - - -	105	6664
Calemberg -	Pounds - - - -	93.19	7511
Calicut - -	Seyras - - - -	163.05	4293
Candia - - -	Rottoli - - - -	85.91	8148
Carthagena -	(See *Spain.*)		
Caffel - - -	Pounds - - - -	93.32	7501
Caftile - - -	(See *Spain.*)		
Chamberry -	Pounds - - - -	105.72	6621
China - - -	Catties - - - -	75.45	9277
Civita Vecchia	Pounds - - - -	132.90	5267
Cologne - -	Pounds - - - -	97	7216
Conftance - -	Pounds - - - -	96.09	7285
Conftantinople	Okas - - - -	35.55	19688
	Lodras - - - -	80.80	8663
	Chekies - - -	142.22	4922
Copenhagen -	Pounds - - - -	90.80	7725
Corfu - - -	Pounds - - - -	111	6304
Corfica - -	Pounds - - - -	131.72	5315
Cracow - -	Pounds - - - -	112	6250
Cremona - -	Pounds - - - -	138.33	5060
Cyprus - -	Rottoli - - - -	19.07	36708
Damafcus - -	Rottoli - - - -	25.28	27690
Dantzic - -	Pounds - - - -	103.07	6791
Denmark - -	(See *Copenhagen.*)		
Deventer - -	Pounds - - - -	96.43	7259
Drefden - -	Pounds - - - -	97.14	7206
Dunkirk - -	Pounds - - - -	105.86	6612
Elbing - - -	Pounds - - - -	106.73	6558
Embden - -	Pounds - - - -	91.29	7668
England - -	Avoirdupois pounds	100	7000
Erfurt - - -	Pounds - - - -	96.08	7285
Ferrara - - -	Pounds - - - -	133.67	5237
Florence - -	Pounds - - - -	133.56	5241
Frankfort - -	Pounds - - - -	97.02	7210
France, Poids de	Marc pounds - -	92.64	7556
	Kilogrammes - -	45.35	15436
	Hectogrammes -	453.50	15435
Gallipoli - -	(See *Naples.*)		
Geneva - -	Heavy pounds -	82.35	8502
	Light pounds - -	98.82	7085
Genoa - - -	Pefo groffo Rottoli	92.86	7538
	Pefo fottile pounds	142.74	4904
Gothenburg -	(See *Sweden.*)		
Groningen -	Pounds - - - -	92.69	7552
The Hague -	(See *Amfterdam.*)		
Hamburgh -	Pounds - - - -	93.63	7476
Hanover - -	Pounds - - - -	93.20	7511
Havre-de-Grace	Pounds - - - -	85.78	8160
Heidelberg -	Pounds - - - -	89.89	7787
Hildefheim -	(See *Brunfwick.*)		
Holland - -	(See *Amfterdam.*)		
Holftein - -	Pounds - - - -	93.83	7460
Japan - - -	Catties - - - -	76.92	9100

TABLE XII.—*continued.*

		Weight of 100 lbs. Avoirdupois.	Weight of a single lb. Mark, &c.
			E. Grains.
Kiel	Pounds	95.18	7354
Konigsberg	Pounds	119.27	5869
	New (See *Berlin.*)		
Leghorn	Pounds	133.56	5241
Leipsic	Common pounds	97.14	7206
	Butcher's weight lb.	90	7771
Liebau	Pounds	109.84	6373
Liege	Pounds	95.49	7330
Lindau	Heavy pounds	78.58	8908
	Light pounds	98.23	7126
Lisbon	Pounds	98.80	7085
Lisle	Pounds	105.61	6628
London	(See *England.*)		
Lubec	Pounds	93.83	7460
Lucca	Pounds	135.59	5163
Lucern	Pounds	94	7447
Luneburg	(See *Hanover.*)		
Lyons	Poids de table pound	105.87	6612
	Silk weight pound	98.81	7084
Madeira	Pounds	104.10	6724
Madras	Vis	32	21875
	Pollams	1280	547
Madrid	(See *Spain.*)		
Magdeburg	(See *Berlin.*)		
Majorca	Rottolos	107.82	6492
Malabar	(See *Calicut.*)		
Malacca	Catties	74.07	9450
Malaga	(See *Spain.*)		
Malta	Pounds	143.20	4888
Manheim	Pounds	91.65	7638
Mantua	Pounds	143.70	4871
Marseilles	Pounds	111.63	6271
Mecca	Rottoli	98	7144
Mecklenburg	Pounds	93.86	7458
Memel	Pounds	109.82	6374
Messina	(See *Sicily.*)		
Milan	Peso Grosso pounds	60.39	11592
	Peso Sottile pounds	140.90	4968
Minorca	Heavy pound	37.88	18480
	Light pound	113.63	6160
Mocha	Maunds	33.33	21000
	Vakias	133335	525
Modena	Pounds	141.93	4932
Monaco	Pounds	136.87	5114
Montpellier	Com. weight pounds	113.58	6163
Morea	Silk weight pounds	113.50	6167
	Pounds	90.79	7710
	Okas	37.83	18503
Moscow	(See *Russia.*)		
Munich	Pounds	80.87	8656
Munster	Pounds	95.31	7344
Nantes	(See *France.*)		
Naples	Rottoli	50.91	13750
	Libre	141.41	4950
Narva	Pounds	96.84	7228
Negropont	Rottoli	84.73	8261
Neufchatel	Poids de Marc, (See *France.*)		
	Poids de Fer pounds	87.18	8029

		Weight of 100 lbs. Avoirdupois.	Weight of a single lb. Mark, &c.
			E. Grains.
Nice	Pounds	146.25	4786
Nimeguen	Pounds	91.65	7638
Nordlingen	Pounds	92.53	7565
Norway	(See *Bergen.*)		
Novi	(See *Genoa.*)		
Nuremberg	Pounds	88.94	7870
Oldenburg	(See *Hamburgh.*)		
Oporto	(See *Lisbon.*)		
Oran	Rottolos	90	7775
Ormus	Seyras	149.73	4675
Osnaburg	Pounds	91.80	7625
Ostend	(See *Antwerp.*)		
Paderborn	(See *Munster.*)		
Padua	Peso Sottile pounds	133.33	5250
	Peso Grosso, (See *Venice.*)		
Palermo	(See *Sicily.*)		
Paris	(See *France.*)		
Parma	Pounds	139.33	5024
Passau	Pounds	94.41	7414
Pegu	Vis	30	23333
Pernau	Pounds	108.86	6430
Perugia	Pounds	130	5382
Pillau	Pounds	113.56	6164
Pisa	Pounds	139.22	5028
Poland	(See *Warsaw.*)		
Pondicherry	Vis	30.88	22668
Portugal	(See *Lisbon.*)		
Prague	Pounds	88.16	7940
Presburg	(See *Vienna.*)		
Ragusa	Pounds	124.84	5607
Ratisbon	Pounds	79.81	8771
Ravenna	Pounds	151.42	4628
Reggio	Pounds	137.48	5092
Revel	Pounds	105.32	6646
Riga	Pounds	108.46	6454
Rochelle	(See *France.*)		
Rome	Pounds	133.69	5236
Rostock	Pounds	88.75	7887
Rotterdam	Pounds	91.80	7625
	Light weight pound	96.39	7262
Rouen	Poids de Vicomté Pounds	87.40	8009
Russia	Pounds	110.86	6314
Saltzburg	Pounds	81	8642
St. Gall	Heavy pounds	77.58	9022
	Light pounds	97.55	7176
St. Maloes	(See *France.*)		
St. Remo	(See *Genoa.*)		
St. Sebastian	Pounds	92.64	7556
Sardinia	Pounds	114.29	6125
Sayde	Rottoli of Damascus	24.35	28746
	Ditto of Acre	20.75	33740
Scotland	Pounds Dutch Weight	92.11	7600
Siam	Catties	38.76	18060
Sicily	Rottoli Grossi	51.93	13475
	Ditto Sottili	57.14	12250
	Libre	142.85	4900
Sienna	Pounds	101.38	6904

TABLE XII.—*continued.*

		Weight of 100 lbs. Avoirdupois.	Weight of a ſingle lb. Mark, &c.
			E. Grains.
Smyrna	Okes	36.51	19172
	Rottoli	81.13	8628
Spain	Caſtillian weight lb.	98.40	7114
Stade	Pounds	95.46	7333
Stettin	(See *Berlin.*)		
Stockholm	(See *Sweden.*)		
Stralſund	Pounds	93.83	7460
Straſburg	Pounds	96.34	7266
	Or, like *France.*		
Sumatra	Catties	35.56	19683
Surat	Seers	107.14	6533
Surinam	(See *Amſterdam.*)		
Sweden	Victualie weight Pounds	106.67	6562
	Miner's weight Marks	120.68	5800
	Landſtatt weight Marks	126.70	5525
	Stapelſtatt weight Marks	133.33	5250
Tangiers	Pounds	94.27	7425
Teneriffe	Pounds	98.77	7087
Tetuan	Rottoli	63.96	10944
Toulon	(See *Marſeilles.*)		
Trieſte	(See *Venice* and *Vienna.*)		

		Weight of 100 lbs. Avoirdupois.	Weight of a ſingle lb. Mark, &c.
			E. Grains.
Tripoli (in Syria)	Okes	37.45	18691
Tripoli (in Africa)	Rottoli	89.28	7840
Tunis	Ditto	90.09	7770
Turin	Pounds	122.93	5694
Ulm	Pounds	96.77	7234
Valencia	Heavy pounds	84.72	8262
	Light pounds	127.08	5508
Venice	Peſo Groſſo pounds	94.74	7389
	Peſo Sottile pounds	150	4667
Verona	Peſo Groſſo pounds	91.19	7676
	Peſo Sottile pounds	136.35	5134
Vicenza	Peſo Groſſo pounds	92.75	7547
	Peſo Sottile pounds	133.33	5250
Vienna	Pounds	81	8638
Warſaw	Old weight pounds	120	5832
	New Poliſh wt. Pounds	112.25	6236
Wiſmar	Pounds	93.76	7466
Wurtzburg	Pounds	95.08	7362
Yvica	Pounds	97.97	7145
Zant	(See *Venice.*)		
Zell	(See *Hanover.*)		
Ziriczee	Pounds	103.94	6735
Zurich	Heavy pounds	86.03	8136
	Light pounds	96.78	7233
Zwoll	Pounds	94.10	7439

Plan for the Reviſion of foreign Weights, &c.—The commercial world will learn with ſatisfaction that a plan has lately been commenced, under the auſpices of the Britiſh government, for reviſing the tables of compariſon between foreign weights and meaſures; as it is well known that many of the tables in uſe abound in contradictory ſtatements; and even where they agree, they are frequently found to differ from mercantile experience.

The origin of thoſe tables of compariſon cannot be traced. It is probable that they have been gradually formed through a long courſe of ages, from the caſual reports of individuals in different countries. When, therefore, it is conſidered, how uncertain ſuch reports muſt have been, and alſo to what changes weights and meaſures are expoſed from decay, accident, or deſign, it is not ſurpriſing that ſo much confuſion ſhould be experienced, eſpecially in tables where no general reviſion has ever taken place.

The only compariſon of the kind upon record is that made in 1767, by M. Tillet, at the Paris Mint, by order of the French government. His operations, however, were confined to money weights, and theſe only of a limited number of places. His tables, as far as they extend, have been generally uſed, although their accuracy is, in many inſtances, diſputed, eſpecially by Kruſe, and other German writers. Nelkenbrecker, in his elaborate work on monies, weights, and meaſures, publiſhed at Berlin in 1810, gives a long ſtatement (page 508.) of diſcrepances between Tillet's reports and thoſe of other aſſay maſters.

But the moſt numerous and important errors are in the tables of commercial weights and meaſures; and therefore with a view of remedying an evil ſo perplexing to merchants, our government has recently iſſued an order to the Britiſh conſuls abroad, to ſend home well-atteſted copies of foreign ſtandard weights, that they may be accurately compared with thoſe of England at his majeſty's mint. Correct ſtatements are likewiſe required of the mathematical dimenſions of meaſures of capacity, and of their comparative contents, as eſtimated and acted upon by merchants.

We have authority further to ſtate, that the plan was examined and approved by the Board of Trade, on the 14th of January 1818; and, by their lordſhips' recommendation, the order to the conſuls has been iſſued from the foreign-office, by Viſcount Caſtlereagh.

The copies of ſtandards thus tranſmitted to London are to be weighed and compared by Robert Bingley, eſq. F.R.S., the king's aſſay-maſter of the Mint; and the reſults of thoſe important compariſons are to be publiſhed by Dr. Kelly, who projected the plan, and who will perform the calculations. The reviſed tables are expected to be brought out in the ſecond edition of his Cambiſt; and ſhould they be printed before our Cyclopædia is finiſhed, we hope for the author's permiſſion to inſert them in our *Addenda.*

WEIGHTS

WEIGHTS *and Meaſures*, in *Agriculture* and *Rural Economy*, are of great conſequence to the land-owner and the farmer, as being the proportions or quantities by which various ſorts of produce, of the agricultural and other ſuch kinds, are diſpoſed of and ſold. They are found to vary very greatly in different diſtricts and parts of the country, as well as in different places and towns of the ſame diſtrict or county, and even in the markets of the ſame town. Conſequently, the confuſion, uncertainty, inconvenience, and loſs which are thus produced, are often very great and troubleſome. We have already, in the preceding article, obſerved, that the two principal weights eſtabliſhed in Great Britain are the troy and avoirdupois weights, and by theſe moſt of the articles of farm produce, and thoſe of many other kinds, are ſold in this country.

There are ſome, however, that are diſpoſed of in other ways, as will be ſeen below.

However, as the diverſity of weights and meaſures (in different places) creates much perplexity and uncertainty in the purchaſe as well as diſpoſal of different ſorts of produce, it would not only be highly deſirable, but convenient and advantageous, to have one univerſal ſtandard or ſyſtem of weights and meaſures. For an account of the attempts that have been made to obtain ſuch a ſtandard, ſee STANDARD.

Different Weights and Meaſures for Farm and other produce by Troy Weight.

24 Grains	make	1 Pennyweight
20 Pennyweights	-	1 Ounce
12 Ounces	- -	1 Pound.

By this weight are weighed gold, ſilver, amber, bread, corn, and all liquors.—14 oz. 11 dwts. $15\frac{1}{2}$ grains, or 292 dwts. nearly, are equal to a pound avoirdupois.

By Avoirdupois Weight.

16 Drams	make	1 Ounce
16 Ounces	- - -	1 Pound
28 Pounds	- - -	1 Quarter
4 Quarters	- - -	1 Hund. weight
20 Hund. weight	- - -	1 Ton.

By this weight are weighed all the farm produce, ſuch as butter, cheeſe, and many other articles; and all metals, except thoſe of the finer kinds. In other caſes,

$7\frac{1}{2}$ Pounds	make	1 Gallon of train-oil
8 Pounds	- -	1 Stone of butcher's meat
14 Pounds	- -	1 Stone of horſeman's weight
$19\frac{1}{2}$ Hundreds	-	1 Fodder of lead.

In Wool Weight.

$7\frac{1}{2}$ Pounds	make	1 Clove
2 Cloves	- - -	1 Stone
2 Stone	- - -	1 Todd
$6\frac{1}{2}$ Todds	- - -	1 Weigh or Wey
2 Weys	- - -	1 Sack
12 Sacks	- - -	1 Laſt.

In Hay Weight.

56 Pounds of old hay, or 60 Pounds of new ditto	make	1 Truſs
36 Truſſes	- - - -	1 Load.

In Bread Weight.

	lb.	oz.	dr.
A peck loaf weighs - -	17	6	$0\frac{1}{2}$
A half ditto - - - -	8	11	0
A quartern ditto - - -	4	5	8

By Dry Meaſure.

2 Pints	make	1 Quart
2 Quarts	- - - -	1 Pottle
2 Pottles	- - - -	1 Gallon
2 Gallons	- - - -	1 Peck
4 Pecks	- - - -	1 Buſhel
4 Buſhels	- - - -	1 Coomb
2 Coombs, or eight buſhels	-	1 Quarter
4 Quarters, or 32 buſhels in the country, and 36 in London		1 Chaldron
5 Quarters	- - - -	1 Weigh or Wey
2 Weys, or 10 quarters	- -	1 Laſt.

By this meaſure are meaſured corn, ſalt, lead, ore, oyſters, different other ſuch matters, and all dry goods. The ſtandard Winchester buſhel is a cylinder $18\frac{1}{2}$ inches diameter, and 8 inches deep.

By Long Meaſure.

3 Barleycorns	make	1 Inch
12 Inches	- - - -	1 Foot
3 Feet	- - - -	1 Yard
6 Feet	- - - -	1 Fathom
$5\frac{1}{2}$ Yards	- - - -	1 Pole, rod, or perch
40 Poles	- - - -	1 Furlong
8 Furlongs	- - - -	1 Mile
3 Miles	- - - -	1 League
60 Geographical, or $69\frac{1}{2}$ Engliſh miles	-	1 Degree
360 Degrees	- - - -	The circumference of the Globe.

This comprehends length only, as in the above caſes.

By Square Meaſure.

144 Square inches	make	1 Square foot
9 Square feet	- - -	1 Square yard
100 Square feet	- - -	1 Sq. of flooring
$272\frac{1}{4}$ Square feet	- - -	1 Square rod
40 Square rods	- - -	1 Square rood
4 Square roods	- - -	1 Square acre
30 Square acres	- - -	1 Square yard of land
100 Square acres	- - -	1 Square hide
640 Square acres	- - -	1 Square mile.

Square meaſure comprehends length and breadth, and is uſed in meaſuring land, in paving, flooring, painting, glazing, plaiſtering, roofing, ſlating, tyling, and for ſeveral other rural purpoſes.

In land meaſuring is uſed Gunter's chain, which is 4 poles or 22 yards, or 66 feet long, and contains 100 links, each link being 7.92 inches long.

And 43560 ſquare feet or 4840 ſquare yards, or 160 ſquare poles, that is, 160 poles in length and 1 pole in breadth, or 4 ſquare roods, or 10 ſquare chains, that is, 10 chains in length and 1 chain in breadth, make an acre of land.

By Cubic or Solid Meaſure.

1728 Cubic inches	make	1 Cubic foot
27 Cubic feet	- - -	1 Cubic yard
40 Feet of rough timber 50 Feet of hewn ditto	-	1 Load

This comprehends length, breadth, and thickneſs.

And

And 108 folid feet, that is, 12 feet in length, 3 feet in breadth, and 3 deep, or commonly 14 feet long, 3 feet 1 inch broad, and 3 feet 1 inch deep, are a ftack of wood.

And 128 folid feet, that is, 8 feet long, 4 feet broad, and 4 feet deep, are a cord of wood.

In Coal Meafure.

4 Pecks	make	1 Bufhel
3 Bufhels	- - - -	1 Sack
12 Sacks, or 36 bufhels	- -	1 Chaldron
21 Chaldrons	- - - -	1 Score

In Corn Meafure.

1 Load of corn	makes	5 Bufhels
1 Laft of ditto	- - -	43 Do.

It is enacted by 31 George III., that a Winchefter bufhel of corn fhould weigh as follows:

	lb.			lb.	
Wheat	57	avoirdupois,	Wheat meal	56	Flour, 45lb. of which fhould be equal to a Winchefter bufhel unground.
Barley	49	- -	Flour	48	
Bigg	42	- -	Ditto	41	
Oats	38	- -	——	32	
Rye	55	- -	——	53	

After thefe ftatements of the different weights and meafures which are in common ufe for different forts of produce, it may not be improper to notice fome of the differences of weights and meafures, as they exift in different diftricts, towns, and parts of the kingdom, according to the account which has been given of them, and as they are injurious to the farmer.

In the counties or diftricts near the metropolis, the ftatute meafures are pretty commonly employed, though there are many irregularities and deviations; but in thofe at fome diftance there are more frequent and remarkable variations and differences.

In the county of Middlefex, the weights and meafures made ufe of are moftly thofe of the ftandard legal kind, and confequently the variations in them are but little.

Wood is fold by the ftack, as packed three feet by three, and twelve feet long, containing in this manner 108 cubical feet.

Effex is now pretty much in the fame ftate as above, in regard to its weights and meafures, though formerly they varied very greatly, wheat being fold either by weight or meafure, as agreed upon. The meafure then eight gallons and a half the bufhel; and the weight, that ufually termed the peck weight, or the medium of what eight and a half of good wheat would weigh.

Then all other forts of grain were fold by meafure, but by that which was very different in different places, and for different forts, the bufhel of barley, malt, oats, &c. being often nine gallons; others eight and a half, and eight and three pints, &c. There are ftill fome remains of thefe meafures in the county. Various articles, too, are ftill fold there by the tale, the dozen, the fcore, and the hundred of fix fcore, fuch as hop-poles, faggots, &c.

The writer of the Berkfhire Agricultural Report remarks, that, notwithftanding the fines and forfeitures attached to felling corn by any other than the ftandard bufhel, and the obvious ill confequences refulting from the practice without one counterbalancing advantage, that county, like moft others, has its diverfity of meafures, which only encourages jobbers, to the prejudice of the grower of corn; who, influenced by habit, does not always take into confideration, that if he fhould fell nine gallons inftead of eight to the bufhel, he is giving a bufhel in every quarter of grain more than the laws allow, or juftice requires, and that the dealer is probably making that proportion of profit, out of his ignorance or obftinacy.

The owners of land cannot, therefore, more effectually ferve their tenants, it is fuppofed, than by exerting themfelves to introduce an uniformity of meafure in their refpective neighbourhoods.

The nine-gallon bufhel prevails in fome parts of the county, but in others the ftandard. At Faringdon and Wantage, the former is almoft exclufively ufed; but at Abingdon both it and the ftandard bufhel are employed. The former is the cuftom of the market, however, unlefs the contrary be fpecified; but malt fold out of the town is only eight gallons meafure.

Corn is commonly fold by the load of five quarters. In building, hedging, and ditching, the perch or pole of eighteen feet is the ufual meafure.

Wood is fold by the foot, and load-underwood by the cord, in fome places abfurdly called a load, and by the proper load.

Befides the ftatute acre, there are alfo common field acres, which are fometimes more, and fometimes lefs, than the ftatute.

In weights the diverfity is great in moft places.

In the county of Suffex, the weights and meafures moft commonly ufed are, the pound, ftone, acre, load, bufhel, &c. There are feveral forts of acres, which are a great fource of perplexity and confufion—the fhort acre, the ftatute acre, the foreft acre, and various others: the foreft acre is nine fcore rods; the ftatute, eight fcore; and the fhort acre, fix fcore in fome places, in others five fcore. The ftranger, unaware of the variations that prevail in the weights and meafures, is, it is faid, liable to fall into miftakes in every ftep he takes; and that until a radical reform is brought to bear, the prefent confufion in buying and felling muft prevail, and the honeft and unfufpecting will be taken in by the crafty and defigning.

In the other fouthern diftricts or counties, the variations in their weights and meafures are much the fame, though lefs than in thofe of the north.

It is ftated in the Gloucefter Report on Agriculture, that in the market of that town, the bufhel varies from nine to ten gallons; in the foreft diftrict it is nearly ten gallons; on the Cotfwolds about nine; in the vale nine and a half; and in the lower vale, and at Cirencefter, nine and a quart, of all forts of grain.

Near Briftol, potatoes, green peas, &c. are fold by the double peck, containing two common ones ftruck level with the top; while at Gloucefter, and higher up the vale, it is a common peck heaped up. Wool is generally fold by the ftone weight of $12\frac{1}{2}$lbs., or the tod of $28\frac{1}{2}$lbs. Butter often by the pound of 18 oz.; and the quart of about 3lbs.

In Herefordfhire the peculiar weights and meafures which are at prefent in ufe are thefe, according to the Survey on Agriculture for that diftrict.

1 Pound of frefh butter	-	18 Ounces
1 Stone	- - - -	12 Pounds
1 Cuftomary acre	- -	$\frac{2}{3}$ Of a ftatute acre
1 Hop acre	- - -	That fpace of ground which contains 1000 plants; *viz.* about $\frac{1}{2}$ a ftatute acre
1 Lugg	- - -	49 Square yards of coppice-wood

Wood

1 Wood acre - -	$\frac{3}{5}$ Larger than a ftatute, *i. e.* as 8 are to 5
1 Day's math - -	About a ftatute acre of meadow or grafs land, being the quantity ufually mown by one man in one day
1 Perch of fencing -	7 Yards
1 Perch of walling -	$16\frac{1}{2}$ Feet
1 Perch of land - -	$5\frac{1}{2}$ Yards (as ftatute)
1 Bufhel of grain - -	10 Gallons
1 Bufhel of malt - -	$8\frac{1}{2}$ Gallons.

In the Report on Agriculture for Shropfhire, it is ftated, that wheat, barley, and peas, are fold by the ftrike or bufhel, which, in Shrewfbury market, is 38 quarts, but in fome other markets it is 40 quarts. That the 38 quarts of wheat fhould weigh 75lbs., the 40 quarts 80lb. In other markets in the county, the bufhel of wheat does not weigh more than 70lbs.: this is chiefly applicable to the eaftern diftrict of the county. The bufhel of flour is every where 56lbs. That 38 quarts of barley weigh about 65lbs. That a bufhel of oats means three half bufhels of the cuftomary meafure at Shrewfbury, and fhould weigh better than 93lbs. But that in other markets it means $2\frac{1}{2}$ bufhels, fometimes heaped, fometimes ftricken, and fometimes a medium between both. That a bag of wheat means three bufhels cuftomary meafure. The quarter bufhel is called a hoop or peck; and the fourth of that is called a quarter. Butter, when frefh, weighs 17 oz. to the pound; when falted, 16 oz. The laft is reckoned by the gawn, which fignifies 12lbs. of 16 oz. in Shrewfbury, and 16lbs. of 16 oz. at Bridgnorth. Cheefe is fold by the cwt., which, at Shrewfbury, means 121lbs., and 113lbs at Bridgnorth. Coals are fold by the ton, which is 20 cwt. of 112lbs. at fome pits, and 120lbs. at others: the ftack is now rarely ufed; it was a meafure of four feet fquare, and would fometimes weigh 25 cwt. Hay is fold by the ton, of 20 cwt. of 112lbs. Home-made linen cloth is fold by the ell, which meafures a yard and a half; and it is added, that the acre is the ftatute acre. That the workman's rood in digging is eight yards fquare; but in hedging eight yards in length.

It is fuggefted, too, that there is an error in the ftandard meafure, that in the Exchequer not agreeing with the requifitions of the 13 Will. III. c. 5. By which ftatute, the bufhel is ordered to be $18\frac{1}{4}$ inches round, and 8 deep; it would confequently contain

Cubic inches - - - - - -	2150
That in the Exchequer contains - -	2124
Eight of the ftandard gallons - -	2168
Thirty-two ditto quarts - - -	2240
Sixty-four ditto pints - - -	2027

That the difference between the bufhel and 32 of the quarts is, therefore, 116 cubic inches, or nearly three pints and a half.

It is ftated, too, that in the northern part of the North Riding of Yorkfhire, the cuftomary bufhel exceeds that of the Winchefter, by full two quarts; but nearer to the fouthern extremity, feldom by more than one: the bufhel of fome individuals in the Riding is ftill larger, meafuring about 10 *per cent.* more than the ftatute requires.

And further, that a ftone of wool in York market is fixteen pounds, and four ounces in each ftone are allowed for draught; that is, for the draught of each fleece, the wool-buyers being empowered by act of parliament to weigh each fleece *feparately*, if they like. That at Ripon market, a ftone of wool is 16 pounds 12 ounces. And a ftone of wool in the Weftern Moorlands is $17\frac{1}{2}$ pounds; the half pound, the writer apprehends, is for draught, as in York market.

But that at Darlington, where the wool grown about Richmond in that diftrict is chiefly fold, the ftone is 18 pounds. And that in the Eaftern Moorlands, the weights ufed by individuals vary up to 19 pounds to the ftone.

That the pound of butter in the Riding varies from 16 to 24 ounces. But that a ftone of all other commodities throughout the whole of it is 14 pounds.

In Chefhire, though the variety in the weights and meafures is very confiderable, it is lefs on the whole than in fome other parts of the country.

The weights in this diftrict are ufually the avoirdupois 112lbs. to the hundred weight. Some articles are fold by what is called the long hundred of 120lbs. Cheefe is one of thefe. Hay, too, is generally there fold by the cwt. of 120lbs.

Butter, in moft parts of the county, is difpofed of by the pound weighing 18 ounces. In fome places it is fold in lumps, made up in moulds of different forms, called difhes, or half difhes. Thefe weigh 24 or 12 ounces each.

Potatoes are ufually difpofed of by the bufhel weighing 90 pounds.

Wheat by the bufhel weighing either 70 or 75 pounds.

Oats by the bufhel weighing from 45 to 50 pounds, as the price and bargain may be.

Oatmeal by the load weighing 240 pounds.

Barley is fometimes fold by the bufhel of 60 pounds, and fometimes by the meafure of 38 quarts.

Malt by the meafure of 32 or 36 quarts.

Land was formerly very generally meafured there by what is called the Chefhire acre, containing 10,240 fquare yards; and this meafure ftill continues to be ufed to a certain extent, particularly in the northern part of the county. The ftatute acre is now, however, it is faid, in much more general ufe.

A rood of land is 64 yards. A rood of hedging, ditching, and other fuch operations, eight yards in length. And a rood of marl is 62 cubic yards.

In the Lancafhire Report on Agriculture, it is obferved, that the rod is of no lefs than fix different lengths in different parts of the county; namely, the ftatute, or $5\frac{1}{2}$ yards, 6, $6\frac{1}{2}$, 7, $7\frac{1}{2}$, and 8 yards, to the rod, pole, or perch: and that the meafures are equally variable. At Lancafter a load of wheat, beans, and peas, is four and a half bufhels (Winchefter); barley, fix Winchefter bufhels; oats, feven and a half Winchefter bufhels: they have alfo a meafure called a *windle*, which is equal to three Winchefter bufhels. But that wheat has been fold lately by the weight of 280lbs.

That at Ulverftone, a load of wheat is four and a half Winchefter bufhels; oats, fix Winchefter bufhels. And that at Manchefter, a load of wheat is fixteen fcore; a load of oats, nine Winchefter bufhels; a load of beans, five Winchefter bufhels; a load of potatoes, twelve fcore and twelve pounds, wafhed; unwafhed, thirteen fcore. That Liverpool town's bufhel is $34\frac{1}{2}$ quarts for oats, barley, and beans, making exactly 36 quarts Winchefter, or one-eighth more than a Winchefter bufhel, and by the cuftom of trade, one given in at every fcore, or twenty-one bufhels; of late, wheat, barley, and oats, have been fold by weight, but never yet beans; wheat, 70lbs. to the bufhel; barley, 60lbs.; and oats, 45lbs.: and probably this mode by weight is the faireft for both a buyer and feller; for, befides the difficulty of getting a true ftandard bufhel or meafure, the dexterity

 of

of corn-meters is ſuch, that it is aſſerted they can gain either to the buyer or ſeller from 10 to 20 *per cent.* in different modes of meaſurement; that 5 *per cent.* can be obtained by this practice, by even bunglers in the buſineſs: this is an enormous profit, and the unfairneſs of ſuch practices merits the ſevereſt reprehenſion.

That at Preſton the windle of wheat, beans, and barley, is three and a half Wincheſter buſhels; but of late 220lbs. have been reckoned a windle of wheat: they have alſo a meaſure there called a peck, which is twenty-eight quarts, four of which are called a windle.

In reſpect to weights, there are three different ones expreſſed under the general term hundred weight; namely, 100lbs., 112lbs., and 120lbs. The ſtone, too, varies. In Liverpool, 20lbs. are the weight allowed for the ſeveral articles under that denomination, as beef, hay, ſtraw, &c.; and probably all the articles produced from land. And butter is required to weigh 18 ounces avoirdupois, or it may be ſeized by the magiſtrates.

At Lancaſter, and the neighbourhood, they have ſeveral different weights, as the Lancaſter peck, of twenty-four quarts; the common peck, of ſixteen quarts; the half Wincheſter; the windle, of three and a half buſhels; the met, of fifty-ſix quarts; the ackendale, or ackentyde, the eighth part of the above, or ſeven quarts, and the meaſure of four quarts. The load of malt is ſix buſhels.

Butter eighteen ounces to the pound; other articles ſixteen.

There are alſo different local variations in many articles.

In Weſtmoreland, the pound conſiſts of twelve, ſixteen, eighteen, or twenty-one ounces; and the ſtone of fourteen, ſixteen, or twenty pounds. There is alſo a Wincheſter buſhel, a cuſtomary buſhel equal to three of theſe, a buſhel of two buſhels for the ſale of potatoes near Appleby, and one of two and a half for that of barley. Rye is ſold by the boll of two buſhels, and potatoes by the load of four buſhels and a half heaped; or more generally a bag, which holds ſeven and a half buſhels, is filled and ſold for a load of potatoes.

There is the ſtatute acre, too, of 4840 ſquare yards, the cuſtomary acre of 6760 raiſed from the perch of ſix and a half yards, and a third acre on the borders of Lancaſhire, raiſed from the perch of ſeven yards, containing 7840, being the ſame as the Iriſh plantation acre.

It is remarked, likewiſe, in the Cumberland Report on Agriculture, that the ſame confuſion in weights and meaſures prevails there, as in many other parts of the kingdom.

That a Wincheſter buſhel is thirty-two quarts; a Carliſle buſhel, ninety-ſix quarts; and a Penrith buſhel, ſixty-four quarts, for wheat and rye; and eighty quarts, for barley, oats, and potatoes.

That a ſtone of tallow, wool, yarn, or hay, is 16lbs.; and a ſtone of butcher's meat 14lbs., but in many places 16lbs.

That the pound is ſixteen ounces, by which butter and various other articles are weighed.

The writers of the Account of Agriculture for Northumberland, ſtate that their weights and meaſures are in a ſad ſtate of confuſion; a pound, a ſtone, a buſhel, and a boll, are rarely the ſame in different markets, and frequently vary in the ſame market for different articles.

At Newcaſtle.

4 Beatments	make	1 Peck
2 Pecks		1 Kenning
2 Kennings		1 Buſhel, Wincheſter
2 Buſhels		1 Boll.

At Hexham, with Rye and Peas.

4 Quarts	make	1 Forpit
4 Forpits		1 Peck
4 Pecks		1 Buſhel
2 Buſhels		1 Boll = 4 Wincheſter buſhels.

For Oats and Barley.

4 Quarts	make	1 Forpit
5 Forpits		1 Peck
4 Pecks		1 Buſhel
2 Buſhels		1 Boll = 5 buſhels Wincheſter.

At Alnwick.

3 Quarts	make	1 Forpit
4 Forpits		1 Peck
3 Pecks		1 Buſhel, Wincheſter
2 Buſhels		1 Boll of wheat
6 Buſhels		1 Boll of barley or oats.

At Wooler.

4 Quarts	make	1 Forpit
3 Forpits		1 Peck
3 Pecks		1 Buſhel
6 Buſhels		1 Boll.

That a ſtone of wool in ſome parts is 24lbs.; in others, 18lbs.; and a ſtone of every other article is 14lbs.

As the weights and meaſures made uſe of in Scotland differ very materially from thoſe employed in England, it may, of courſe, not be uſeleſs to give a curſory view of them under the preſent head. It has been obſerved by Mr. Somerville, in his Account of the Agriculture of Eaſt Lothian, that land is meaſured by the Scotch acre, which is to the Engliſh acre very nearly in the proportion of five to four.

That the boll is the denomination of corn meaſure always uſed, but the contents vary according to the ſpecies of grain meaſured. But that there are uniformly four firlots in the boll of all grain; but the firlot differs in ſize in the proportion of 21, 25, to 31. Wheat, rye, beans, and peas, are ſold by the ſmall firlot; malt, barley, and oats, are ſold by the large one. Four ſmall firlots are 4.087276 Wincheſter buſhels; four large ones are 5.96263 buſhels Wincheſter. The boll of wheat then is a ſmall fraction more than half a quarter; and the boll of barley, a fraction leſs than three-fourths of a quarter. But this calculation applies, it muſt be remembered, to the Linlithgow boll, which is accounted the ſtandard meaſure of Scotland: the meaſure actually uſed in Eaſt Lothian is ſomewhat larger.

In the Mid-Lothian Report on Agriculture, it is ſtated, that flour, pot-barley, groceries, iron, and ropes, are bought and ſold there, by what is termed Engliſh weight, being 16 oz. to the pound, and 16lbs. to the ſtone. But that butcher's meat, oatmeal, and flax, are bought and ſold by what is called Dutch weight, of which the proportion to the Engliſh is as $17\frac{1}{2}$ to 16.

That wool, hay, and butter, are bought and ſold by trone weight, of which the proportion is to the Engliſh, as 22 to 16. That other articles are bought and ſold by either of theſe weights, as it may happen.

But that in long meaſure the inch is the root, of which 12 go to the foot, and 37 to the Scotch yard.

And that land is meaſured by a chain 24 yards in length, or 74 feet, divided into 100 links, of 8.888 inches each in length; 10 ſquare chains make an acre, or 5760 ſquare yards Scotch, equal to 6084.444 Engliſh; and as

the

the Engliſh acre conſiſts of 4840 ſquare yards, hence the proportion that the Scotch acre bears to the Engliſh is, with a ſmall fraction more, as 5 to 4, as ſeen above.

That in liquid meaſure the *pint* is the root, containing 103.404 cubic inches; the half and quarter in proportion.

That the Linlithgow wheat firlot, the only ſtandard meaſure for that grain in Scotland, contains $21\frac{1}{4}$ pints; hence in cubic inches 2197.34. The Wincheſter buſhel, in like manner the Engliſh ſtandard, contains 2150.42 cubic inches; hence the Scotch wheat firlot is about $2\frac{1}{7}$ *per cent.* greater than the Engliſh buſhel.

And the Linlithgow barley meaſure, which is likewiſe the ſtandard, contains 31 pints, or 3205.54 cubic inches; hence $5\frac{23}{24}$ buſhels are very nearly equal to the Scotch boll of 4 firlots.

That ſtraw is ſold by tale, 40 windlens to a kemple, generally from 14 to 16 ſtone trone weight.

It is noticed, that in Eaſt Lothian, meal is ſold by the peck of eight pounds Amſterdam weight; and that the boll of meal contains ſixteen pecks or eight ſtones.

It is ſtated in the Clydeſdale Report on Agriculture, that in the dry meaſure, uſed in the ſale of grain of all kinds, a boll contains four firlots, a firlot four pecks, and a peck four forpits or lippies; 16 bolls make a chalder. The firlot uſed to meaſure barley and oats, is almoſt one-half larger than the firlot for meaſuring wheat, beans, peas, &c. That both theſe meaſures are about one-ſixteenth larger than the Linlithgow ſtandards of the ſame denominations. But for more than thirty years paſt, wheat has been bought and ſold by the Linlithgow ſtandard, which is now attempted to be introduced for other grains.

That in the lower parts of the county potatoes have been meaſured, for theſe forty years, with a diſh of the ſhape of a caſk, the peck meaſure holding fifteen Scotch pints; its weight, full of potatoes recently dug, is 43lbs. avoirdupois. In the higher parts of the county potatoes are ſold by the barley meaſure.

That the peck, or *ſleek*, for meaſuring pears and apples, holds about eighteen pints. The confuſion occaſioned by the irregularity of weights and meaſures, is too obvious, the writer ſays, to require any comment.

In the Argyleſhire Agricultural Report, it is ſaid that at Inverary the boll of meal is eight ſtone Scotch troy, or Dutch $17\frac{1}{2}$lbs. avoirdupois to the ſtone. At Campbelton it is ten ſtone, of the ſame weight; or ſixteen pecks of 10lbs. Scotch troy, or 10lbs. 15 oz. avoirdupois each.

That in ſome parts of the Knapdale and Lorn, the boll is nine ſtone. That in the firſt of the above places, oats, barley, and malt, are meaſured by a firlot of 3438.183 cubic inches; equal to one firlot, two pints, one mutchkin, Scotch ſtandard meaſure, which makes the boll (of four firlots) 7.258 *per cent.* better than the Scotch ſtandard meaſure, and equal to ſix buſhels, one peck, nine pints, 10.2 cubic inches, Engliſh ſtandard meaſure.

And that in Kintyre, oats, barley, or bear and malt, were, for time immemorial, ſold by a heaped peck, of which the ſtandard lay with the dean of Guild in Campbelton. Of this meaſure, ſeventeen pecks made, and ſtill make, the Kintyre boll from Auguſt to Patrickmas, and only ſixteen from that date to the new crop; and the diviſions of the boll are regulated by the ſame proportions. But from the inconvenience of meaſuring by the heaped peck, it has been converted into the ſtriked one containing the ſame quantity; and this new ſtriked peck committed to the dean of Guild, has been ſince the ſtandard of the diſtrict. The dimenſions of it are twelve Engliſh inches diameter, equally wide throughout, and ten and a tenth Engliſh inches deep. The contents of it in cubic inches are 1142.28576, equal to eleven Scotch pints, and a very little more than two-thirds of a gill, which makes the Kintyre boll 19418.85792 cubic inches, before Patrickmas, and 18276.57216 after it. A lippie more, or $\frac{1}{64}$th of a boll, for town dues, is given with every boll delivered in Campbelton. The firſt is equal to nine Wincheſter buſhels, and 65.03112 cubic inches, (about $\frac{1}{33}$ of a buſhel) and equal to one boll eight pecks, 1.61788 lippie, Linlithgow ſtandard meaſure. The latter is equal to eight and a half Wincheſter buſhels, excepting 2.0394 cubic inches, and to one boll ſix pecks, $3\frac{46}{250}$ lippies Linlithgow. The Wincheſter buſhel contains 2150.42 cubic inches. The Linlithgow boll ſtandard meaſure 12822.096.

That at Inverary, the peck of potatoes contains fourteen pints and one mutchkin, ale meaſure. At Campbelton, it contains about nine Engliſh wine gallons, and is given heaped; and generally weighs about 56lbs. avoirdupois.

But that beans and peas are ſold in Kintyre by the old peck ſtriked, or by a meaſure one-third leſs than that for oats and bear. Lineal and liquid meaſures are the ſame with the Scotch ſtandards. Butter, cheeſe, tallow, hay, wool, and lint, are ſold by the ſtone of 24lbs. avoirdupois. Butcher's meat by the pound of twenty-four ounces avoirdupois at Inverary, and of ſixteen ounces at Campbelton. The herring-barrel contains thirty-two Engliſh gallons of wine meaſure, or 67.28 cuſtomary ale pints of 109.866 cubic inches each.

Theſe facts and ſtatements ſufficiently ſhew the neceſſity of ſome regulation being ſpeedily adopted of adjuſting weights and meaſures to ſome ſimple ſtandard, both in this and the northern parts of the kingdom.

The table of weights conſtructed by lord Somerville, and introduced below, may be uſeful to the ſtock-farmer and grazier in moſt ſituations.

TABLE for the Equalization of different Weights.

Scores.	Stones, at 14lbs.		Stones, at 8lbs.		Scotch Stones 16lbs.		Hundred, 112lbs.		
	St.	lbs.	St.	lbs.	St.	lbs.	Cwt.	qrs.	lbs.
20 equal	28	8	50	0	25	0	3	2	8
25 —	35	10	62	4	31	2	4	1	24
30 —	42	12	75	0	37	4	5	1	12
35 —	50	0	87	4	43	6	6	1	0
40 —	57	2	100	0	50	0	7	0	16
45 —	64	4	112	4	56	2	8	0	4
50 —	71	6	125	0	62	4	8	3	20
55 —	78	8	137	4	68	6	9	3	8
60 —	85	10	150	0	75	0	10	2	24
65 —	92	12	162	4	81	2	11	2	12
70 —	100	0	175	0	87	4	12	2	0
75 —	107	2	187	4	93	6	13	1	16
80 —	114	4	200	0	100	0	14	1	4

TABLE OF PRICES.

Scores at	3¼d.	3½d.	3¾d.	4d.	4¼d.	4½d.	4¾d.	5d.	Difference.
	l. s. d.	l. s. d.	l. s. d.	l. s. d.	l. s. d.	l. s. d.	l. s. d.	l. s. d.	l. s. d.
1	0 5 5	0 5 10	0 6 3	0 6 8	0 7 1	0 7 6	0 7 11	0 8 4	0 0 5
2	0 10 10	0 11 8	0 12 6	0 13 4	0 14 2	0 15 0	0 15 10	0 16 8	0 0 10
3	0 16 3	0 17 6	0 18 9	1 0 0	1 1 3	1 2 6	1 3 9	1 5 0	0 1 3
4	1 1 8	1 3 4	1 5 0	1 6 8	1 8 4	1 10 0	1 11 8	1 13 4	0 1 8
5	1 7 1	1 9 2	1 11 3	1 13 4	1 15 5	1 17 6	1 19 7	2 1 8	0 2 1
20	5 8 4	5 16 8	6 5 0	6 13 4	7 1 8	7 10 0	7 18 4	8 6 8	0 8 4
25	6 15 5	7 5 10	7 16 3	8 6 8	8 17 1	9 7 6	9 17 11	10 8 4	0 10 5
30	8 2 6	8 15 0	9 7 6	10 0 0	10 12 6	11 5 0	11 17 6	12 10 0	0 12 6
35	9 9 7	10 4 2	10 18 9	11 13 4	12 7 11	13 2 6	13 17 1	14 11 8	0 14 7
40	10 16 8	11 15 4	12 10 0	13 6 8	14 3 4	15 0 0	15 16 8	16 13 4	0 16 8
45	12 3 9	13 2 6	14 1 3	15 0 0	15 18 9	16 17 6	17 16 3	18 15 0	0 18 9
50	13 10 10	14 11 8	15 12 6	16 13 4	17 14 2	18 15 0	19 15 10	20 16 8	1 0 10
55	14 17 11	16 0 10	17 3 9	18 6 8	19 9 7	20 12 6	21 15 5	22 18 4	1 2 11
60	16 5 0	17 10 0	18 15 0	20 0 0	21 5 0	22 10 0	23 15 0	25 0 0	1 5 0
65	17 12 1	18 19 2	20 6 3	21 13 4	23 0 5	24 7 6	25 14 7	27 1 8	1 7 1
70	18 19 2	20 8 4	21 17 6	23 6 8	24 15 10	26 5 0	27 14 2	29 3 4	1 9 2
75	20 6 3	21 17 6	23 8 9	25 0 0	26 11 3	28 2 6	29 13 9	31 5 0	1 11 3
80	21 13 4	23 6 8	25 0 0	26 13 4	28 6 8	30 0 0	31 13 4	33 6 8	1 13 4
85	23 0 5	24 15 10	26 11 8	28 6 8	30 2 1	31 17 6	33 12 11	35 8 4	1 15 5
90	24 7 6	26 5 0	28 2 6	30 0 0	31 17 6	33 15 0	35 12 6	37 10 0	1 17 6
95	25 14 7	27 14 2	29 13 9	31 13 4	33 12 11	35 12 6	37 12 1	39 11 8	1 19 7
100	27 1 8	29 3 4	31 5 0	33 6 8	35 8 4	37 10 0	39 11 8	41 13 4	2 1 8

TABLE—*Continued.*

Scores at	5¼d.	5½d.	5¾d.	6d.	6¼d.	6½d.	6¾d.	7d.	Difference.
	l. s. d.	l. s. d.	l. s. d.	l. s. d.	l. s. d.	l. s. d.	l. s. d.	l. s. d.	l. s. d.
1	0 8 9	0 9 2	0 9 7	0 10 0	0 10 5	0 10 10	0 11 3	0 11 8	0 0 5
2	0 17 6	0 18 4	0 19 2	1 0 0	1 0 10	1 1 8	1 2 6	1 3 4	0 0 10
3	1 6 3	1 7 6	1 8 9	1 10 0	1 11 3	1 12 6	1 13 9	1 15 0	0 1 3
4	1 15 0	1 16 8	1 18 4	2 0 0	2 1 8	2 3 4	2 5 0	2 6 8	0 1 8
5	2 3 9	2 5 10	2 7 11	2 10 0	2 12 1	2 14 2	2 16 3	2 18 4	0 2 1
20	8 15 0	9 3 4	9 11 8	10 0 0	10 8 4	10 16 8	11 5 0	11 13 4	0 8 4
25	10 18 9	11 9 2	11 19 7	12 10 0	13 0 5	13 10 10	14 1 3	14 11 8	0 10 5
30	13 2 6	13 15 0	14 7 6	15 0 0	15 12 6	16 5 0	16 17 6	17 10 0	0 12 6
35	15 6 3	16 0 10	16 15 5	17 10 0	18 4 7	18 19 2	19 13 9	20 1 4	0 14 7
40	17 10 0	18 6 8	19 3 4	20 0 0	20 16 8	21 13 4	22 10 0	23 6 8	0 16 8
45	19 13 9	20 12 6	21 11 3	22 10 0	23 8 9	24 7 6	25 6 3	26 5 0	0 18 9
50	21 17 6	22 18 4	23 19 2	25 0 0	26 0 10	27 1 8	28 2 6	29 3 4	1 0 10
55	24 1 3	25 4 2	26 7 1	27 10 0	28 12 11	29 15 10	30 18 9	32 1 8	1 2 11
60	26 5 0	27 10 0	28 15 0	30 0 0	31 5 0	32 10 0	33 15 0	35 0 0	1 5 0
65	28 8 9	29 15 10	31 2 11	32 10 0	33 17 1	35 4 2	36 11 3	37 18 4	1 7 1
70	30 12 6	32 1 8	33 10 10	35 0 0	36 9 2	37 18 4	39 7 6	40 16 8	1 9 2
75	32 16 3	34 7 6	35 18 9	37 10 0	39 1 3	40 12 6	42 3 9	43 15 0	1 11 3
80	35 0 0	36 13 4	38 6 8	40 0 0	41 13 4	43 6 8	45 0 0	46 13 4	1 13 4
85	37 3 9	38 19 2	40 14 7	42 10 0	44 5 5	46 0 10	47 16 3	49 11 8	1 15 5
90	39 7 6	41 5 0	43 2 6	45 0 0	46 15 6	48 13 0	50 12 6	52 10 0	1 17 6
95	41 11 3	43 10 10	45 10 5	47 10 0	49 9 7	51 9 2	53 8 9	53 8 4	1 19 7
100	43 15 0	45 16 8	47 18 4	50 0 0	52 1 8	54 3 4	56 5 0	58 6 8	2 1 8

WEIGHT,

Weight, *Pondus*, in *Mechanics*, is any thing to be raiſed, ſuſtained, or moved by a machine; or any thing that in any manner reſiſts the motion to be produced. See Motion, &c.

In all machines, there is a natural ratio between the weight and the moving power. If the weight be increaſed, the power muſt be ſo too; that is, the wheels, &c. are to be multiplied, and ſo the time increaſed, or the velocity diminiſhed.

"The centre of gravity F, (*Plate* XL. *Mechanics*, *fig*. 6.) of a body I H, together with the weight of the body, being given; to determine the point M, in which, lying on a horizontal plane, a given weight G, hung in L, cannot remove the body I H out of its horizontal ſituation."

Conceive a weight hung in the centre of gravity F, equal to the weight of the whole body I H, and find the common centre of gravity M, of that and the given weight G. If the point M be laid on the horizontal plane, the weight G will not be able to move the body H I out of its place.

"The centre of gravity C (*fig*. 7.) of a body A B, together with its weight G, being given; to determine the points L and M, wherein props M N and L O are to be placed, that each may bear any given proportion of the weight."

In the horizontal line A B, paſſing through the centre of gravity C, aſſume the right lines M C and C L in the given ratio. Props, then, M N, L O, placed in theſe points, will be preſſed in the given ratio.

Hence, if in the points M, L, in lieu of props, you place the ſhoulders or arms of porters, &c. they will be able to bear the burden alike; if their ſhares be proportioned to their ſtrengths. Thus we have a way of diſtributing a burden in any given ratio.

Weights, *Groſs*, *Neat*, *Penny*, *Aſſay of*, *Ancel*. See the ſeveral articles.

Weight *of the Atmoſphere*. See Atmosphere.

Weight *of the Air*, is equal to the elaſticity thereof.

To find the Weight of a Cubic Inch of Air.—Weigh a round glaſs veſſel full of common air, very accurately; then exhauſt the air out of it; weigh the exhauſted veſſel, and ſubtract the latter weight from the former, the remainder is the weight of the air exhauſted.

Find, then, the content of the veſſel by the laws of meaſuring; and the ratio of the remaining air to the primitive air. This done, the bulk of the remaining air is found by the rule of three; which being ſubtracted from the capacity of the veſſel, the remainder will be the bulk of air extracted. Or, if the air-pump be very tight, and the exhauſtion continued as long as any air is got out, the remaining air will be ſo ſmall, that it may be very ſafely neglected, and the content of the veſſel taken for the bulk of the exhauſted air.

Having, therefore, the weight and bulk of the whole exhauſted air, the weight of one cubic inch is eaſily had by the rule of three.

This method was firſt uſed by Otto Guericke, and afterwards by Burcher de Volder, who gives us the following particulars in his experiment. 1. That the weight of the glaſs ſpherical veſſel he made uſe of, full of common air, was 7 lbs. 1 oz. 2 drs. 48 grs.; when exhauſted of air, 7 lbs. 1 oz. 1 dr. 31 grs.; and when full of water, 16 lbs. 12 oz. 7 drs. 14 grs. The weight of the air, therefore, was 1 dr. 17 grs. or 77 grs.; the weight of the water 9 lbs. 11 oz. 5 drs. 43 grs. or 74743 grs. Conſequently, the ratio of the ſpecific gravity between water and air is 74743 : 77 :: $970\frac{53}{77}$: 1. Now, De Volder having found a cubic foot of water to weigh 64 lbs., by inferring, as 970 is to 1, ſo is 64 lbs. to a fourth proportional, deduced by the rule of three, the weight of a cubic foot of air, *viz*. 1 oz. 27 grs. or 507 grs. nearly. Wolfii Elem. tom. ii. p. 291.

From other later experiments accurately made with the hydroſtatical balance, a cubic inch of air appears to be equal to two-ſevenths of a grain, and therefore a cubic foot equal to $493\frac{5}{7}$ troy grains. There are various ways of eſtimating the weight of the air; for which, ſee Air, Atmosphere, Barometer, *Specific* Gravity, &c.

It may be eaſily determined by fitting a braſs cap, with a valve tied over it, to the mouth of a thin bottle or Florence flaſk, whoſe contents are exactly known, and ſcrewing the neck of this cap into the hole of the plate of the air-pump; then, having exhauſted the flaſk of its air and taken it off from the pump, ſuſpend it at one end of a balance, and nicely counterpoiſe it by weights in the ſcale at the other end: when this is done, raiſe up the valve with a pin, and the air will ruſh into the flaſk, and cauſe it to deſcend. When it is full of air, put grains into the ſcale at the other end to reſtore the equilibrium; and if the flaſk holds exactly a quart, it will be found, that 17 grs. will be ſufficient for this purpoſe, when the quickſilver ſtands at $29\frac{1}{2}$ inches in the barometer; and this ſhews, that when the air is at a mean ratio of denſity, a quart of it weighs 17 grs.; and conſequently a gallon weighs 68 grs.: *i. e*. 231 cubic inches of air are equal in weight to 68 grs., and 1728 cubic inches, or a cubic foot of air, weighs $509\frac{156}{231}$ grs.; and as a cubic foot of water weighs about 437702 troy grains, the ſpecific gravity of water will appear to be more than 850 times that of air. See Air.

The weight of *ſea-water* is different in different climates. Mr. Boyle having furniſhed a learned phyſician, going on a voyage to America, with an hydroſtatical balance, and recommended him to obſerve, from time to time, the difference of weight he might meet withal; this account was returned him: that the ſea-water increaſed in weight, the nearer he came to the line, till he arrived at a certain degree of latitude, as he remembers, about the 30th; beyond which, it retained the ſame ſpecific weight, till he came to Barbadoes. Philoſ. Tranſ. N° 18.

The weight of a cubical inch of good brandy, rum, or other proof ſpirits, is 235.7 grs.; therefore, if a true inch cube of any metal weighs 235.7 grs. leſs in ſpirits than in air, it ſhews the ſpirits are proof; if it loſes leſs of its aerial weight in ſpirits, they are above proof; if it loſes more, they are under: for the better the ſpirits are, they are the lighter; and the worſe, the heavier.

As all bodies expand with heat and contract with cold, in different degrees, the ſpecific gravities of bodies are not preciſely the ſame in ſummer as in winter. It has been found, that a cubic inch of good brandy is 10 grs. heavier in winter than in ſummer; as much ſpirit of nitre, 20 grs.; vinegar, 6 grs.; and ſpring-water, 3 grs. Hence it is moſt profitable to buy ſpirits in winter, and ſell them in ſummer, ſince they are always bought and ſold by meaſure. It has been found, that 32 gallons of ſpirits in winter will make 33 in ſummer. Ferguſon's Lect. p. 98. 4to. See *Specific* Gravity, and Hydrometer.

Weight *of the Human Body*. It is to be obſerved, that the heat and dryneſs of the air both leſſen the weight of the body, and the cold and moiſture of the air both increaſe this weight. See Moisture.

Much ſleep, much food, and little exerciſe, are the principal things which increaſe the weight of the body, and make animals grow fat. Conſequently, if the weight of the body be too great for good and uninterrupted health, it may be leſſened by diminiſhing ſleep and food, and by increaſing creafing exercife. On the contrary, if the weight of the body be too little for good health, it may be increafed by adding to food and fleep, and by leffening exercife; and the food muft be increafed chiefly by increafing drink and liquid nourifhment. For the difcharges are commonly lefs from drink and liquid nourifhment, than from dry and folid food.

There is but one weight under which a body can enjoy the beft and uninterrupted health, and that weight muft be fuch, that perfpiration and urine may be nearly equal at all feafons of the year; for by this means the body will be uniformly drained of its moifture: the inward parts by urine, and the more fuperficial parts by perfpiration, without any irregular and unnatural difcharges, and its moving weight will continue nearly the fame at all feafons of the year. Dr. Bryan Robinfon thinks this weight may be fettled by his obfervations in his Treatife on Food and Difcharges of Human Bodies.

A quick increafe of weight in human bodies often produces diftempers; the beft way to prevent this increafe is either by fafting or exercife. But amidft a variety of difturbing caufes, nothing fo effectually prevents fuch an increafe of weight as a very exact and regular diet, which may prevent the difcharges from running into irregularities and difproportions to one another. See Dr. Bryan Robinfon of the Food and Difcharges of Human Bodies, p. 82. feq.

Men, and other animals of extraordinary weight, are often recorded in the writings of the learned. See Phil. Tranf. N° 479, p. 102.

Weight, *Athletic*, in the *Animal Economy*, that weight of the body under which an animal has the greateft ftrength and activity. Dr. Robinfon thinks this happens when the weight of the heart, and the proportion of the weight of the heart to the weight of the body, are greateft. For the ftrength of an animal is meafured by the ftrength of its mufcles, and the ftrength of the mufcles is meafured by the ftrength of the heart. Alfo the activity of an animal is meafured by the weight of the heart, in proportion to the weight of the body.

If the weight of the body of an animal be greater than its athletic weight, it may be reduced to that weight by evacuations, dry food, and exercife. Thefe leffen the weight of the body by wafting its fat, and leffening its liver, and they increafe the weight of the heart, by increafing the quantity and motion of the blood; fo that by leffening the weight of the body, and by increafing that of the heart, they will foon reduce the animal to its athletic weight. Thus a game cock, in ten days, is reduced to its athletic weight, and prepared for fighting. If the food which, with the evacuations and exercife, reduced the cock to its athletic weight in ten days, be continued any longer, the cock will lofe his ftrength and activity.

It is known by experience, that a cock cannot ftand above twenty-four hours at his athletic weight, and that he has even changed for the worfe in twelve hours. When he is in the beft condition, his head is of a glowing red colour, his neck thick, and his thigh thick and firm; the day after, his complexion is lefs glowing, his neck thinner, and his thigh fofter; and the third day his thigh will be very foft and flaccid. Four game cocks, reduced to their athletic weight, were killed, and found to be very full of blood, with large hearts, large mufcles, and no fat.

It is to be obferved, that the athletic weight of an animal is a very dangerous weight. Fevers and apoplexies are the diforders which commonly happen to animals under or near the athletic weights. Hence, horfes fed upon dry food are much more fubject to fevers and apoplexies than horfes fed upon grafs. Robinfon's Differtation, p. 117, &c.

Weights, *Seffions for*. See Sessions.

Weight, *Live and Dead, of Animals*, in *Agriculture* and *Rural Economy*, the differences between their living and dead weights as affecting their goodnefs and value for the purpofe of the breeder and feeder or fattener. But few correct trials have yet been made in the view of determining this very important point or particular. It would feem, however, from the little that has been done on the fubject, that thofe forts of live-ftock that have the beft forms, and the leaft weight in the different offal parts, are the moft valuable and beneficial to the ftock mafter and farmer.

In neat cattle ftock the difference or lofs in this way is fomewhere about a fourth, but the moft in thofe breeds which are the leaft correct in their forms or fhapes. In fome unimproved breeds it has been found a good deal more, while in thofe which have been greatly improved rather lefs. In calves it will moftly be from a third to a fourth.

In the good Herefords, and fome of the beft long horn or Lancafhire forts, thefe proportions have been found on trial to be very nearly correct, both in the grown beafts and the calves.

In fheep ftock, too, the fame principle, for the moft part, holds good, thofe having the leaft difference or lofs in this way that are the beft in their forms.

In trials with the South Down breed of fheep, as ftated in the Corrected Report on the Agriculture of the County of Suffex, the proportions of the live and dead weight are thefe:

	lbs.
Live weight of the fheep - -	192
Dead weight next day of carcafe -	125

Weight of Offal.

	lbs.	oz.
Blood - - - - - -	6	0
Entrails - - - - - -	11	0
Caul - - - - - -	16	4
Gut fat - - - - - -	5	0
Head and pluck - - -	8	12
Pelt - - - - - -	15	12

In an average fpecimen of a wether of the fame breed:

	lbs.
Live weight of the fheep - -	133
Dead weight the day after - -	73

Weight of Offal.

	lbs.
Blood - - - - - -	4
Tallow - - - - - -	10
Entrails - - - - - -	14
Skin and feet - - - -	16
Head and pluck - - - -	9

In one of general Murray's breed of the fame kind:

	lbs.
Live weight - - - - -	129
Dead weight - - - - -	62

Weight of Offal.

	lbs.
Tallow - - - - - -	6

It is remarked that the lightnefs of the offal, fuch as the head, horns, feet, entrails, pluck, blood, pelt, &c. is the circumftance which characterizes a good fheep; and it is faid, ſaid, that Diſhley wethers well fattened are in the proportion of one ounce of bone to a pound of fleſh.

That the offal, in the fat wether of the South Down breed firſt ſtated, was but a fifth part and a fraction of the live weight, as below:

	lbs.	oz.
Live weight - - - - -	192	0
Offal - - - - - -	42	0
Carcaſe - - - - -	125	0
Fat - - - - - -	21	4
Loſt by killing - - - -	3	12
	192	0

Some uſeful information, which has a tendency to elucidate the point concerning the proportion between the live and dead weight of ſome different breeds of ſheep, has been given under the head ſheep. See Sheep, Pelt, and Tallow.

In good pig ſtock the difference in the proportion between the live and dead weight of the animals, or the loſs of weight that is ſuſtained by the farmer, will be found probably to be rather leſs than a fourth in the better breeds, and rather more than that in thoſe which are inferior in their qualities. The beſt breeds of pigs have by much the leaſt loſs in this way, and they have advantages in other reſpects. See Swine.

Theſe facts and ſtatements tend to ſhew the advantages which the farmer has in keeping good live-ſtock of all kinds.

WEIGHTON, Market, in *Geography*, a ſmall market-town in the Holme-beacon diviſion of Harthill wapentake, Eaſt Riding of the county of York, England, is ſituated on a little river called Foulneſs, in the high road between York and Hull, at the diſtance of 19 miles E.S.E. from York, and 192 miles N. by W. from London. Some antiquaries conſidered this place the Roman ſtation, Dolgovitia, till Drake, with great appearance of probability, aſſigned that ſtation to the village of Londeſburgh, nearly three miles north of Weighton. This town conſiſts of one long ſtreet, interſected by a few ſmaller: till within the laſt thirty years, the houſes were in general low and mean, and covered with thatch; but ſince that period, a number of reſpectable buildings have been erected, and conſiderable improvements have been made. A weekly market is held on Wedneſdays, when a great quantity of corn is often ſold, though but little is expoſed, being chiefly diſpoſed of by ſample. Two fairs are held annually for horſes, cattle, and particularly for ſheep, and cheeſe. The trade of the town has been conſiderably increaſed by means of a canal from the Humber; whereby coals and other articles are brought hither, and the barges return laden with grain. By the population return of the year 1811, the inhabitants of this town are enumerated at 1508; the number of houſes as 239. The church is an ancient maſſive edifice; it formerly had a wooden ſpire, which has been recently taken down, and a conſiderable addition made to the height of the tower; the interior of the church has alſo been greatly improved, and furniſhed with an additional gallery. A meeting-houſe for Methodiſts has lately been erected. There is no endowed ſchool in the pariſh. About two miles eaſt of Weighton is the brow of the Yorkſhire wolds, whence very extenſive views are obtained.—Beauties of England and Wales, vol. xvi. Yorkſhire, by J. Bigland, 1812. Drake's Eboracum, or the Hiſtory and Antiquities of York, fol. 1736.

WEIGSDORF, a town of Bohemia, in the circle of Boleſlaw; 8 miles N.N.E. of Krottau.

WEIGSTOTTEN, a town of Auſtria; 6 miles N.W. of Steyr.

WEIKENDORFF, a town of Auſtria; 8 miles S. of Ziſterſdorf.

WEIKERSTORF, a town of Auſtria; 4 miles S.W. of Sonneberg.

WEIKERTSCHLAG, a town of Auſtria; 8 miles W. of Droſendorf.

WEIL, a town of Wurtemberg, on the Wirm. This was an imperial town, till in 1802 it was given to the duke of Wurtemberg, by whoſe dominions it was ſurrounded; 10 miles W.S.W. of Stuttgart. N. lat. 48° 48′. E. long. 8° 50′.

WEILACH, a river of Bavaria, which runs into the Par, near Schrobenhauſen.

WEILBACH, a river of Germany, which runs into the Lahn, 2 miles S. of Weilburg.

WEILBURG, a town of Germany, which gives name to a county belonging to the houſe of Naſſau, hence called Naſſau Weilburg, ſituated on an eminence on the Lahn, over which it has a bridge of ſtone. The prince's palace here contains ſome very elegant apartments; with a fine garden belonging to it, and a chapel anſwerable to the whole. All the roads near the town lie in a direct line, and are planted on each ſide with a row of trees. In the neighbourhood is a large menagerie; 9 miles W. of Wetzlar. N. lat. 50° 26′. E. long. 8° 18′.

WEILE, or Wedel, a ſea-port town of Denmark, in North Jutland, ſituated on a bay in the Little Belt; 38 miles N.E. of Ripen. N. lat. 55° 45′. E. long. 9° 30′.

WEILHAIM, or Weilheim, a town of Bavaria; 26 miles S.W. of Munich. N. lat. 47° 44′. E. long. 11° 4′.

WEILHEIM, a town of Wurtemberg, on the Lauter; 20 miles N.E. of Ulm. N. lat. 48° 33′. E. long. 9° 35′.

WEILKO Strzlcze. See Strelitz.

WEILMUNSTER, a town of the principality of Naſſau Weilburg; 5 miles S. of Weilburg.

WEILNAU, a town of Germany, in the principality of Naſſau Weilburg; 13 miles S. of Weilburg.

WEILTINGEN, a town of Wurtemberg, on the Warnitz; 40 miles S.W. of Nuremberg. N. lat. 49° 3′. E. long. 10° 30′.

WEIMAR, a principality and duchy of Saxony, ſituated in Thuringia, on the ſides of the Ilm; about 24 miles in length, and 20 in breadth, but conſiderable tracts are detached from the main body.—Alſo, a town of Saxony, and capital of a duchy of the ſame name, with a palace of the prince, in which the duke has a valuable library, a cabinet of medals, a muſeum, and a gallery of paintings; and where are kept the archives of the Erneſtine line of the dukes of Saxony; 94 miles W. of Dreſden. N. lat. 51° 2′. E. long. 11° 22′.

WEINBERG, a town of Auſtria; 4 miles S.E. of Freyſtadt.—Alſo, a town of the principality of Anſpach; 3 miles N.N.E. of Feuchtwang.

WEINFELDEN, a town of Switzerland, in the canton of Zurich, and principal place of a bailiwick, in the Thurgau; 4 miles S.W. of Conſtance.

WEINGARTEN, a town of the duchy of Baden; 13 miles S.S.E. of Spire. N. lat. 49° 3′. E. long. 8° 30′.

WEINGE, a town of Sweden, in the province of Halland; 12 miles S.E. of Halmſtadt.

WEINHAUSEN, a town of Weſtphalia, in the principality of Luneburg Zell; 6 miles from Zell.

WEINHEIM, a town of the duchy of Baden, fituated in the Bergftraffe, and famous for its wine. The Roman Catholics, the Lutherans, and the Calvinifts, have each a church; 9 miles N. of Heidelberg.

WEINITZ, or VINIZA, a town of the duchy of Carniola, on the Kulp; 10 miles E.N.E. of Gotfchee.

WEINMANNIA, in *Botany*, a name which feems to have originated with Dr. Patrick Browne, who, without due attention, called it *Windmannia.* The perfon whom he defigned to commemorate was John William Weinmann, an apothecary of Ratifbon, author of a huge botanical German work, entitled *Phytanthozaiconographia*, confifting of four thick folios, with 1025 large coloured engravings of plants. The firft volume appeared in 1737, the laft in 1745, after the author's deceafe. There is a preface to the latter by Haller. Dieterich and Bieler contributed part of the text, and there are ample indexes, in various languages. The plates are rude, and gloomily coloured. Trew, whofe candour neverthelefs is allowed by Haller, fays, "varieties are not diftinguifhed," in this work, "from fpecies, the ftructure of the flowers is fcarcely expreffed, nor was the author competent to refer his plants to their true genera." Burmann began a Dutch edition, with fome additions, in 1736. The book is neceffarily expenfive, on account of its bulk, and is rare in England. We have feldom had occafion to confult it, nor have we ever done fo without difappointment.—Linn. Gen. 195. Schreb. 263. Willd. Sp. Pl. v. 2. 436. Mart. Mill. Dict. v. 4. Juff. 309. Poiret in Lamarck Dict. v. 7. 578. Lamarck Illuftr. t. 313. (Windmannia; Browne Jam. 212.) —Clafs and order, *Octandria Digynia.* Nat. Ord. akin to *Saxifragæ*, Juff.; or rather, we fhould think, as he himfelf hints, to his *Rhododendra.*

Gen. Ch. *Cal.* Perianth inferior, of four ovate, fpreading, permanent leaves. *Cor.* Petals four, equal, undivided, larger than the calyx. Nectary glandular, furrounding the bafe of the germen. *Stam.* Filaments eight, erect, thread-fhaped, longer than the petals; anthers roundifh, of two cells. *Pift.* Germen fuperior, ovate, acute; ftyles two, fomewhat fpreading, the length of the ftamens, permanent; ftigmas obtufe. *Peric.* Capfule elliptic-oblong, with two points, two cells, and two valves, whofe inflexed margins form the double partitions. *Seeds* about eight in each cell, roundifh.

Eff. Ch. Calyx of four leaves. Petals four. Capfule fuperior, with two beaks, two cells, and two valves with inflexed margins. Seeds feveral.

A very handfome genus of extra-European fhrubs, with oppofite, compound or fimple leaves, accompanied by interfoliaceous deciduous ftipulas. The flowers are fmall, copious, racemofe, rarely panicled. *Capfules* permanent long after the feeds are fhed. CUNONIA, (fee that article,) appears to differ from this genus, merely by adding one-fifth to the parts of fructification, which in this cafe is of no avail whatever.

Sect. 1. *Leaves compound.*

1. W. *glabra.* Smooth Pinnate Weinmannia. Linn. Suppl. 228. Willd. n. 1. Swartz Obf. 151. (W. pinnata; Linn. Sp. Pl. 515, excluding the reference to Browne.) —Leaves pinnate; leaflets obovate, crenate, fmooth on both fides. Capfule roundifh-elliptical, bluntifh.—Native of the Weft Indies. The *ftem*, ufually fhrubby, fometimes becomes a *tree*, forty feet high, with round, rugged *branches*; when young angular, and coarfely downy. *Leaves* of fix pair, more or lefs, with an odd one, of obovate, abrupt *leaflets*, half an inch at moft in length, all nearly equal, furnifhed with one rib and feveral tranfverfe veins; entire and wedge-fhaped towards the bafe. *Common footftalk* jointed, each articulation, between the leaflets, winged with a leafy rhomboid expanfion, tapering moft downward, and hairy at each end. *Clufters* oppofite, at the end of each branch, on hairy axillary ftalks, denfe, about an inch long when in flower; twice as long, and much more lax, when in fruit. *Flowers* very fmall, white, on fafciculated, fhort, thick, hairy partial ftalks. *Capfules* about half the fize of hempfeed, brown; their *ftalks* elongated; their valves obtufe, tipped with the *ftyles*, and, as they ripen, turning their pale narrow edges, which had formed the partitions, outwards. Permanent *ftyles* moftly recurved, rather fhorter than the valves. We have not feen the *feeds*.

2. W. *tinctoria.* Red-tan Weinmannia. (Weinmannia; Lamarck t. 313. f. 1. Tan-rouge; Commerfon MSS.)— Leaves pinnate; leaflets elliptical, crenate, fmooth on both fides. Capfule ovato-lanceolate, taper-pointed. Seeds hairy. —Gathered by Commerfon in the ifle of Bourbon, where it is known by the name of *Tan-rouge*, becaufe the bark ferves to dye leather of a red colour. The flowers are fuppofed to furnifh the bees with much of their honey. French botanifts appear to have confounded this plant with the preceding. It is certainly what Lamarck has figured, and what Poiret has quoted, for *W. glabra*, the latter having taken *Tan-rouge* from hence, for his French generic name of the whole genus, though without adverting to its ufe in the ifle of Bourbon, or its being a native of that country. The *leaves* are full twice the fize of *W. glabra*, with elliptical, not obovate, leaflets: wings of their *footftalks* fimilar to the laft. *Clufters* of *flowers* much more lax, and lefs hairy, three or four inches long; the *flowers* twice as large. *Capfules* of a very different fhape, and paler redder hue, tapering into the ftraight erect *ftyles*, which are not a quarter fo long as the *valves*, nor are the edges of the latter ever turned outward, or flattened. The *clufters* of ripe *capfules* are cylindrical, denfe, four or five inches in length. *Seeds* clothed with a few long prominent hairs.

3. W. *hirta.* Hairy-leaved Weinmannia, or Baftard Brafiletto. Swartz Ind. Occ. 691. Willd. n. 2. Poiret in Lam. n. 3.—Leaves pinnate; leaflets elliptic-ovate, crenate, hairy at the back. Capfules oblong.—Native of lofty mountains in the fouth part of Jamaica, in St. Andrew's parifh, near Coldfpring, the refidence of Matthew Wallen, efq. (See WALLENIA.) This, according to Dr. Swartz, from whom we have a fpecimen, is a very rare fpecies. It is either a *fhrub*, or a handfome *tree*, from forty to fifty feet high, crowned at the very top of its fmooth *trunk* with lax, hairy, or fomewhat downy, rufty-coloured *branches.* The *leaves* moft refemble the laft in fhape, but are clothed beneath, fometimes on both fides, with coarfe, fcattered, prominent hairs. The leafy borders of each joint of the common *footftalk* are narrower, and lefs angular, than thofe of our firft or fecond fpecies, and their midrib is very hairy beneath. *Clufters* alfo very hairy, an inch or two in length, in pairs at the fummits of the branches. *Flowers* the fize of the laft, white. *Capfule*, according to Swartz, fmall, oblong, rather pointed, with feveral fmall roundifh *feeds*. This tree flowers in September and October. Some fpecimens, in the herbarium of the younger Linnæus, excite a doubt whether the hairinefs of the foliage may invariably be relied on. Still we have no doubt of the diftinctnefs of thefe three fpecies. The third is perhaps moft allied to the fecond, which appears to be what Dr. Swartz faw marked *W. arborea*, and which Commerfon was faid to have gathered in the ifle of Mauritius. We do not at all comprehend how the joints of the common *footftalk* can be termed "fomewhat heart-fhaped," in *W. hirta*; they are rather more truly obovate

vate than in either of the foregoing, being lefs angular, or deltoid.

4. W. *trichofperma*. Hairy-feeded Weinmannia. Cavan. Ic. v. 6. 45. t. 567. Poiret n. 2.—Leaves pinnate; leaflets elliptic-oblong, ferrated, fmooth on both fides. Capfule roundifh-elliptical. Seeds denfely hairy.—Gathered by Louis Née, at San Carlos, in Chili, bearing ripe capfules in February. *Cavanilles*. By the plate above quoted, this bears moft refemblance to the firft fpecies, efpecially in the acute angles of the deltoid articulations of the *footftalks*, which in all the other fpecies are rounded. But the *leaflets* are longer and more elliptical, ferrated rather than crenate; the *capfules* broadly elliptical, not obtufe, their inflexed edges, if the figure be accurate, much broader, and continuing inflexed. The *feeds* are roundifh-kidneyfhaped, clothed with long, copious, projecting hairs, of which no mention is made by any botanift who has defcribed the *feeds* of *W. glabra* or *W. hirta*, and therefore we muft prefume they do not exift in thofe fpecies. We find fuch hairs, very fparingly, on the globular *feeds* of *W. tinctoria*, but the *capfules* of that fpecies are abundantly different from the prefent.

5. W. *tomentofa*. Woolly Weinmannia. Linn. Suppl. 227. Willd. n. 3. Poiret n. 4.—Leaves pinnate; leaflets elliptical, revolute, entire, woolly beneath.—Gathered in New Granada, by Mutis. A very diftinct and remarkable fpecies. The *branches* are woody, round, denfely leafy, rough, fomewhat warty, of a dark brown; hoary and downy when young. *Leaves* hardly an inch and a half long; leaflets about five pair, with an odd one, each one-third of an inch in length, convex, flightly hairy, fingle-ribbed; the under fide clothed with copious, loofe, hoary, woolly hairs. The joints of the common *footftalk* are rather fhorter than the leaflets, obovate, not angular; their edges revolute, and the under fide woolly. *Stipulas* large, ovate, reflexed, coloured, hairy externally, deciduous. *Flowers* in very denfe *clufters*, rather above an inch long, on thick, fhort, woolly, axillary ftalks. *Calyx* hairy. *Capfules* wanting in our fpecimens.

6. W. *trifoliata*. Three-leaved Weinmannia. Linn. Suppl. 227. Thunb. Prodr. 77. Willd. n. 4. Poiret n. 5. Lamarck f. 2.—Leaves ternate; leaflets obovate, crenate, fmooth.—Gathered by Thunberg, at the Cape of Good Hope. The whole *fhrub* is faid to be very fmooth. *Leaflets* equal, about an inch long, being about two-thirds the length of their common *footftalk*, which is fimple and naked. *Clufters* cylindrical, denfe, two or three inches long, on axillary ftalks about half their own length. The *germen* in Lamarck's figure is roundifh and hairy. We have feen no fpecimen, nor is there any account of the *capfule* or *feeds*.

Sect. 2. *Leaves fimple.*

7. W. *racemofa*. Smooth-clustered Simple-leaved Weinmannia. Linn. Suppl. 227. Willd. n. 5. Forft. Prodr. 27. Poiret n. 580.—Leaves fimple, ftalked, ovate, with toothlike ferratures. Clufters axillary, folitary, nearly fmooth.—Gathered by Forfter, as well as by Menzies, in New Zealand. The *branches* are ftout, woody, repeatedly branched in an oppofite manner, round and rough. *Footftalks* ftout, fmooth, half an inch long, articulated at the fummit with the leaf, which is two, or two and a half, inches long, and one broad, pointed, coriaceous, quite fmooth, ftrongly veined, befet with blunt, inflexed, wavy teeth, or ferratures; paler beneath. *Clufters* about the tops of the branches, though axillary, ftalked, longer than the leaves, cylindrical, continuous; their general and partial *ftalks* either flightly downy, or quite fmooth. *Capfules* obovate, pointed, fomewhat downy; the inflexed edges of their valves finally expanded. We cannot find a *feed* in any of our fpecimens.

8. W. *parviflora*. Small-flowered Weinmannia. Forft. Prodr. 29. Willd. n. 6. Poiret n. 7.—"Leaves fimple, nearly feffile, ovate, pointed, with tooth-like ferratures. Clufters terminal, aggregate, hairy."—Native of Otaheite. *Forfter*. Willdenow, who had feen a dried fpecimen, defcribes the *branches* as hairy when young. *Leaves* on fhort ftalks, oblong, fmooth on both fides. *Clufters* downy, from three to fix at the top of each branch, forming a fort of panicle. *Flowers* but a quarter the fize of the preceding.

9. W. *ovata*. Ovate-Crenate Weinmannia. Cavan. Ic. v. 6. 45. t. 566. Poiret n. 9.—Leaves fimple, elliptical, crenate, acute at each end, on fhort ftalks. Clufters axillary, folitary, oppofite, fomewhat downy.—Native of Peru, in a large alluvial excavation, near the town of St. Buenaventura, flowering in June and July. This is a *tree* eighteen feet high, with furrowed, rather knotty *branches*, thickened at the infertion of the *leaves*, which feem very like thofe of *W. racemofa* in fhape, fize, veins, and fmoothnefs, but are more truly crenate, and ftand on fhorter *footftalks*. *Clufters* oppofite, at the tops of the branches, though axillary and folitary, each two or three inches long; their partial ftalks aggregate, and fomewhat villous. Nothing is known of the *capfule* or *feeds*. We could wifh for better materials than Cavanilles affords us, for diftinguifhing this fpecies from the *racemofa*, n. 7.

10. W. *paniculata*. Panicled Weinmannia. Cavan. Ic. v. 6. 44. t. 565. Poiret n. 8.—Leaves fimple, elliptic-lanceolate, fharply ferrated. Panicles axillary, compound.—Gathered by Louis Née, at the fea-fhore near Talcahuano, in Chili, flowering in February. A *tree* about the ftature of the laft, but the *leaves* are longer, more lanceolate, with parallel veins, and copious fharp ferratures, which give them fome refemblance to the fweet-chefnut leaf. They are fmooth, and ftand on ftout downy *footftalks*. The panicled *inflorefcence* is fingular among all the known fpecies. *Flowers* yellowifh-red. *Capfules* elliptical, acute, downy, beaked with the ftraight *ftyles*, which are as long as the valves. *Seeds* obovate, fmooth, on flender ftalks, pendulous. We have a fpecimen from the late abbé Cavanilles.

WEINSBERG, in *Geography*, a town of Wurtemburg; a part of which is built on a round hill, on which alfo ftands a ruined caftle: the other part lies in a valley. In it is a fpecial fuperintendency. The valley in which it lies is famous for wine; 5 miles N.E. of Heilbronn.

WEINSTEIG, a town of Auftria; 8 miles N. of Korn Neuburg.

WEINZIERL, a town of Auftria; 8 miles S.E. of Ips.

WEIPERSHOFEN, a town of the principality of Anfpach; 5 miles S.E. of Creilfheim.

WEIPERT, a town of Bohemia, in the circle of Saatz; 14 miles W. of Commotau.

WEIR, one of the fmaller Orkney iflands, containing about 65 inhabitants. It had formerly a church, which is now in ruins; 2 miles S. of Roufa.

WEIR, or WEAR, in *Rural Economy*, a fort of dam, bulwark, or ftrong erection, formed acrofs a brook, rivulet, ftream, river, main, or other fuch water-courfe, for the purpofe of diverting or turning the water, in watering land. It is occafionally made in different ways, as of timber alone, fometimes of bricks, or ftones, and timber, and of different other materials, as will be feen below, having from two to eight or ten thoroughs or openings for letting the water pafs through, according as the breadth of the

ftream

ſtream and other circumſtances may be. The height of it is always equal to the depth of the ſtream compared with the adjacent land.

The water of a very ſmall and gentle ſtream may often be diverted for this uſe, by means of a few ſods firmly put down, with ſome ſtones above them : but for lands of any conſiderable extent, the kinds directed below are neceſſary, according as the ſtrength of the reſpective ſtreams may happen to be.

Strong wooden beams or balks thrown acroſs the ſtream, and made cloſe by means of boards well ſecured, are, in many caſes, ſufficiently ſtrong, commodious, and convenient, in ſlow moving waters, of no great power or force.

A few cart-loads of ſtones thrown properly in acroſs the ſtream, forms alſo a bulwark, wide at the baſe, and narrowing towards the top, the whole being puddled with clay or gravelly earth, which ſometimes anſwers well. Over the top of this bulwark, the ſuperfluous waters paſs in a free manner, falling down the gentle ſlope, to which, if well conſtructed, they do no ſort of injury.

A weir ſuitable for a ſmall river may conſiſt too of ſeveral rows of ſtakes, firmly driven down and interlaced with the branches of fir-trees, the intervals of the rows being filled with ſtones. The ſand and mud that come down with the floods fill up this ſort of weir, and render it fit for effecting its purpoſe. In heavy rains the ſuperfluous water paſſes entirely over.

But for more powerful rivers, the weirs may be conſtructed of ſtrong frame-works of wood, firmly and ſtrongly joined together, and the different compartments all paved with large ſtones : the weir riſing very gradually againſt the ſtream, and being made to ſlope gradually away before it, as it flows over it. In this way the largeſt and moſt powerful rivers may moſtly be managed, if the weirs be well ſuited to them ; ſo that it is but in few caſes adviſeable to attempt the watering lands from rivers that cannot be diverted by one or other of theſe ſorts of weirs, as the expence and hazard taken together may greatly exceed the advantage to be derived. It may, however, in ſome caſes of large rivers, be neceſſary and proper to have recourſe to more expenſive weirs, ſuch as that deſcribed below.

In this weir, which was formed on a large, rapid, and ſtrong river, under the direction of the Rev. W. H. Coham, in Devonſhire, after the ſtream had been temporarily diverted, and every thing removed for a proper foundation, a double row of pits was dug into a rocky ſubſtratum, directly acroſs the bottom, or bed of the river, at about five feet aſunder lengthways, by four feet in breadth, and about two feet in depth ; and into theſe pits oak poſts of about ſix or ſeven inches ſquare were fixed. The maſon then raiſed a perpendicular wall, without any cement, about five feet and a half thick, entirely encloſing the poſts, the labourers being employed in the mean time in *backing up* the wall on the higher ſide with ſome of the *ſtiffeſt* clay to be had. This was, however, afterwards found to be wrong ; it ſhould have been done in the *puddle* manner, by means of mould and gravelly earth.

When the wall was raiſed to ſuch a height as was deemed neceſſary, in relation to the level required, and the preſervation of the lands adjacent, the upper parts of the oak poſts were ſawn off, in order to receive croſs-pieces and joiſts, the front poſts being then left to ſtand about ſix inches higher than the hinder ones ; and on theſe joiſts oak planks were pinned, about ſix feet and a half long by three inches thick. Theſe planks were brought forward to project about one foot and a half over the perpendicular of the wall, on the lower ſide, forming a ſort of lip, as it has been termed ; the clay, together with theſe planks, conſtituting an inclined plane, and terminating at the diſtance of about fifteen feet up the ſtream, on the common bed of the river.

The entrance for the *leat* was cut at about thirty feet above the *lip* of the weir, where, to regulate the quantity of water to be admitted, three ſtrong flood-hatches, to be lifted or let down by a lever and windlaſs, were placed ; and through which a column of water, of about eight feet in width by four feet in depth, may be introduced at any time. Between the leat and the river a ſtone wall, ſtrongly cemented, is erected, which is about eight feet in height, and carried from the head of the leat to about thirty feet below the weir, in a parallel line with the river, and at the end of which wall another flood-hatch is fixed on a level with the bed of the river. This latter hatch will always be of great advantage when any reparations may be wanting on the weir ; as on drawing it up when the water is low, the weir in a few hours will be left perfectly dry, and the workmen, with the greateſt convenience, may proceed in their operations. From the top of the ſide wall, above the weir, the ground is made ſloping to the river, and below it is covered with turf, and levelled as a foot-path.

Immediately below the weir, in this caſe, there is an outlet regulated by another flood-hatch, and conducted through a *ſhoot* formed of oak plank, from the leat, and contrived for the admiſſion of ſalmon, which are there ſometimes taken ; and below the lower flood-hatch, a trap, or *willey*, as it is there termed, is made for the catching of ſmaller fiſh : this part of the work does not, however, properly belong to this kind of weir, therefore it need not be more noticed.

The height of the weir is about four feet above the level of the river where it is fixed ; and its length, from bank to bank, directly acroſs, or at right angles with the ſtream, is about forty-eight feet ; forty feet of which is carried at a perfect level, and over which the water falls preciſely at the ſame depth, forming a beautiful caſcade. The remaining portions of the length of the weir, namely, four feet on each ſide, are raiſed, gradually aſcending to the banks for the purpoſe of warding off the torrent from them in time of floods, when the river, in this caſe, is very tumultuous.

The lip part of the weir is found to anſwer perfectly ; as in proportion to the force of the water behind, ſo is the diſtance which it is thrown over the weir from the foundation of the perpendicular wall.

If the writer had not been foiled, and had part of the work to perform over again, in conſequence of the uſe of clay, as already noticed, being under the neceſſity of driving on the weir in a direct line with the former work, into the ſide of the oppoſite bank, as before ; and after removing as much of the clay as could be got at, which will not unite completely with the ſoil, but become liable to be undermined by the water, by making a *puddle*, as uſed in canals of mould and gravel, in its ſtead, which ſucceeded in a complete manner ; the whole coſt of the weir would not have exceeded 75*l*.

This weir or wear, from its preſent appearances, may now, it is ſaid, ſeem to bid defiance to time ; and be ſafely recommended as a pattern to thoſe who may have occaſion to conſtruct any thing of a ſimilar kind, either for watering land, for machinery, or other uſes. See Watering *Land*.

In the weirs or wears which are thrown over large rivers for the purpoſe of raiſing the water for the uſe of mills, and in many other intentions, and which are moſtly conſtructed of of ftone, with ftrong framed wood-work, in fomewhat the above manner, there are many different contrivances calculated for different ufes, fuch as locks for fecuring large fifh, places for taking and preferving thofe of the fmaller forts, and different others. See Dr. Anderfon's Treatife on the Erection of Weirs, &c. where a full explanation of the principles and manner of conftructing them will be found.

WEIS SEE, in *Geography*, a lake of the duchy of Carinthia; 10 miles N.W. of Velach.

WEISA, a town of Saxony, in the circle of Erzgebirg; 3 miles S.S.W. of Wolkenftein.

WEISBRON. See VESPRIN.

WEISCHE OPPA, a river of Silefia, which runs N.E. into the Schwartze Oppa.

WEISCHENFELD, a town of Bavaria, in the bifhopric of Bamberg; 18 miles E.S.E. of Bamberg. N. lat. 49° 49′. E. long. 11° 19′.

WEISDORF, a town of Germany, in the principality of Culmbach; 3 miles E. of Munchberg.

WEISEN, a town of Pruffia, in the province of Oberland; 10 miles W.S.W. of Leibftadt.

WEISENBAD, a town of Saxony, in the circle of Erzgebirg; 3 miles S.S.E. of Wolkenftein.

WEISENBERG, a townfhip of Pennfylvania; 60 miles N. of Philadelphia.

WEISENBERG, or WOSSBERK, a town of Lufatia; 8 miles E. of Budiffen. N. lat. 51° 12′. E. long. 14° 40′.

WEISENBRUN, a town of Bavaria, in the bifhopric of Bamberg; 24 miles S. of Cronach.

WEISENBURG, a town of Auftria; 12 miles S.S.W. of St. Polten.

WEISENBURG. See WEISSEMBURG.

WEISENHORN, a town of the duchy of Baden, fituated in a county to which it gives name, on the Roth; 11 miles S.E. of Ulm. N. lat. 48° 17′. E. long. 10° 8′.

WEISENKIRCHEN, a town of Auftria; 11 miles S.W. of Tulln.

WEISFURT, a river of Silefia, which runs into the Oder, 3 miles below Beuthen.

WEISKIRCH, a town of Bohemia, in the circle of Boleflaw; 3 miles S.S.E. of Krottau.

WEISKIRCHEN, or HRANITZE, a town of Moravia, in the circle of Prerau; 15 miles E.N.E. of Prerau. N. lat. 49° 30′. E. long. 17° 43′.

WEISMAYN, a town of Bavaria, in the bifhopric of Bamberg; 20 miles N.E. of Bamberg. N. lat. 50° 6′. E. long. 11° 18′.

WEISSE, CHRISTIAN-FELIX, in *Biography*, a German poet, was born in 1726, at Annaberg, in Saxony, and educated, firft at the Gymnafium of Altenburg, and afterwards at Leipfic. The objects to which his tafte moft powerfully inclined him were poetry and the drama; and he and his friend Leffing concurred in tranflating for the ftage from French and Englifh works, and afterwards in furnifhing original compofitions. He alfo contended with his friend in lyric poetry. After completing his courfe of education, he became private tutor in a family of diftinction at Leipfic, purfuing his dramatic and poetical career, and gaining a great degree of popularity. He alfo edited the Bibliotheque of Belles Lettres, when Nicholai furrendered it. Although, in 1761, he obtained a place in the revenue at Leipfic, he profecuted his employment as a writer for the ftage; and when he became the father of a family, he directed his attention to education, and publifhed feveral pieces in this department: particularly, in 1772, a collection of fhort tales and moral maxims, which had a confiderable circulation; and in 1775 he revived a weekly publication, which Adelung had difcontinued, under the title of the "Children's Friend." This work became afterwards a quarterly publication, and between the years 1775 and 1782, paffed through five editions. From this popular work Berquin derived the idea of his "Ami des Enfans," and he was indebted to it for many of his materials. As Weiffe's children grew to maturity and fettled in the world, he altered the plan of his work, and continued it under the form of Letters; and Berquin alfo followed him in his "Ami des Adolefcentes." In 1790 the beautiful eftate of Stotteritz near Leipfic, which Weiffe inherited, placed his family in affluent circumftances, and furnifhed him with a pleafant refidence. Towards the latter part of his life he contributed fhort fables and poetical tales to journals and periodical publications, which were well received, and at length clofed his life with reputation, in December 1804. His dramatic works, which were continued to five volumes, are faid to have formed an epoch in the hiftory of the German ftage, and both his tranflations and original compofitions were well received. Gen. Biog.

WEISSE, in *Geography*, a river of Pruffia, which runs into the Rufs, 20 miles N.W. of Tilfit.

WEISSEBERG, a mountain of Bohemia, celebrated for the defeat of the elector-palatine, about 3 miles from Prague.

WEISSELBURG, a town of Pruffia, in the province of Oberland; 5 miles S. of Marienwerder.

WEISSELMUNDA. See WEICHSELMUNDE.

WEISSEMBURG, or KORN WEISSEMBURG, or *Wiffemburg*, a town of France, and principal place of a diftrict in the department of the Lower Rhine, fituated on the Lauter, at the foot of the Vofges. This town was formerly imperial, and was ceded to France by the peace of Ryfwick. The fortifications were deftroyed by Louis XIV.; but ftrong lines of defence are fixed from this town to the Rhine, a little to the eaft of Lauterburg, on the S. fide of the Lauter; 27 miles N. of Strafburg. N. lat. 49° 3′. E. long. 8°.

WEISSEMBURG, a town of Bavaria, called *Weiffemburg near the Nordgau*. It contains two churches and a medicinal fpring. Weiffemburg was an imperial town, till in 1802 it was given to the elector of Bavaria; 28 miles S.S.W. of Nuremberg. N. lat. 48° 58′. E. long. 10° 55′.

WEISSEMBURG, or *Alba Julia*, or *Carlfburg*, or *Fejervar*, a town of Tranfylvania, capital of a county, and fee of the bifhop of Tranfylvania, beautifully fituated on the Maros. It was a long time the metropolis of Dacia, and the feat of its monarchs, who had a palace here. It was likewife the feat of a Roman legion. The name Alba Julia it owes to Julia Augufta, mother of Marcus Aurelius. Charles VI. named it Carlfburg; 90 miles N.E. of Temefvar. N. lat. 46° 16′. E. long. 24° 10′.

WEISSEN SEE, a lake of Pruffia; 12 miles W. of Lick.—Alfo, a lake of Bavaria, in the territory of Augfburg; 2 miles S.W. of Fueffen.—Alfo, a lake of Carinthia; 6 miles S. of Saxenburg.

WEISSENAU, a princely abbey of Germany, in the circle of Swabia. In 1802 it was given to the elector of Bavaria; 2 miles S. of Ravenfburg.

WEISSENBACH, a town of the principality of Culmbach; 5 miles E. of Kirch Lamitz.—Alfo, a town of Auftria; 12 miles N. of Grein.—Alfo, a town of Auftria; 9 miles W. of Freyftatt.

WEISSENBERG, a townfhip of Pennfylvania, in the county of Northampton, containing 1046 inhabitants.

WEISSENBORN, a town of Saxony, in the circle of Erzgebirg; 3 miles S.S.E. of Freyberg.

WEISSENBURG, a town of Saxony, in the circle of Erzgebirg; 5 miles S.S.W. of Zwickau.—Alſo, a village of Switzerland, in the canton of Berne, celebrated for its medicinal baths; 18 miles S. of Berne.

WEISSENDORF, a town of Bavaria, in the biſhopric of Bamberg; 9 miles S.W. of Forcheim.

WEISSENFELS, a town of the duchy of Carniola; 28 miles W.N.W. of Crainburg.—Alſo, a town of Thuringia, on the Saal. It gives title to a branch of the houſe of Saxony, called Saxe Weiſſenfels, who ordinarily reſide in a citadel above the town, called Auguſtuſberg; 18 miles W.S.W. of Leipſic. N. lat. 51° 14′. E. long. 11° 59′.

WEISSENHORN, a town and citadel of Bavaria, which gives name to a county belonging to the lords of Fugger; 8 miles S.E. of Ulm.

WEISSENKIRCH, a town of Bavaria, in the principality of Aichſtatt; 3 miles S.S.E. of Aichſtatt.

WEISSENPACH, a town of Auſtria; 4 miles N.W. of Bohmiſch Waidhoven.

WEISSENSEE, a town of Thuringia, near what formerly conſtituted an inland lake, which was divided into the Great and Leſs, or into the Upper and Lower, between both which it lay; but the former being drained in the year 1705, and converted into arable and meadow grounds, a ſmall part of it only being then left; and this alſo has been ſince dried up; 14 miles N. of Erfurt. N. lat. 51° 10′. E. long. 11° 6′.

WEISSENSTADT, a town of Germany, in the principality of Bayreuth, on the Egra, where it forms a large pond or lake, abounding in fiſh; 6 miles N.N.W. of Wonſiedel.

WEISSENTHURN, a town of Sclavonia; 18 miles N.N.W. of Verovitza.—Alſo, a town of the duchy of Stiria; 3 miles E.S.E. of Judenburg.

WEISSESTEIN, a town and caſtle of Bavaria; 10 miles N.N.E. of Deckendorf.

WEISSIA, in *Botany*, an Hedwigian genus of Moſſes, is now, by nearly univerſal conſent, united to GRIMMIA, for reaſons given under that article. There is indeed no difference of habit, nor any certain character, however minute and obſcure, between them. This is the more to be regretted, as we have few more meritorious claimants for diſtinction in cryptogamic botany than Mr. Frederic William Weis, author of the *Plantæ Cryptogamicæ Floræ Gottingenſis*, an octavo volume, printed at Gottingen, in 1770. No ſtudent in that department of the ſcience can diſpenſe with this little book, in which the ſynonyms of the deſcriptions are treated with equal practical ſkill. *Fungi*, and neceſſarily Sea-weeds, are excluded from this *Flora*. We truſt ſome reſponſible author will reſtore a *Weiſia*, worthy of bearing the name. The double *ſs* is a blunder which requires correction.

WEISSLAREUT, in *Geography*, a town of Germany, in the principality of Culmbach; 4 miles S. of Hof.

WEISSNITZ, or WEISSERITZ, a river of Saxony, which riſes in two branches, the Wilde and Rothe, which unite two miles E. of Tharand, and afterwards run into the Elbe, near Dreſden.

WEISTHURN, a town of Bohemia, in the circle of Konigingratz; 6 miles W. of Schlan.

WEISTRA, a town of Auſtria; 5 miles E. of Steyr.

WEISTRITZ, a town of Sileſia, in the principality of Schweidnitz, on a river of the ſame name. Gold is found in the environs; 2 miles S. of Schweidnitz.

WEISTRITZ, a river of Sileſia, which runs into the Oder, near Schweidnitz.

WEISWASSER, a town of Bohemia, in the circle of Boleſlaw; 6 miles N.W. of Jung Buntzel.—Alſo, a town of Sileſia, in the principality of Neiſſe; 4 miles S.W. of Patſchkau.

WEISZBACH, a town of Saxony, in the circle of Erzgebirg; 5 miles N.N.W. of Wolkenſtein.

WEITENFELDS, a town of the duchy of Carinthia; 2 miles W.S.W. of Gurck.

WEITENHAGEN, a town of Anterior Pomerania; 2 miles S.S.W. of Griefswalde.

WEITENSTEIN, a town of the duchy of Stiria; 8 miles S.E. of Windiſch Gratz.

WEITRA, or WEITRACH, a town of Auſtria; 36 miles N.W. of Crems. N. lat. 48° 41′. E. long. 14° 59′.

WEITRASILD, a town of Auſtria; 2 miles S. of Hardegg.

WEITTENEG, a town of Auſtria, on the Danube; 18 miles above Crems.

WEITZ, a town of the duchy of Stiria; 11 miles N.E. of Gratz.

WEITZSBERG, a mountain of Stiria; 10 miles N.E. of Gratz.

WEIXEN, a river of Auſtria, which runs into the Danube, 3 miles below Grein.

WEIZLPACH, a town of Auſtria; 12 miles W.S.W. of St. Polten.

WEKLSDORF, a town of Bohemia, in the circle of Konigingratz; 7 miles N.W. of Branau.

WELACH. See VELACH.

WELANG, a ſmall iſland in the Eaſt Indian ſea. S. lat. 1° 25′. E. long. 130° 30′.

WELAU, a town of Pruſſia, in the province of Samland; 28 miles E.S.E. of Königſberg. N. lat. 54° 36′. E. long. 21° 23′.

WELCH MOUNTAINS, mountains of Pennſylvania; 30 miles W. of Philadelphia.

WELCHEIM, a town of Bavaria; 7 miles N.W. of Neuburg.

WELCKERSHAUSEN, a town of Germany, in the county of Henneberg; 3 miles N. of Meinungen.

WELCOME BAY, a bay on the weſt end of the iſland of Java. S. lat. 6° 35′. E. long. 105° 30′.

WELD, or WOLD, *reſeda luteola* of Linnæus, a plant uſed by the dyers to give a yellow colour; and for this reaſon called, in Latin, *luteola*, of *luteus*, yellow. For the characters, ſee RESEDA.

When the plants are pulled, they may be ſet up in ſmall handfuls to dry in the field, and when dry enough, tied up in bundles and houſed dry; care being taken to houſe them looſely, that the air may paſs between them to prevent their fermenting. That which is left for ſeeds ſhould be pulled as ſoon as the ſeeds are ripe, and ſet up to dry, and then beat out for uſe; for if the plants are left too long, the ſeeds will ſcatter. Mortimer and Miller.

Weld is much cultivated in Kent, for the uſe of the London dyers.

Mr. Hellot obſerves, in his Art de Teindre, that for dyeing with weld, the beſt proportions of alum and tartar for the preparatory liquor are four parts of alum, and one of tartar, to ſixteen of the wool; the quantity of the tartar being determined by the greater or leſs brightneſs of colour propoſed; and that the wool, thus prepared, is to be boiled again with three or four parts of weld to one of wool, but often much leſs: that for light ſhades, it is cuſtomary to diminiſh the alum, and omit the tartar; and that, in this caſe, cafe, the colour is more flowly imbibed, and proves lefs durable.

With a view to economy, the weaker fhades of colour are dyed in the fame bath, after the ftronger are finifhed. A golden yellow, more or lefs orange, is given by a weak madder bath, after the welding.

Silk is dyed of a golden-yellow, generally with weld alone, according to the following procefs: the ftuff is firft boiled in foap-water, alumed and wafhed, then paffed twice through a weld bath, in which, the fecond time, fome alkali is diffolved, which gives a rich golden hue to the natural yellow of the weld. The colour is further deepened by a little annotto. The folutions of lime with weld give to filk a bright clear yellow. In order to dye cotton yellow, Berthollet directs firft to cleanfe it with wood afhes and water, to rinfe, alum, and dry without further rinfing, and then to pafs it through a yellow bath, in which the weld is fomewhat more than the weight of the cotton. When the colour has fufficiently taken, the cotton is thrown into a bath of fulphate of copper and water, and kept there for an hour; after which it is boiled with white foap-water, and, laftly, wafhed and dried. In order to obtain a deeper jonquil-yellow, the aluming is omitted, and, inftead of this operation, a little verdigrife is added to the weld bath, and the cotton finifhed with foda.

Weld is particularly preferred to all other fubftances in giving the lively green lemon-yellow. It is, however, expenfive; and it is alfo found to degrade and interfere with madder colours more than other yellows. We may here add, that the fine delicate yellow, obtained from weld, is much ufed by the London paper-ftainers, and fold in the form of hard lumps, confifting chiefly of chalk faturated with the colouring matter. Meffrs. Collard and Frafer have given the following improved procefs:—Diffufe any quantity of fine whiting in boiling water; add to it one ounce of alum for every pound of whiting, which will occafion a brifk effervefcence, and ftir thefe materials well together till the gas is wholly difengaged. On the other hand, boil in a feparate veffel fome weld with water juft fufficient to cover it, for fifteen minutes, filter the yellow decoction, and then mix it with the whiting and alumine in fuch proportions, that the earths may appear to be faturated with the colouring matter. Then let the mixture remain a day at reft, and at the bottom will be the precipitated earth firmly united with the colour, and of a fine yellow tinge, which may be conveniently dried on chalk-ftones.

The weld yellow is a water colour, and is never mixed with oil.

Weld, in *Agriculture*, is a plant which is not unfrequently cultivated in the field by the farmer as a crop, for the purpofe of giving and affording a bright yellow and lemon colour to woollens, filks, cotton, and thread, as well as for its ufe in the manufacture of check and fuftian, and in fome other intentions. It is for the flower-ftems that it is principally grown, as being ufeful in the procefs of dyeing thefe feveral articles. It is often known by the names of *woold* and *dyer's weed.*

It may be noticed, that in the growth and culture of this plant, the foils moft fuitable are thofe of the fertile mellow kinds, whether of the loamy, fandy, or gravelly forts; but it may be grown with fuccefs on fuch as are of a poorer quality; but in the former, the plants will rife to a much greater height, and produce much larger leaves and ftems, than in the latter defcription of lands.

It has, however, been ftated, that the foil moft fuitable to it, in Effex, is the ftrong ftiff loam moderately moift, but not wet. A foil rather moift, but mellow, feems the moft fuitable and proper for it.

It is neceffary, in the preparation of the ground, that there fhould be a tolerable degree of finenefs produced in the mould of the foil, which may be effected by repeated ploughings given in the more early fpring months, and fuitable harrowings. The furface of the land in the feed furrow fhould be left as level as poffible, that the feed may be difperfed more evenly over it, and with greater regularity and exactnefs.

In this, as in many or indeed moft other cafes, the feed fhould be collected from the beft plants, and thofe which have remained upon the ftems till rendered perfectly ripe; as fuch only vegetates perfectly, and the plants in fuch cafes fhould not be left ftand too long, as the feed is liable to fhed. It fhould be perfectly frefh when ufed, as old feed never comes up well, or in fo regular a manner.

In regard to the proportion of feed which is neceffary, it is commonly from about two quarts to a gallon the acre, according to circumftances, when fown alone: but when mixed with other crops, a little more may be required, which fhould be blended with a little fand, or fome other fuch material, at the time of fowing it on the land, as rendering it capable of being fown more evenly.

It may be obferved in refpect to the time of fowing, that this fort of crop may be put into the ground either in the fpring, as about the latter end of April or beginning of May; or in the latter end of fummer, as the beginning of Auguft; being moftly fown in conjunction with other crops in the firft period; but when fown alone at the latter feafon, the produce is in general the beft and moft full. Some of the writers in the Effex Report on Agriculture fpeak of the culture of this fort of crop as fimply that of tranfplanting from the feed-beds about Midfummer. The feed, in thefe cafes, is fown in the beds in the early fpring, for raifing the plants. In the county of Norfolk, it is faid, that they fow it in the month of April with barley, in the proportion of from a quarter to half a peck to the acre, in the manner of clover, and frequently with clover at the fame time, to be mown or fed in the following year, after the weld is pulled.

It is moftly fown broad-caft, whether grown in mixture with other plants or alone; and as the feeds are of a very fmall fize, it requires an expert feedfman to perform the bufinefs with regularity and exactnefs, which is a matter of much importance to the fuccefs of the crop, as, where the plants ftand too clofely together, much unneceffary trouble and expence muft be incurred in the thinning them out by the hoe afterwards; and where they ftand too thinly upon the ground, there muft be a great lofs from the deficiency of plants. That the fowing may be executed with more regularity, it is the cuftom with fome to blend other fubftances, fuch as the above, with the feed that has nearly the fame weight, as by this means they fuppofe it may be effected with greater exactnefs, facility, and readinefs.

It is ftated that weld, when grown with other forts of crops, fuch as barley, buck-wheat, beans, peas, clover, or grafs-feeds, is ufually put in after them; in fome cafes immediately, but in others not till fome time has elapfed. With the firft and fecond forts, when fown fo late as the beginning of May, it is moftly the practice to fow it directly afterwards, giving the land a flight harrowing with a very light clofe-tined harrow to cover it in. The barley being fown under furrow, the weld-feed with fome is immediately fown over the furface, and lightly harrowed in, and then rolled. Where the barley feeding is performed fo early as March,

March, or the beginning of April, the fowing of the weld-feed is beft deferred till May, when it may be difperfed over the land, and left in that manner to be wafhed in by the rains. With bean and pea crops, it is often fown before the laft breaking or hoeing of the crops in the latter end of June, or beginning of July. In cultivating it with clover and grafs-feeds, it is often fown at the fame time with them; but a better practice is, perhaps, to delay it till fome time afterwards, as both thefe crops require to be fown at too early a period for this plant to rife fafely. But in cafes where no other fort of crop is grown with weld, which is probably the beft method, it is ufually fown evenly over the furface of the land, and covered in by harrowing with a light bufh harrow, having afterwards recourfe to the roller in light forts of land.

Though it is common in cultivating crops of this fort, not to pay any attention to them after being fown; yet as the plants are of flow growth, and liable to be greatly injured in their progrefs by the rifing of weeds, it muft be of much benefit not only to keep them perfectly clean, but alfo to have the mould ftirred about their roots. In about a month from the time of fowing, the plants are moftly in a ftate to be eafily diftinguifhed; a hoeing fhould be then given when the weather is dry, which may be performed in the fame manner as for turnips only, ufing fomewhat fmaller hoes for the purpofe. Some direct that the plants in this operation fhould be fet out to the diftance of three or four inches; but it is better to let them have more room, as fix, feven, or eight inches; which not only leffens the expence of the bufinefs, but contributes to the advantage of the crop. In the fpring, a fecond flight hoeing may be practifed about March, in a dry time; and if any weeds rife afterwards, a third may be given in May. Where the land has been well prepared, one hoeing in autumn and another in the fpring may be fully fufficient. Hand-weeding, though practifed by fome, is in general too expenfive in thefe cafes.

It may be obferved, that the proper period for pulling this fort of crop is when the bloom has been produced the whole length of the ftems, and the plants are juft beginning to turn of a light or yellowifh colour, as in the beginning or middle of July in the fecond year. The plants are ufually from one to two feet and a half in height. It is thought by fome advantageous to pull it rather early, without waiting for the ripening of the feeds, as by this means there will not only be the greateft proportion of dye, but the land will be left at liberty for the reception of a crop of wheat or turnips; but in this cafe, a fmall part muft be left folely for the purpofe of providing feed. In the execution of the work, the plants are drawn up by the roots in fmall handfuls, and fet up to dry, after each handful has been tied up by one of the ftalks, in the number of four together in a fort of erect pofition againft each other, as is done in fome other kinds of crops.

It is remarked, that fometimes they, however, become fufficiently dry by turning, without being fet up. After they have remained till fully dry, which is moftly effected in the courfe of a week or two, they are bound up into larger bundles, that contain each fixty handfuls, and which are of the weight of fifty-fix pounds each; fixty of thefe bundles conftituting a load. Thefe laft are tied up by a ftring made for the purpofe, and fold under the title of woold cord, in many places where this kind of crop is much grown and provided for the dyer and calico-printer.

On account of the weld plant being extremely uncertain in its growth, and the whole crop feldom becoming in a ftate to be pulled at the fame time, it is proper to have an experienced labourer to direct the bufinefs of pulling, in order that the pullers may not proceed at random, but take the different parts as the plants become ready, or in danger from the blight. In which laft cafe, the greateft poffible difpatch fhould be made, as the lofs of weight in the produce will daily increafe, and the grower be of courfe greatly injured in the quantity of it.

After the weld is become fufficiently dried, which is known by the crifpnefs of the leaves, and the ftems turning of a light colour, and when the plants are ripe, the feeds fhelling out; according to fome, it fhould be ftacked up lightly in the barn, in order to prevent its taking on too much heat; while others advife, that it fhould be ftacked up clofely in the manner of wheat, being left to fweat in the fame way as hay, as the more this takes place, the better; the quality of the weld being thereby increafed, if there be no mouldinefs. When the crop has ftood till fully ripened, the feed may be taken before it is put into the barn, which may be eafily procured by rubbing, or flightly beating each of the little handfuls againft each other over a cloth, tub, or any other convenient receptacle, as, by threfhing, the quantity of the weld would be much reduced in weight. The price of this fort of feed is moftly about ten or twelve fhillings the bufhel, which may be fold to the feedfmen in a ready manner.

It may be obferved, that in crops of this kind the produce is in fome degree uncertain, depending much upon the nature of the feafon; but from half a load to a load and a half is the quantity moft commonly afforded, which is ufually fold to the dyers at from five or fix to ten or twelve pounds the load, and fometimes confiderably more.

This is a fort of crop which is moftly difpofed of to the dyers and calico-printers, as well as other manufacturers. The demand for it, however, is fometimes very little; while at other times it is fo great, as to raife the price to a very high degree.

Weld is a crop which is particularly liable to be injured by the blight, which probably has induced the growers of it to raife it with thofe of other kinds, efpecially of the grafs fort; becaufe, where the weld crop does not fucceed, a portion of fheep feed may be afforded by the others, for winter and fpring ufe. It is noticed, that the blight frequently comes on fo fuddenly, that crops which appeared healthy, and in a vigorous ftate of growth, during the whole of the winter and fpring, promifing a large produce, are about the month of May attacked by this vegetable difeafe, fo as to be nearly deftroyed. It is known to be prefent by the plants, efpecially about the lower parts of the ftems of them, turning of a yellowifh or pale reddifh colour, while the upper parts remain green, and feem healthy. When it appears early in the month of May, there is always danger of the crop being deftroyed; but when it comes on at a later period, or where the plants from other caufes, as the drynefs of the feafon, begin to change colour in the fhanks, the only chance is that of having them pulled as expeditioufly as the bufinefs can be performed, and in the readieft manner poffible.

It may be remarked, that it would feem better and more convenient to cultivate this crop alone, or without any mixture of other plants; as, in the former way, it muft be much injured and confined in its growth, on account of the clofenefs and fhade produced by the plants of the other crops that furround it. It is the cuftom, too, when grown with other crops, efpecially thofe of the grafs kinds, to very commonly feed them down in the winter and fpring feafons with

with ſheep, or ſome other light ſort of live-ſtock, under the notion that they will not touch the weld plants; but this is by no means the caſe, as they are found to feed upon them without any nicety, and muſt, of courſe, do very great injury to their growth and flowering. In caſes where weld is ſown among clover, as is not unfrequently the caſe, the beſt method is probably to pull it out when it has got to maturity, before the clover is cut. Where ſown on ſummer fallowed land with rape and graſs-ſeeds, towards the latter end of that ſeaſon, in which caſe it often does extremely well, the crops are moſtly fed by lambs in the courſe of a month or ſix weeks after the ſowing, when little or no injury can be ſuſtained by the cropping of the weld plants.

Weld, on account of the great conſumption of vegetable food which it cauſes, without contributing any thing to the amelioration of the land, can only be introduced with propriety, probably, in ſituations where manure or ſubſtances of that kind can be eaſily obtained. However, in caſes where the crops of this kind are cultivated with ſufficient tillage, care, and attention, they may be a good preparation for wheat or turnips, in ſome inſtances.

It may ſometimes, too, be grown with advantage in the neighbourhoods of large dyeing, printing, and other ſuch manufactories, where the conſumption, and conſequently the demand for it, are very great. If this ſort of produce cannot be diſpoſed of ſoon after it is pulled and tied up, it may be preſerved perfectly ſound for ſeveral years, by being ſtacked either in the barn or on ſtands in the open air, taking care to prevent the attacks and ravages of rats, or other vermin.

Weld, or *Weald*, in a *Chorographical Senſe*. See Weald.

WELDEREN, or Marienburg, in *Geography*, a town of Germany, in the biſhopric of Munſter; 3 miles N.E. of Dulman.

WELDING, in the *Manufactures*, denotes the forging of iron, when intenſely heated; or, more generally, the intimate union which ſubſiſts between the two ſurfaces of two pieces of malleable metal, when heated almoſt to fuſion, and hammered. This union is ſo ſtrong, that when two bars of metal are properly welded, the place of junction is as ſtrong relatively to its thickneſs as any other part of the bar. Welding heat is the heat neceſſary for producing this effect. Bar-iron cannot be welded to another piece of iron, unleſs both be heated to nearly 60° of Wedgwood's pyrometer, which is equal to 8.877 of Fahrenheit's ſcale, and is called the welding heat; but if caſt-ſteel be heated to this point, it would be fuſed, and run from under the hammer; and, therefore, it was for a long time thought to be impoſſible to uſe it in conjunction with iron, in the ſame manner as the other kinds of ſteel are employed. But ſir Thomas Frankland at length diſcovered, that if the caſt-ſteel be made only of a white heat, and the iron of a welding heat, the ſteel will then be ſoft enough to unite with the iron, and yet the former will not become fluid by the operation. It will, however, be proper to give the neceſſary temperatures to the two metals ſeparately, and then to unite them at one ſingle heat. (Phil. Tranſ. for 1795, p. 296.) Mr. Parkes obſerves, that ſome nicety is required in the proceſs of welding iron, ſo that the outſide of the weld does not oxidize too much and fly off in ſcales, before the inſide is brought up to a welding heat. When, therefore, a ſkilful workman is about to weld two pieces of iron, he carefully obſerves the progreſs of the heat; and if one becomes too hot, he rolls it in ſand to preſerve it from the action of the atmoſphere; and when one piece acquires the neceſſary temperature before the other, he covers that with ſand, whilſt he is bringing the correſponding piece up to a ſufficient heat for its uniting properly with the former. Silex, when mixed with the oxyd of iron, forms a very fuſible compound, which covers the work under operation, and prevents a further oxidation of the metal. Iron and platina are capable of a firm union by welding. See ſir John Hall's Experiments, in vol. vi. of Edinb. Phil. Tranſ. p. 71. Parkes's Eſſays, vol. iv.

Welding, the proper heat ſmiths give their iron in the forge, in order to double up the ſame, when wanted to weld a work in the doublings, ſo as to be in one piece thick enough for the purpoſe it is wanted for.

Welding-*Heat* is the ſtrong heat, when the iron is propereſt to bind.

WELDON, Great, in *Geography*, a ſmall market-town in the hundred of Corby, and county of Northampton, England, is ſituated in Rockingham foreſt, 4 miles E.S.E. from the town of Rockingham, and 84 miles N.N.W. from London. A weekly market is held on Wedneſdays, but on a ſmall ſcale; and here are four annual fairs. The market-houſe, over which are the ſeſſions-chambers, ſupported by columns, was built by lord viſcount Hatton. The pariſh is famous for its quarries of rag-ſtone, which takes a high poliſh, and is in great eſteem for chimney-pieces, ſlabs, &c. In the vicinity of this place were diſcovered, in the year 1738, ſome fragments of Roman teſſelated pavements, one of which was ninety-ſix feet long, and ten broad. Connected with this were the floors of ſeven rooms; the centre one, being the largeſt, was terminated at one end with five ſides of an octangular projection. Among the ruins were found ſeveral Roman coins of the lower empire. A wall has been built round the Roman pavement, and a wooden roof placed over it. Near Great Weldon, and forming part of the pariſh, is Little Weldon, a village ſo called in reference to the town, though exceeding it in population. The whole pariſh, according to the return to parliament in the year 1811, contained 166 houſes, and 815 inhabitants.—Beauties of England and Wales, vol. xi. Northamptonſhire, by Rev. J. Evans, and J. Britton, F.S.A., 1810.

WELDS, a river of America, which runs into the Connecticut, in the ſtate of Vermont.

WELEDIA, a town of Egypt, on the left bank of the Nile; 5 miles N. of Siut.

WELFORD, a town of England, in Northamptonſhire, with 931 inhabitants, including 683 employed in manufactures; 15 miles N.W. of Northampton.

WELHARTITZ, a town of Bohemia, in the circle of Prachatitz; 8 miles N.W. of Schuttenhofen.

WELIN, a town of Bohemia, in the circle of Chrudim; 12 miles N.E. of Chrudim.

WELITZEN, a town of Pruſſia, in the province of Natangen; 5 miles S.S.E. of Marggrabown.

WELKI, a town of Bohemia, in the circle of Kaurzim; 7 miles N.E. of Prague.

WELL, a town of Hindooſtan, in Viſiapour; 12 miles E.S.E. of Raibaug.—Alſo, a town on the north coaſt of the iſland of Sumatra. N. lat. 4° 40′. E. long. 97° 20′.

WELL, a hole dug under ground, below the level or ſurface of the water collected in the ſtrata.

It is uſually of a cylindrical figure, and commonly walled with ſtone, and lined with mortar.

In ſinking wells, it is a conſideration of ſome importance, that they ſhould be lined with free-ſtone, and not, as is uſually the caſe, with bricks; becauſe moſt of the bricks which are made in this country, have the property of hardening the water; but the ſtone does not produce this effect.

M. Blondel informs the Royal Academy of Sciences of a device they ufe, in the Lower Auftria, which is encompaffed with the mountains of Stiria, to fill their wells with water; *viz.* that they dig in the earth, to the depth of twenty or twenty-five feet, till they come to a clammy earth, which they bore into, continuing the operation till the water breaks forcibly out; which water, in all probability, comes from the neighbouring mountains, in fubterraneous channels. Caffini obferves, that in many places of Modena and Bologna, they make themfelves wells by the fame artifice. Dr. Derham adds, that the like has been fometimes found in England, particularly in Effex.

In the Philofophica Tranfactions we are informed, by Mr. Norwood, that, in Bermudas, wells of frefh water are dug within twenty yards of the fea, and even lefs, which rife and fall with the tides, as the fea itfelf does. He adds, that, in digging wells in that ifland, they dig till they come almoft to a level with the furface of the fea; and then they certainly find either frefh water, or falt: if it prove frefh, yet, by digging two or three feet deeper, they always come at falt water. If it be fandy ground, they ufually find frefh water; but if hard lime-ftone rock, the water is commonly falt, or brackifh.

Lay-well, near Torbay, ebbs and flows very often every hour; though fomewhat oftener in winter than in fummer. Dr. Oliver obferves, its flux and reflux fometimes return every minute; though, at other times, not above twenty-fix or twenty-eight times in an hour. Philof. Tranf. No. 104.

In Scotland they have a well, which Sibbald has mentioned as foretelling ftorms. It is a deep and large well near Edinburgh, and from the noifes heard in it at certain times is called by the people the *routing well.* They go to this to liften after the prefages of weather, and it is faid that ftorms are particularly foretold by it; and that noifes are not only heard in it before ftorms happen, but that they are always heard determinately and diftinctly on that fide whence the ftorm will come.

In the Philofophical Tranfactions we have an account of a boiling-well, &c. See Spring.

Well, in *Rural Economy*, a deep circular opening, pit, or fort of fhaft, funk by digging down through the different ftrata or beds of earthy and other materials of the foil, fo as to form an excavation for the purpofe of containing the water of fome fpring or internal refervoir by which it may be fupplied, for domeftic or other ufes of different kinds.

It is ufual to have wells bricked round from the bottom to the top, and frequently to have pumps fixed in them. The width is moftly from three to four feet, which, where the fprings are ftrong, may afford and contain a fufficient quantity of water.

As wells are fupplied from fprings, and thefe are formed in the bowels of the earth, by water percolating through the upper ftrata, and defcending downwards until it meets with a ftratum of clay or other impervious material that intercepts it in its courfe, it may naturally be concluded, that an abundant fpring for this ufe need never be expected in any diftrict or place that is covered to a great depth with fand, without any ftratum of clay to force it upwards, as is the cafe in the fandy deferts of Arabia, and the immeafurable plains of Lybia. Neither are we to expect abundant fprings for wells in any foil that confifts of an uniform bed of clay from the furface to a great depth; for it muft always be in fome porous ftratum that the water flows in abundance, and it can be made to flow horizontally in that only, when it is fupported by a ftratum of clay, or other fubftance that is equally impermeable by water. By this means is explained the *rationale* of that rule fo univerfally eftablifhed in digging for wells, that if begun with fand, gravel, or other fuch matters, it need feldom be hoped to find water until clay is come to; and that if clay be begun with, none can be hoped for in abundance till fand, gravel, or porous rock is met with.

Hence, as the doctrine of wells is fo much and fo intimately connected with the nature of the ftrata and the fprings afforded by them, it may not be unneceffary to obferve, that in cafes where differently formed ftrata of fand, to a confiderable depth, reft upon beds of clay, and have a free iffue at the loweft ends of them, if wells were funk into the fand-beds higher up no water could be there permanently found until they penetrated quite through the ftrata of fand, and went to fome depth into the beds of clay that lie below them. In fuch cafes, the water could never rife in the wells much higher than a certain point; becaufe, whenever it rofe as high as the porous fand, it would flow along through it until it made its efcape below; and if the beds of clay fhould extend backwards under the ground a great way, and at a great depth below the furface, fo as to form an abundant and never-ceafing ftream under the beds of fand, it muft neceffarily follow, that the wells will continue conftantly at the fame height, exactly as in the cafe of a ftrong bafon at a fountain, into which a pipe of water conftantly flows, fo as to keep it running over.

If, however, the ftreams that run below the beds of fand be fmall, and the draught of water from the wells, at particular times, be uncommonly large, the furface of the water in the wells will of courfe be made to fink: they may be, indeed, quite drained of water at times, fo as to require to be left for a while till they fhall fill again. This may be occafionally a very ferious inconvenience, and ought to be guarded againft by enlarging the refervoir, which may be effected either by widening the diameter of the wells, or by finking them to a greater depth in the clay, or by both thefe means. Hence it appears, it is faid, that in cafes of this fort, very wide wells ought always to be made. Other cafes, however, will come to be noticed in the courfe of this article, in which the ftraiteft well that can be made, would fupply a quantity of water as abundant as thofe that are wider. In thefe cafes, pipes as above will be found very ufeful.

Nor would the phenomena here defcribed, it is faid, be in the leaft varied if the wells, inftead of being dug in the fand immediately below the vegetable mould, fhould be firft funk through a confiderable thicknefs of fome other ftrata. The depth of the well only would be greater, and all other circumftances the fame.

It may be here noticed, that quickfand, when it comes in the way of well-digging, affords impediments which can only be furmounted with great labour and difficulty. The beft and moft obvious remedy in fuch cafes when they occur, is probably to endeavour to find the means of opening an outlet by which the water may be fuffered to run off or difcharge itfelf. This, where the quickfand is fituated above the level of the fea, or fome adjoining plain, may in many cafes be effected at very little expence, if due attention be beftowed upon the pofition and natural dip of the ftrata, which may be difcovered by various means befides boring. But there are cafes, particularly where the quickfand is produced by a cavity like a bafon fcooped out of the entire bottom, fo as to contain water to a confiderable depth, which in fome particular fituations may be deemed incurable.

It deferves alfo to be remarked, as a circumftance neceffarily

ceffarily accompanying fprings of this kind, that the digging wells in a higher pofition, will not fenfibly diminifh the quantity of water that flows over the lower furface of the clay ; for, as the well, as foon as it is filled, muft overflow, that will not intercept one drop more water than what is drawn up out of it. Were it even poffible to pump the water from the well as faft as it falls into it, fo as never to allow one drop to run over, the cafe would not be much altered, becaufe no more water could be thus intercepted than that which would have flowed into the mouth of the well in its defcent ; fo that every drop that would pafs the mouth of the well, on either fide, would flow forward to the lower fituation, as if no well had ever been made. Hence we fee that fprings of this fort can never be intercepted by wells, or fenfibly affected by other wells placed either higher or lower than them. Wherever this caufe exifts, water will be found nearly in equal abundance, whatever the relative fituation of the well may be in refpect to others : nothing but an uninterrupted trench, of a fize fufficient to intercept all the water as it flowed, and to carry it off, could dry up the fprings or wells below it.

It may alfo be obferved, that if the bed of fand be of great extent, if it be at laft fupported by a bed of clay or other impervious matter, water will undoubtedly be there found, whatever may be the depth of the bed of fand above it, if a well be dug through it ; for, as the water that falls in fhowers upon the earth's furface neceffarily finks through that pervious ftratum, it is foon beyond the reach of the fun, fo as not to be evaporated, and muft fink downwards till it meets with an impervious ftratum, fo that there can be no doubt but that under the immeafurable deferts of Lybia, there muft be water in abundance to fupply any number of perfons, were wells there funk to the requifite depth ; nor is that depth, perhaps, in many cafes, nearly fo great as has been in general apprehended.

There are many other cafes of ftrata and fprings, as concerned in the opening and forming of wells, that conftitute different claffes of fprings for this ufe, as thofe where the water is confined and pent up in retentive beds, fo as to be capable of fupplying wells by fimply boring down into them, or making flight openings in other ways, by which the water may flow up. Some inftances of thefe and other forts will be noticed and confidered below.

In the execution of the work of digging wells, there is no great difficulty, the perfon employed in the bufinefs chiefly working down by means of a fmall fhort-handled fpade and a fmall implement of the pick-axe kind ; the earthy materials being drawn up in buckets by the hand or a windlafs fixed over the opening for the purpofe. Where perfons converfant with this fort of bufinefs are employed, they ufually manage the whole of the work, bricking round the fides with great facility and readinefs ; but in other cafes, it will be neceffary to have a bricklayer to execute this part of the bufinefs. As the expence and trouble of digging and getting up the materials in thefe cafes are confiderable, other means have been had recourfe to, in order to leffen or prevent them. The moft ingenious of thefe is that propofed by a French philofopher, who has advifed that the ground fhould be perforated to a fufficient depth by means of an auger, or borer : a cylindrical wooden pipe being then placed in the hole and driven downward with a mallet, and the boring continued, that the pipe may be forced down to a greater depth, fo as to reach the water or fpring. In proportion as the borer becomes filled with earth, it fhould be drawn up and cleared, when by adding frefh portions of pipe, the boring may be carried to much extent under ground, fo that water may in moft cafes be thus reached and obtained. It is ftated that wells made in this manner are fuperior to thofe conftructed in the common method, not only in point of cheapnefs, but alfo by affording a more certain and abundant fupply of water, while no accident can poffibly happen to the workmen employed. In cafe the water near the furface fhould not be of a good quality, the perforation may be continued to a ftill greater depth, till a purer fluid can be procured ; and where wells have become injured or tainted from any circumftance or accident, when previoufly emptied, and the bottom perforated in a fimilar manner, fo as to reach the lower fheet of water, it will rife in the cylindrical tube in a pure ftate into the body of the pump fixed for the purpofe of bringing it up.

This is certainly an ingenious, ready, and fafe method of forming wells ; but it requires a large expenfive boring auger, and which, if carried to any great depth, would ftand in need of an apparatus for being wrought by means of horfe-power. Befides, other parts would be neceffary, fuch as punches, chifels, and other fuch mouth-pieces, for being fixed on occafionally, in order to work through hard ftrata of many different kinds ; and, in fome inftances, it would be liable to be wholly impeded by the nature of the fubftances through which it had to get in its paffage to the water or fpring. In fome cafes, it may, however, anfwer in a ready and perfect manner, and be of great ufe and convenience. There would be much difficulty, too, in driving down the wooden pipes in many cafes, efpecially if to any confiderable depth, and great nicety be required in making them fo as pretty exactly to fit the aperture formed by the boring auger. And, befides, from their fmallnefs, except they were made from caft-iron, or fome other proper metal, they would not by any means be durable, but fpeedily become leaky and out of order. The beft mode would therefore probably be that of having metallic-pipes caft for the purpofe, and fo formed as to fit exactly upon each other, to any depth that might be neceffary in finking wells.

In fome cafes and kinds of ftrata, wells formed in this manner could not, however, anfwer perfectly, as they require much width or fpace at the bottom parts, and fometimes to be dug confiderably into the impervious bed or matter, as feen above.

It may be neceffary and ufeful to fhew the nature of the different beds or layers of materials which are dug or funk through in forming the openings for wells in different cafes, as well as the manner and heights to which the water or fprings rife in them under various circumftances. Some cafes of wells are ftated in the Corrected Report on Agriculture, for the diftrict about the metropolis, that explain thefe points in a pretty clear manner.

It is noted, that in the year 1791, the prefent vicar of Northall, then Mr. archdeacon Eaton, agreed with Mr. White, of Putney, to fink a well in the court adjoining to the vicarage. The workmen firft dug through a bed of folid blue clay 60 feet in depth, under which was a ftratum of rough porous ftone about a foot thick. To this fucceeded a fecond ftratum of clay, differing a little from the former in colour, 29 feet in depth ; then a ftratum of fine grey fand, intermixed with extraneous foffils, as oyfter-fhells, bivalves, &c. This ftratum continued for twenty-three feet, and was fucceeded by another of clay, of a red or ferruginous colour, lefs firm in its confiftence than that which occurred before, and intermixed now and then with gravel and ftones of a confiderable fize. After digging through this ftratum for fifty-one feet, at the depth of one hundred and fixty-four feet from the furface, water was found, which, on the removal of the ftone which lay imme-

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diately over, the ſpring burſt up with ſuch force, and in ſuch abundance, that the workmen immediately made the ſignal to be drawn up. Within the firſt four hours after its diſcovery, the water roſe to the height of eighty feet, in the next twenty-four hours about forty feet more; after which it continued to riſe gradually for the next fortnight, till it reached its preſent level, which is only four feet from the ſurface of the earth, the depth of the water being now only one hundred and ſixty feet.

Depths of ſtrata paſſed through:

		Feet.
1	Clay	60
2	Stone	1
3	Clay	29
4	Sand	23
5	Clay	51
		164

At Mr. Munday's brewery at Chelſea, a well was dug about the year 1793, to the depth of three hundred and ninety-four feet, within twenty or thirty feet of the edge of the river, moſtly through a blue clay or marl. At the depth of near fifty feet, a quantity of looſe coal, twelve inches in thickneſs, was diſcovered; and a little ſand and gravel were found about the ſame depth. The well-digger uſually bored about ten, fifteen, or twenty feet at a time lower than his work, as he went on; and on the laſt boring, when the rod was about fifteen feet below the bottom of the well, the man felt, as the firſt ſignal of water, a rolling motion, ſomething like the gentle motion of a coach paſſing over pavement. Upon his continuing to bore, the water preſently puſhed its way by the ſide of the auger with great force, ſcarcely allowing him time to withdraw the borer, put that and his other tools into the bucket, and be drawn up to the top of the well. The water ſoon roſe to the height of two hundred feet.

In 1794, a well was ſunk at Norland-houſe, for Mr. Vuliamy, a little on the road towards the town of Uxbridge, to the depth of two hundred and thirty-ſix feet, and then a hole of five inches and a quarter was bored down, and a copper pipe of the ſame diameter as the borer, was driven down to the additional depth of twenty-four feet into a ſtratum of ſand filled with water; when a mixture of ſand and water inſtantly ruſhed upwards through the aperture of the pipe in ſuch abundance, as to riſe one hundred and twenty-four feet, that is, one hundred feet in the well part, and twenty-four in the pipe, in the courſe of eleven minutes, and one hundred and nineteen feet more in one hour and nine minutes; or on the whole it roſe two hundred and forty-three feet in one hour and twenty minutes. A ſound line was then let down, which diſcovered that ſand had roſe in ſuch quantity as to fill the well to the height of ninety-ſix feet. This was under the neceſſity of being repeatedly dug out, by which the ſand was ultimately reduced ſo conſiderably as to permit the water to riſe through it more and more freely, until it flowed over the top of the well at the rate of forty-ſix gallons in the minute. There is ſtill, however, a great body of ſand in the well, through which the water filters by aſcent, which is excellently calculated for freeing it from every ſort of impurity. If a greater ſupply of water at this well were neceſſary for the valuable purpoſe of turning machinery of any ſort, or for any other ſuch uſe, it might certainly, it is ſaid, be obtained after the rate of ſeveral hundred gallons in the minute, by continuing to clear out the ſand until the obſtruction it affords ſhould become of little conſequence; but, in this caſe, the quality of its water is of more importance than the quantity. The water, in this inſtance, is now had in a very high ſtate of purity, as the originally excellent water, rendered ſo by flowing in a ſtratum or body of clear ſand, is further purified and improved by filtrating by aſcent through many ſeet in thickneſs of the ſame material.

Other circumſtances have occurred in digging and forming wells in different ſituations. It is ſtated in the Rural Eſſays, that in ſinking a well at Sheerneſs, near the mouth of the river Thames, ſometime ſince, ſome extraordinary phenomena or appearances occurred, many of which were deemed, by different perſons, rather of a wonderful kind. They were theſe: that ſort is placed upon a neck of land, very little elevated above the ſurface of the ſea. In digging the well, they paſſed firſt through a bed that conſiſted wholly of ſand to the depth of thirty feet, the whole of the water found in which was of a ſalt taſte, when at that depth they diſcovered a ſpring of *ſalt*-water, which, not being irreſiſtibly abundant, they found themſelves enabled to wall out; which being accompliſhed, they then ſunk further, through a bed of clay for ſome fathoms more. They here found another ſpring of ſalt-water, as before; which having walled out in a ſimilar manner, they continued to dig through the ſame bed of clay, for three hundred feet more; at the bottom of which they found a bed of gravel, from which iſſued a copious ſtream of freſh water, which ſoon filled the well within five feet of the top; at which height nearly it has ever ſince remained.

Extraordinary as theſe circumſtances may appear, they are perfectly explicable on the principles and appearances which take place in boring and tapping ſprings. The freſh water, in this caſe, being confined and pent up at a very great depth in the earth, by impervious beds of materials, when the gravel or porous ſtratum that contained the water was ſunk down into it, was forced up and roſe, of courſe, to the height of the internal ſource or reſervoir from which the water originally came in the diſtant high ground. If the ſpring in this inſtance ſhould afford more water than is taken from the well, it will continue always about the above height; ſo that the water can only ſink in the top of the well, when more is drawn from it than the ſpring can ſupply in a given time. See TAPPING *Springs*.

The ſprings of ſalt-water in this caſe are capable of being explained on the ſuppoſition of fiſſures or openings having been formed by the working of ſome ſort of animal, or other unknown cauſe, ſo as to have penetrated the bed of clay, from the edge next the ſea to ſome diſtance, as far inward, at leaſt, as the opening of the well; through which, of neceſſity, ſalt-water would flow into the well as ſoon as it was opened. See Philoſophical Tranſactions, vol. 74.

Another inſtance of a ſomewhat ſimilar kind, though leſs complicated, as being diveſted of the circumſtance of the ſalt-water, is mentioned to have taken place at Derby, under the direction of a late eminent phyſician and philoſopher. A well was ſunk in that place, which lies in a bottom, ſurrounded by many different hills; in which, after digging through a bed of clay for ſome conſiderable depth, an abundant ſpring of freſh water was found, which, as in moſt caſes of this nature, ruſhed up with great impetuoſity, and ſoon filled the well to the top, where it flowed over in a pretty full ſtream. This was inſtantly ſeen, and conceiving that it probably deſcended through ſome narrow ſubterraneous paſſage, from a height greater than that of the houſes of the town, readily imagined that if the ſides of the well could be raiſed to a ſufficient height, making them at the

the ſame time ſtrong enough to bear the preſſure of the water within, it might be conveyed by this means to the higheſt floors of the houſes; which was actually effected to the great convenience and advantage of the family.

The ſame circumſtances might be taken advantage of in many other ſituations and caſes, with equal benefit and convenience in this way, and ſtill more in many others, eſpecially in the turning of machinery.

Even the ſituation of the metropolis itſelf is ſaid to afford a ſtrong example in elucidation of the ſame general principle. It is well known that this is every where built upon a ſolid bed of clay, that extends to a great depth, and which lies above a large baſon of water there confined and pent in, that can in no way be let off or diſcharged; in conſequence of which, it is with certainty known, that water may be found by ſinking a well in any place; and that the well-diggers are become ſo expert, that they can with little difficulty tell, until within a few feet of the depth to which the well muſt be ſunk before water be found. They know, too, that when the water is found, it always riſes in the well until it reaches a certain height, where it remains ſtationary ever after, never riſing or falling ſcarcely more than an inch from its level under any diverſity of ſeaſon: and if the workmen be permitted to take their levels from a known point, they can tell, before they begin to dig, the preciſe length of pump that will be required to raiſe the water to the ſurface.

Thus, if a well be ſunk in one of the loweſt ſituations in the city, as about Fleet-market, and it ſhould be found that it there requires to be dug forty feet before water is met with, and that the well makes a ſort of drawing or tapping, the water will riſe in the well to the height of a certain level, where it will, of neceſſity, become ſtationary, which is at the height of about ten feet from the ſurface of the ground. If in St. Paul's church-yard, which by a careful level has been found to riſe fifty feet above the former ſituation; the well in this place will require to be ſunk about ninety feet before it reaches the water, and that the water will riſe to the certain level, and no higher; ſo that there the water will require to be lifted fifty feet to reach the ſurface of the ground. If in a lower part of the town, as about Aldgate and Fenchurch-ſtreet, the water there is found at ſixty feet, and will riſe to within thirty feet of the top. If about Thames-ſtreet, and its continuations near the river, the depths to which the wells muſt be dug, and the diſtance from the ſurface of the ground to the water will be rather various: in ſome caſes, the water would riſe within three or four feet of the ſurface, and in low places, run over the top. The depth of digging will be moſtly much leſs than in the laſt caſe before the water is reached.

A caſe, which is ſtrikingly illuſtrative of wells where they flow over the tops, is recorded by the above writer, as having alſo lately occurred in the vicinity of the metropolis. A gentleman bought a houſe and farm a little beyond Kenſington gravel-pits, on the right-hand ſide of the road, nearly oppoſite to Holland-houſe. The premiſes were entirely deſtitute of water, which appeared to the occupier to be ſo great an inconvenience, that he determined to try if he could find any there by ſinking a well, and reſolved, rather than not ſucceed, to go to a very great depth. He began digging, and went down very far without diſcovering any ſymptoms of water; but not diſcouraged by this circumſtance, he ſtill proceeded. At length, when he had gone very deep, he found water, and was infinitely more fortunate than he expected; for he feared that after he had found water, it would be neceſſary to raiſe it by artificial means from ſo great a depth, as muſt greatly enhance the price of it. The water, however, roſe in the well very quickly till it reached the top, and there it ran over in a very copious ſtream, overflowing the field around it, till it found out a level for itſelf, forming a living rill, that continues to flow at all times of the year. The owner of the ground, after having made of it a fine piece of water for his pleaſure, and ſupplied all his building with it abundantly, made that part of it iſſue through a pipe into a ſtone baſon by the road ſide, for the accommodation of paſſengers of every ſort; where it ſtill continues to flow, running from thence along the ditch to the bottom of the eminence on which it ſtands; the ſurplus water from the pond being conveyed off by another channel.

Theſe caſes of wells are ſtill further illuſtrated and explained by the nature of what happens in ſinking deep pits and ſhafts in many places for different purpoſes, and from the large burſts of internal waters which take place in many inſtances and ſituations. See Quarries, &c. *Draining of*, and Spring-*Draining*.

On the whole, the facts and ſtatements which have been given above, may ſufficiently explain and elucidate the manner in which water is ſupplied and obtained in the digging and forming of wells, as well as the nature and diſtribution of the ſtrata by which it is conducted, contained, and forced up into them. However, in moſt caſes, before the ſinking of wells is undertaken or begun upon, the nature of the different circumſtances of the particular caſes ſhould be well and fully inquired into and conſidered, and the probability of ſucceſs coolly and maturely weighed from a nice examination of the different ſprings and wells in the immediate neighbourhood; as where this is not the caſe, much labour, trouble, and money, may often be expended to little or no purpoſe, and great diſappointment be ſuſtained.

Well-*Digging*, the art of ſinking wells, and lining them with ſtone or brick, that they may preſerve their figure; as this operation is neceſſary for wells in all ſoils except rock. There are two methods of building the ſtone or brick within the well, which is called the ſteining. In one of theſe a circular ring is formed, of the ſame diameter as the intended well; and the timber of which it is compoſed is of the ſize of the brick-courſes, with which the well is to be lined. The lower edge of this circle is made ſharp, and ſhod with iron, ſo that it has a tendency to cut into the ground; this circular kirb is placed flat upon the ground, and the bricks are built upon it to a conſiderable height, like a circular wall. The well-digger gets within this circle, and digs away the earth at the bottom; the weight of the wall then forces the kirb, and the brick-work with which it is loaded, to deſcend in the earth, and as faſt as the earth is removed it ſinks deeper, and the circular brick-wall is increaſed or raiſed at top as faſt as it ſinks down; but when it gets very deep, it will ſink no longer, particularly if it paſſes through ſoft ſtrata: in this caſe, a ſecond kirb of a ſmaller ſize is ſometimes began within the firſt.

When a kirb would not ſink from the ſoftneſs of the ſtrata, or when it is required to ſtop out water, the bricks or ſtones muſt be laid one by one at the bottom of the work, taking care that the work is not left unſupported in ſuch a manner as to let the bricks fall as they are laid: this is called under-pruning.

Well-diggers experience ſometimes great difficulty from a noxious air which fills the well, and ſuffocates them if they breathe it.

The uſual mode of clearing wells of noxious air, is by means of a large pair of bellows and a long leathern pipe, which is hung down into the well to the bottom, and freſh air is forced down to the bottom by working the bellows.

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This is intended to difplace the damp air or gas, but is not very efficacious, becaufe the damp air is of a greater fpecific gravity than pure air; fo that ten gallons of frefh air is perhaps blown into the well, before two gallons of noxious air is difplaced: and this probably happens becaufe the atmofpheric air is fpecifically lighter than the noxious air, and afcends through the latter to the top of the well, difplacing but a fmall quantity of it. Such bellows, &c. are feldom to be procured on the fpot when wanted, and are too weighty and cumberfome to carry about. If water is thrown down in a fhower, it will fometimes clear the air; but this is laborious, in a deep well, to draw it up again.

The following apparatus may be ufed with great fuccefs in fuch cafes; and as with fifty feet of pipe its weight amounts only to thirty pounds, it may eafily be carried to any diftance. Tubes of every kind being perpendicularly fituated, and having their internal air rarefied, caufe a current or ftream of air to afcend through them. Suppofe fix lengths of metal pipe, each eight feet long, and two inches diameter, all made of tin plate, except the upper one, which is of copper, the better to bear the heat; let a cylindrical veffel be alfo made of copper, holding about two gallons, fixed faft to the upper pipe, and having through the fides of it a number of holes to admit air for the fupport of the fire, which is kindled within it. The veffel muft be fo fixed as to have at leaft five feet of pipe above its top.

The method of placing it in the well is, firft, to lower down the bottom length, into the upper end of which, the lower end of the fecond length is joined, paffing a wire through both to prevent their drawing apart again in holes made for that purpofe; then fill the joint round with oil-putty, fo as to render it air-tight. The upper end of each length of tube is wired, to prevent bending; which wiring alfo forms a receptacle for the putty. Then proceed in the fame manner, with the remainder of the pipes, until the bottom one nearly reaches the furface of the water, but not quite. The fire-pan is to be fupported on two timbers, placed for that purpofe acrofs the top of the wall, and a conical cover may be fitted over it to prevent the heat from paffing away too rapidly, and to confine it to the fides of the pipe. The apparatus being thus fixed, it foon becomes filled with air of the fame quality as that in the well; and as their power of gravity is the fame, both the external and internal air become ftationary, from which there can be no good effect. To put the experiment into execution, fill the fire-pan with lighted charcoal or wood, &c. the copper-pipe which is furrounded by the fire, being by this means heated, a rarefaction of the internal air takes place, which air by this means is lightened, and the external denfe air, continuing to prefs with the fame weight as firft into the bottom of the tube, the equilibrium is deftroyed, and a fucceffion of noxious air paffes up through the pipe, as through the funnel of a chimney, till the whole quantity is carried off; after which the pure air, which has in the meantime introduced itfelf into the well, begins to pafs off by the fame paffage fo long as the fire is continued, though the ftream of air paffing out of the top of the vertical-pipe feems fmall, yet the effect is great, becaufe that ftream confifts entirely of noxious air that is required to be removed. The effect will be greater when the fire-pan is placed lower on the pipe, as by that means more external air becomes rarefied; but if the fire-pan is placed too low down in the well, the charcoal fire produces carbonic acid gas in great quantities, and renders the air in the well unfit for refpiration.

WELL, in *Agriculture*, a term fometimes applied to a fort of pipe-chimney or vent-hole left in a ftack, rick, or mow of hay, or other fimilar materials, in order to prevent its being overheated. Such vent-holes fhould be avoided as much as poffible in all cafes, as injuring and deftroying much hay about them, and being hurtful in other ways. See STACKING *Hay*.

WELLS, *Ebbing* and *Flowing*, in *Rural Economy*, fuch as have their waters rifing and falling in an almoft momentary alternate manner. See SPRING, and WELL.

WELLS, *Farm* or *Field*, in *Agriculture*, fuch as are dug in thefe fituations for the ufe of live-ftock.

Wells of this fort are of much ufe and convenience, as they prevent the trouble and difadvantage of driving cattle to diftances for the purpofe of getting water. See POND.

WELL, in the *Military Art*, denotes a depth which the miner finks into the ground, from which he runs out branches or galleries, either to prepare a mine, or find out, and difappoint, the enemy's mine.

WELL, in a *Ship*, an apartment formed in the middle of a fhip's hold to inclofe the pumps, from the bottom to the lower deck. It is ufed as a barrier to preferve thofe machines from being damaged by the friction or compreffion of the materials contained in the hold, and particularly to prevent the entrance of ballaft, &c. by which the tubes would prefently be choaked, and the pumps rendered incapable of fervice. By means of this enclofure, the artificers may likewife more readily defcend into the hold, in order to examine the ftate of the pumps, and repair them as occafion requires. Falconer.

WELL *of a Fifhing Veffel*, an apartment in the middle of the hold, which is entirely detached from the reft, being lined with lead on every fide, and having its bottom pierced with a fufficient number of fmall holes, paffing alfo through the fhip's floor, fo that the falt-water running into the well is always kept as frefh as that in the fea, and yet prevented from communicating itfelf to the other parts of the hold. Falconer.

WELL alfo implies in the fame range, or even with a furface.

WELL-*Drain*, in *Agriculture*, that fort of vent or difcharge for the wetnefs of land, which is conftructed in fomewhat the well or pit manner. See WELL-*Draining*, and SPRING-*Draining*.

WELL-*Draining*, that means of clearing lands from wetnefs which, in certain flat fituations, is accomplifhed by making large deep pits or wells, and the conftant or occafional ufe of fuitable machinery. In the execution of the bufinefs of forming a draining well in loofe ground, a ftrong wooden frame is neceffary to be funk, as the work of digging the well or pit proceeds; the fides of which being made, fo as in the end to be fufficiently open or permeable, to admit the water to enter freely within it, and clofe enough to prevent groffer matters from interrupting the machinery; efpecially when of the mill kind. The fize of the frame for this purpofe muft, confequently, be adapted and fuited to the nature of the engine which is employed. The laves of a mill, it has been obferved, would require a length of frame, which muft neceffarily be proportionally ftrong; but, that for a pump, a frame of inconfiderable expence would be fufficient; whether of wood or uncemented brick-work.

In this fort of draining, which is applicable in many cafes of cold wet flat lands lying in the valley-tracts in moft parts of the country, the wetnefs is drawn off by thefe forts of powerful machinery, working in the fpring time, after wet feafons, or at other periods when neceffary or wanted. See SPRING-*Draining*.

WELL-*Grown*, in *Ship-Building*, implies, that the grain of the wood follows the fhape required, as in knee-timbers, &c.

WELL-

WELL-*Hole*, in *Building*, is the hole left in a floor, for the ftairs to come up through. See STAIRS.

WELL-*Room*, of a *Boat*, denotes the place in the bottom where the water lies, between the cieling and the platform of the ftern-fheets, from whence it is thrown out into the fea with a fcoop. Falconer.

WELL-*Water*. See WATER.

WELLAND, in *Geography*, a river of England, which paffes by Stamford, Market Deeping, Spalding, &c. and empties itfelf into the German fea, in what is called "The Wafh," between the counties of Lincoln and Norfolk.—Alfo, a river of Canada, which runs into the Niagara, between lake Erie and lake Ontario.

WELLE CORONDE, *Sandy Cinnamon*, a name given by the Ceylonefe to a fpecies of cinnamon, which feels hard and gritty between the teeth, as if it were full of particles of fand, though in reality there is no fand among it.

The bark of this tree comes off very eafily: but it is not fo fit to roll up into quills as the right cinnamon, for it is more rigid and ftubborn, and apt to burft open. It is of a fharp but bitterifh tafte. The roots of all the cinnamon trees yield more or lefs camphor, but this as fmall a quantity as any of them. Phil. Tranf. N° 409.

WELLES, in *Geography*. See WELLS.

WELLESCHIN, a town of Bohemia, in the circle of Bechin; 10 miles S. of Budweifs.

WELLESMITZA, a town of Servia, on the Danube; 10 miles S.E. of Orfova.

WELLFLEET, a townfhip of Maffachufetts, in the county of Barnftaple, containing 1402 inhabitants, with a large harbour near Cape Cod. The inhabitants own 25 veffels, from 30 to 100 tons, employed in the whale, cod, mackarel, and oyfter fifhing; 60 miles by water S.E. of Bofton.

WELLFLEET *Bay*, a bay of the ftate of Maffachufetts, on the E. fide of Cape Cod Bay.

WELLIA TAGERA, *H. M.* in *Botany*, a filiquous plant of Malabar, with a pentapetalous flower, and long flat pods, with tranfverfe partitions between the contained feeds. It grows to the ordinary height of a man, with a ftem as big as a man's arm, and is tranfplanted into gardens only on account of its beauty. It is an evergreen.

All the parts of this plant, the root excepted, are exhibited, with an addition of cummin, white fugar, and milk, againft a virulent gonorrhœa. The leaves boiled in cow's milk, or ufed in baths, expel the gout. The bark, triturated with fugar and water, is proper for the diabetes. The bark of the root, and green faffron mixed with milk, give relief under the nodous gout, called by the Malabarians *fonida badda*. Raii Hift. Plant.

WELLIBALDSBURG, ST., in *Geography*, a town and citadel of Bavaria, in the bifhopric of Aichftat, near Aichftat.

WELLIN, a town of Bohemia, in the circle of Koniggratz; 16 miles S.W. of Biezow.

WELLINGBOROUGH, a market-town in the hundred of Hamfordfhoe, and county of Northampton, England, is principally fituated on a red fand-ftone rock, of which material the houfes are generally built. The town is difpofed along the flope of a hill, nearly a mile to the north of the river Nen, 11 miles N.E. by E. from the county-town, and 68 miles N.N.W. from London. It appears to have been of fome note in the Saxon times, when a great part of it was deftroyed by the Danes. After the Norman Conqueft, it occurs among the numerous poffeffions annexed to the abbey of Croyland, in Lincolnfhire; and at the fuit of the monks of that houfe, was conftituted a market-town, by a charter from king John. In July 1738, it is ftated, that about eight hundred dwelling-houfes, befides outhoufes, &c. were confumed by fire. A new town has been raifed, and now affumes a much more refpectable appearance than before the conflagration. The church is a fpacious edifice, having at its weft end a tower, furmounted by a fpire: the roofs of the aifles, chancel, and chantry chapel, are decorated with various carved work; and on each fide of the chancel are three ftalls fimilar to thofe in cathedral choirs: the eaftern window is richly ornamented with tracery, and fculpture in ftone. This church had a guild to the honour of the Bleffed Virgin; the revenues of which fraternity were, in the fecond year of Edward VI., appropriated to the erection and endowment of a free grammar-fchool. Here are alfo a large charity-fchool, and two meeting-houfes for the public worfhip of Independent Diffenters. A weekly market is held on Wednefdays; and three fairs annually. The chief fource of traffic is corn, the market for which is greatly improved by the decay of that of Higham-Ferrers, at four miles diftance. Here is alfo a confiderable manufacture of lace; as alfo of tammies, harrateens, and other worfted ftuffs. In the population return of the year 1811, the inhabitants of this parifh are enumerated as 3999, occupying 749 houfes. About half a mile north-weft of the town, in an open field, is a chalybeate fpring, called Red-well, formerly much celebrated for its medicinal virtues: in the year 1626, king Charles and his queen refided here a whole feafon, for the benefit of drinking the water, pure from the fource.—Beauties of England and Wales, vol. xi. Northamptonfhire; by the Rev. J. Evans, and J. Britton, F.S.A. Bridges's Hiftory of Northamptonfhire, 2 vols. fol. 1791.

WELLINGTON, a large market-town in the hundred of Kingfbury Weft, and county of Somerfet, England, is fituated on the borders of Devonfhire, at the diftance of 20 miles W.S.W. from Somerton, and 149 miles in the fame bearing from London. The earlieft hiftorical account of it commences with the reign of Alfred, who beftowed the manor on Affer, who had been tutor to feveral of his children, and was afterwards advanced to the fee of Sherborne, and died poffeffed of that dignity, in the year 883. After his death, the king granted the manor to the firft bifhop of Wells, for the fupport of the epifcopal honours of himfelf and his fucceffors. It continued annexed to that fee, till the reign of Edward VI., when it became the property of the duke of Somerfet by purchafe from bifhop Barlow. The town confifts of four ftreets, the principal of which, called the High-ftreet, is very wide and fpacious; the houfes are in general well built and commodious. It is a place of confiderable trade: the chief articles manufactured here are, ferges, druggets, and pottery. A weekly market, on Thurfdays, is well fupplied with all kinds of provifions; and two fairs are annually held. According to the population return of the year 1811, the parifh contained 755 houfes, and 3874 inhabitants, of whom 565 families were ftated to be employed in trade and manufacture. The church is a fpacious ftructure, confifting of a nave, chancel, two aifles, and two fmall chapels. At the weft end is a fine embattled tower, a hundred feet in height, decorated with twelve pinnacles of excellent workmanfhip. In the fouth chapel is a magnificent tomb in honour of fir John Popham, lord chief juftice of England, in the reign of queen Elizabeth. On the table of this monument are the effigies of fir John and his lady, under an arched canopy, richly ornamented with the family arms, rofes, paintings, and obelifks. The whole is fupported by eight columns of black marble, five feet high, with Corinthian capitals, green and gilt. Sir John was a munificent patron to Wellington: among

among other benefactions, he erected an hofpital for fix men and fix women, being old and infirm; two children were alfo to be educated here. This edifice is ftill ftanding: fir John endowed it with an eftate in land, which is vefted in governors, and properly applied.—Beauties of England and Wales, vol. xiii. Somerfetfhire. Collinfon's Hiftory of Somerfetfhire, 3 vols. 4to. 1791.

Wellington, a fmall market-town in the Wellington divifion of the hundred of Bradford, and county of Salop, England, is fituated near the Wrekin-hill, at the diftance of 12 miles E. by S. from Shrewfbury, and 151 miles N.W. from London. It is neatly built, and contains many good houfes. The market, which is held on Thurfdays, is well fupplied, and much frequented; and here are three annual fairs. The church, which has been lately rebuilt, is fupported on caft-iron pillars, and the window-frames are of the fame material, which gives a lightnefs to the edifice: one of the frames is fifteen feet in height. Near the church is a very refpectable charity-fchool. In this town and its vicinity, at the commencement of the civil war, king Charles, then on his march to Shrewfbury, muftered his forces, and after iffuing orders for the obfervance of ftrict difcipline, made a folemn proteftation that he would defend the eftablifhed religion, govern by law, and preferve the liberty of the fubject; and that if he conquered he would uphold the privileges of parliament. The parifh of Wellington includes, befides the town, fix townfhips. The return of the year 1811 ftates the population to be 8213; the number of houfes 1724. The chief employment of the inhabitants is in the coal-works; here are alfo fome mines of iron-ore. About two miles fouthward from the town is the Wrekin, a ftupendous mountain 1100 feet in height. Through the adjacent country runs the Roman road called the Watling-ftreet.

Beneath the Wrekin, and adjoining the road leading to Shrewfbury, is Orleton, the feat of William Cludde, efq. of an ancient family in this county. The manfion at prefent has a modern appearance, but is of very great antiquity, and till of late was enclofed with walls and a gate-houfe, and was furrounded by a moat.—Beauties of England and Wales, vol. xiii. Salop; by J. Nightingale, and R. Rylance, 1811.

WELLINKOVEN, a town of Germany, in the county of Mark; 6 miles W. of Schwiert.

WELLOE, (The,) a rock in the Englifh channel, near the coaft of Cornwall; 9 miles S.E. of Penzance. N. lat. 5°. W. long. 5° 14′.

WELLS, William Charles, F.R.S., I. and E., licentiate of the Royal College of Phyficians, London, and one of the phyficians to St. Thomas's Hofpital, in *Biography*, was the fon of parents who left Scotland and fettled in Carolina, in 1753, and born in Charleftown, South Carolina, in May 1757. Few lives have been more diverfified by incident and more fedulouſly devoted to literary and fcientific purfuits, and therefore more entitled to notice in our biographical fketches than the fubject of this article. Before he had attained the age of feven years, he was fent to a confiderable grammar-fchool at Dumfries, where he remained nearly two years and a half; and in the autumn of the year 1770 he removed to Edinburgh, and attended feveral of the lower claffes of the univerfity. At this early age he had the good fortune to become acquainted with Mr. David Hume and fir William Miller, now known by the title of lord Glenlee, whofe friendfhip he afterwards cultivated and valued, and whofe kind offices he gratefully acknowledged. In 1771 he returned to Charleftown, and was apprenticed, in the medical profeffion, to Dr. Alexander Garden, whofe name is well known among naturalifts; and during three years of the time he was with this gentleman, he purfued his ftudies with fuch diligence, that he acquired perhaps more knowledge than in any three fubfequent years of his life. Soon after the commencement of the American war, in 1775, he came to London. The occafion of his removal was his refufal, from confcientious motives, to fign a paper denominated "The Affociation," which was drawn up in order to unite the people in a refiftance to the claims of the Britifh government. At the commencement of the winter of that year he went to Edinburgh, and entered upon his medical ftudies, with the view of taking a degree. To his former two friends, with whom he had kept up a regular correfpondence, he had now the happinefs of adding a third, no lefs intimate and conftant than the others, the prefent Dr. Robertfon Barclay. Having purfued his ftudies for three winters, and paffed his preparatory trials in the fummer of 1778, he left Edinburgh without graduating, and returned to London, where he attended a courfe of Dr. William Hunter's lectures, and became a furgeon's pupil at Bartholomew's hofpital. In 1779 he went to Holland as furgeon to a Scotch regiment, in the fervice of the United Provinces; but receiving offenfive treatment from the commanding officer, he refigned his commiffion, and challenged the aggreffor, under the unjuft charge of military infubordination, for which an attempt was made to punifh him; but without receiving the fatisfaction which he demanded, he went to Leyden in the beginning of the year 1780, and there prepared an inaugural thefis on the fubject of "Cold," which was publifhed at Edinburgh in the clofe of that year, on occafion of his taking the degree of doctor in medicine. At this time he commenced his acquaintance with Dr. Lifter, a gentleman no lefs diftinguifhed for his integrity and liberality than for his fkill in his profeffion; and it redounds in no fmall degree to the honour of Dr. Wells, that their friendfhip continued without interruption till his death. Nor was it lefs honourable to both thefe gentlemen, that they were introduced to an acquaintance with each other by their common friend Dr. James Currie, the author of "Medical Reports," and the biographer of Burns; whofe premature death was lamented by all who knew him, and were duly apprized of the eminent rank which he occupied in the medical profeffion. In the beginning of the year 1782 Dr. Wells vifited Carolina, then in the poffeffion of the king's troops, for the purpofe of arranging the affairs of his family; and whilft he was there, he fuftained a variety of offices, feemingly very incompatible with each other, and which no perfon deftitute of his verfatile talents and peculiar activity could have fatisfactorily performed. He was an officer in a corps of volunteers, a printer, a bookfeller, and a merchant, a truftee for the management of the affairs of fome of his father's friends in England, and on one occafion a judge-advocate. In December 1782, when the king's troops were obliged to evacuate Charleftown, he removed to St. Auguftine, in Eaft Florida, and there edited the firft weekly newfpaper that had been publifhed in that country, having brought with him a printing-prefs, which had been taken to pieces for the convenience of carriage, and which he contrived, with the affiftance only of a negro-carpenter, to refit for ufe. During his refidence in Florida, he became captain of a corps of volunteers, and manager of a company of officers, who had agreed to act plays for the relief of the pooreft of the loyal refugees from Carolina and Georgia, and occafionally an actor himfelf. In 1784 he removed from St. Auguftine to London, and becoming acquainted with Dr. Baillie, commenced an intimate, fteady, and affectionate friendfhip, the benefits of which he experienced till his death. Having fpent three months at Paris in the year 1785, he returned to London in the

the autumn of that year, and settled as a physician in this city. His father had resided in London from the commencement of the American war, and had amassed a fortune of 20,000*l.*; but by misfortunes in trade his circumstances were now embarrassed, so that Dr. Wells, at the outset of his profession, was obliged to raise money by loans, amounting to 600*l.* For the first few years after settling in London he scarcely took a fee, and after having been engaged for ten years in the exercise of his profession, his receipts from every source did not amount to 250*l. per annum.* However in the next five years he was able to pay part of his debt, and before his death he had the satisfaction of having paid the whole of it, both principal and interest; and it should be mentioned to his honour, that when his income was very limited, he allowed an annuity of 20*l.* to a poor relation.

In 1788 he was admitted a licentiate of the Royal College of Physicians in London; and he took part with those who asserted their eligibility and right of admission to the class of fellows. After the decision of this claim in the court of king's bench, he applied in 1797 for examination, so that if he were found to be fit, he might be returned a fellow. But this application was unavailing; and yet about four years before his death the president of the college sent him a message, expressing a wish to know if he had any desire to become a fellow; to which he replied in the negative. In 1790 he was appointed a physician to the Finsbury Dispensary, in which connection he remained till the year 1798. In 1793 he was chosen a fellow of the Royal Society; and in 1800 he became physician of St. Thomas's hospital, having been assistant physician from the year 1798. In the year 1800 he was seized with a slight fit of apoplexy; but by adopting a very abstemious mode of living, he escaped any subsequent attack. From this time, however, his health declined.

In 1812 he commenced some experiments on dew, and after he had an opportunity of pursuing them, he wrote an "Essay" on the subject, which was published in August 1814, the year in which he was admitted into the Royal Society of Edinburgh; and in 1816 the Royal Society of London adjudged to him the honour of the gold and silver medals of count Rumford's donation for this essay. Although from the year 1814 to the commencement of his last illness his health was in some respects improved, he was afflicted with painful and threatening symptoms. These symptoms became gradually more alarming; and though in his last illness some hopes were entertained by his medical friends, Dr. Baillie and Dr. Lister, of his recovery, yet on the 8th of August he was suddenly seized, while he was sitting up, with the sensation of a tremulous motion in the chest, which he referred to the heat, from which time his illness intermitted. "After this," says his biographer, "an expectation was entertained of his recovery. His life was continued until the evening of the 18th of September 1817; and until the near approach of its termination, his mind was clear and active, and his spirits calm and cheerful."

Our limits will merely allow our enumerating his principal publications. Of his political papers we shall only mention one, which was written in 1781, by the desire of the commandant of the garrison of Charlestown, general Nesbit Balfour. The object of this paper was to shew, by military usage, and the nature of the case, that persons in the American service who, after having been taken prisoners and sent to their homes under their military paroles, and who appeared again in arms against the British government, subjected themselves to the punishment of death. This paper was frequently published in the newspapers, and it is probable that it was owing to this publication that general Balfour and lord Moira thought themselves justified in putting to death a colonel Haynes, the propriety of which act was afterwards a subject of debate in the British parliament. The philosophical pieces of Dr. Wells were the following: *viz.* "An Essay upon single Vision with Two Eyes," 1792, (see VISION, in the Addenda); "Two Letters, in reply to Dr. Darwin's Remarks in his Zoonomia upon what Dr. Wells had written in his Essay upon Vision, on the apparent Rotation of Bodies which takes place during the Giddiness occasioned by turning ourselves quickly and frequently round," 1794, contained in the Gentleman's Magazine for September and October; "A Paper upon the Influence which incites the Muscles to contract in Mr. Galvani's Experiments," 1795; "Experiments upon the Colour of the Blood," 1797; "Some Experiments and Observations on Vision," 1811; all published in the Philosophical Transactions. "An Essay upon Dew," 1811. In this essay the author has introduced new facts and ingenious observations, of which we shall give some account in our additions to the article DEW. "An Answer to Remarks in the Quarterly Review upon the Essay on Dew," and "An Answer to Mr. Prevost's Queries respecting the Explanation of Mr. B. Prevost's Experiments on Dew," 1815; "A Letter to Lord Kenyon relative to the Conduct of the Royal College of Physicians of London, posterior to the Decision of the Court of King's Bench, in the Case of Dr. Stanger;" "A short Letter on the Condensation of Water upon Glass," 1816; which three last appeared in Dr. Thomson's Annals of Philosophy. "Some Biographical Sketches by Dr. Wells" appeared in the Gentleman's Magazine.

Almost all his writings upon medical subjects are contained in the second and third volumes of the Transactions of a Society for the Promotion of medical and chirurgical Knowledge: and their subjects are,—erysipelas; the entire want of hair in the human body; the dropsy, which succeeds scarlet fever; aneurism of the aorta attended with ulceration of the œsophagus and wind-pipe; epilepsy and hemiplegia, apparently produced by a sharp projection from the inner table of the skull; tetanus; aneurism of the aorta, communicating with the pulmonary artery; enlargement of the cæcum and colon; gangrene of the cellular membrane between the muscles and skin of the neck and chest; rheumatism of the heart; red matter and serum of the blood in the urine of dropsy, which has not originated in scarlet fever; and observations on pulmonary consumption and intermittent fever, chiefly as diseases opposed to each other, &c.; to which may be added, a case of aphonia spasmodica, in the second volume of Medical Communications. His manuscript papers were directed to be destroyed, with the exception of one, relating to the difference of colour and form between the white and negro races of men, which will be published.

The literary productions of Dr. Wells have sufficiently established his reputation as a learned and skilful physician, as an acute and inventive philosopher, and as a perspicuous, vigorous, and elegant writer; and it is said, that those who knew him personally estimated him much more highly than persons who were acquainted only with his writings. His mental powers were strong, acute, comprehensive, and versatile; and he was capable of the most close and long-continued attention, and of directing this attention at pleasure. Although he was not eminently distinguished as a classical scholar, or as a deep mathematician, he had read some of the Greek and most of the Latin classics with great attention; wrote Latin with facility and correctness; and made himself mafter of the elementary books of the inferior branches of the mathematics. He was well acquainted with natural philofophy, and particularly optics, and alfo with the facts of modern chemiftry; he was an acute metaphyfician, and intimately verfed in the theories of morals and politics, in ancient and modern hiftory, commerce, and political economy; he had fuccefsfully ftudied belles lettres, and was familiar with the beft writers in the Englifh language; and his own ftyle was pure, perfpicuous, and occafionally forcible and elegant. In converfation he was inftructive and interefting; and in active life prompt and decifive, and at the fame time prudent and cautious. In his habits and manners, he was indefatigable in his application; frugal, and yet as far as his circumftances would allow liberal; high-minded, but fenfible of obligation and grateful for kindnefs; refentful, yet placable; irafcible even on trivial occafions, but exercifing felf-command under great provocations when the importance of circumftances and propriety required it; indignant at infolence and oppreffion, and regardlefs of all perfonal confequences in expreffing his refentment, but fubmiffive to the appointments of heaven, and calm and cheerful under the fufferings which flowed from them. "A fenfe of duty," fays his biographer, "was the paramount feeling of his mind, to which other paffions gave way, and which danger and difficulty ferved only to make more active and vigorous." Such is the tribute which has been evidently dictated by a friend; and yet we have reafon for being affured that it is, upon the whole, fuch as the merit of Dr. Wells juftly claimed. Gent. Mag. for November 1817.

Wells, in *Geography*, a city of Somerfetfhire, England, is fituated in the hundred of Wells-forum, at the diftance of 18 miles from Bath, 21 miles from Briftol, and 121 miles W. by S. from London. It is faid to owe its origin to a remarkable fpring called St. Andrew's well, the waters of which were fuppofed to poffefs extraordinary medicinal properties. Thefe are recorded to have been higly beneficial to Ina, king of the Weft Saxons, whofe religious zeal therefore prompted him to found a collegiate church here in the year 704, and which he dedicated to the above faint. This church was converted into a cathedral in the year 905, when three new bifhoprics were conftituted by order of king Edward the elder, and Wells was then made an epifcopal fee. This was afterwards transferred to Bath by bifhop Villala, about the end of the eleventh century, who built a palace there, and affumed the title of bifhop of Bath. Great contentions foon arofe between the two chapters of Bath and Wells, refpecting the right of election to the epifcopal office. The matter being referred to the arbitration of the bifhop himfelf, it was determined that his fucceffors fhould take their title from both churches; that an equal number of delegates from both chapters fhould enjoy the privilege of voting, and that the inftallation fhould take place in both cathedrals. This regulation, which was made by bifhop Robert, about the year 1135, continued until the reign of Henry VIII., when an act of parliament was paffed for vefting the power of election folely in the dean and chapter of Wells. Henceforward the cathedral and epifcopal feat have been fixed at Wells, but the title of the bifhop is of "Bath and Wells." To the pious zeal of its bifhops, the city is indebted for that truly interefting ftructure, its cathedral church. The building of king Ina having, in the courfe of four centuries, fallen into a dilapidated ftate, was about the year 1150 rebuilt on a much larger fcale by its bifhop. In 1239 it received confiderable additions by bifhop Joceline, who altered, or fitted up the choir, and made other improvements; the fouth-weft tower was added by bifhop Harewell, and other contributors, in 1366; in 1415 the northweft tower was raifed by bifhop Bubwith; and finally, the chapel of the Virgin Mary was added by bifhop Beckington, about the year 1445. Other parts of this interefting fabric were erected and adorned by other prelates, but the precife time of thefe alterations is not recorded. The cathedral, as it now appears, confifts of a nave, with two aifles, a tranfept, and choir, alfo with fide-aifles; at the eaftern extremity of the choir is a fmaller tranfept, and the chapel of the Virgin; on the north fide is a porch, alfo a covered paffage to the chapter-houfe and deanery. Over the interfection of the nave and tranfept is a large quadrangular tower, 160 feet in height, refting on four broad arches, and at the weft end are two other towers. The length of the nave is 190 feet; of the choir to the altar, 108; and of the chapel of the Virgin, 52 feet. The whole fabric exhibits fpecimens of the different ftyles of architecture which prevailed between the twelfth and fifteenth centuries; but the moft interefting part is the weft front, certainly one of the moft impofing examples of architectural and fculptural workmanfhip in the kingdom. It is adorned with a great number of niches and canopies, with ftatues of the apoftles, popes, princes, bifhops, &c. It is divided into five portions in height by bold buttreffes, and four decided compartments, horizontally. In the centre is a large entrance door-way to the nave, over which are three tall lancet-fhaped windows; above thefe is a pyramidal façade to the gable of the roof, crowned with pinnacles, and adorned with numerous niches, ftatues, &c. The buttreffes are likewife covered with panelling, tabernacles, and ftatues. The interior of the church is full of intereft and beauty. Its nave confifts of nine clustered columns on each fide, fupporting pointed arches, over which is a triforium, or open gallery. A third ftory above this difplays a feries of windows, which, with the other arches, are moftly of the lancet-fhape. The columns, crofs-fpringers under the roof, and the whole architecture of this part of the church, difplay the ftyle of the early part of the thirteenth century. In the nave are two elegant monumental chapels, or oratories, to the refpective memories of bifhops Bubwith and Knight. Adjoining the latter is a curious ftone pulpit. At the interfection of the nave with the tranfepts is a large central tower, which refts on four folid piers, or cluftered columns, fuftaining four arches, and over which are inverted arches. The choir is richly ornamented, and lighted by fix highly pointed windows on each fide, and a large eaftern window over the communion-table. Behind the latter are three open arches to the lady chapel, which is fingular in form, decoration, and character. Immediately behind the altar is a circular arrangement of columns, eaft of which is an abfis, forming a half octagon. The whole is furrounded by large windows, with painted glafs. In this part of the church are feveral curious and interefting monuments. North of the great tranfept is the chapter-houfe, an octangular apartment, in the centre of which is a lofty cluftered column, from which diverge feveral ribs.

Southward from the cathedral is the epifcopal palace, which has more the appearance of a fortified caftle than of the refidence of a bifhop. It is furrounded by a wet moat, an embattled wall, flanked with femicircular turrets, with a venerable gate-houfe on the north fide. The deanery-houfe is a fpacious quadrangular building; and here are good houfes for the prebendaries. The eftablifhment of the cathedral confifts of a bifhop, a dean, twenty-feven prebendaries, nineteen minor canons, a precentor, treafurer, chancellor, and three archdeacons; a number which few other cathedrals have.

The city of Wells is feated in a valley, furrounded by lofty hills, and has fome fpacious ftreets. It was firft made a free borough in the reign of Henry II., by the intereft of Joceline, its bifhop. It afterwards received a charter from king John, by which it was provided with a weekly market; by queen Elizabeth's charter, the corporation confifts of a mayor, recorder, feven mafters, and fixteen common-council men. Wells has fent two members to parliament from the earlieft period: the right of election is in the mayor, mafters, burgeffes, and freemen. The voters are about five hundred; the mayor is the returning officer. By the return to the population act of the year 1811, the number of houfes is ftated to be 930; of inhabitants 5156. Six annual fairs are held here; and markets on Wednefdays and Saturdays. The corporation have a fpacious town-hall for the difpatch of their bufinefs; where alfo the affizes are held. Under this hall is an hofpital, founded by bifhop Bubwith, for the maintenance of thirty poor men and women. Here are feveral other alms-houfes, particularly thofe endowed by Nathaniel Steel and fon, for thirty-two men and women, who are allowed three fhillings each *per* week, with a great-coat for the men, and a gown for the women, once in two years. A charity-fchool was alfo erected here for twenty boys and twenty girls, in the year 1714.

Near the village of Wookey, which is fituated about two miles north-weft from Wells, is a remarkable cavern, called Wookey Hole. In its front is an affemblage of vaft rocks, which rife to the height of at leaft two hundred feet, almoft covered with trees and plants fpringing out of the fiffures. On the left fide of a deep ravine is a natural terrace, which leads to the mouth of the cavern, and through the middle of it runs a clear rapid rivulet, that rufhes out of an arch thirty feet in height, and forty in breadth, impetuoufly making its way over an irregular bed of rocks. Hence, an opening not more than fix feet high, conducts into a fpacious vault, eighty feet in height, entirely covered with ftalactites. Near this is a fimilar, though fmaller vault; and beyond them, a low paffage leads to a fpace nearly circular, and about one hundred and twenty feet in diameter, with a vaulted roof forty feet in height. Near this area is what the vulgar call the Witch's Brewhoufe, where a great number of fingular configurations of ftalactite are obfervable, to which correfpondent appellations have been given, fuch as the boiler, furnace, &c. To the left is what is called the hall, which is very lofty, the centre of the roof being at leaft one hundred feet above the ground. The whole length of the cavern is fuppofed to be fix hundred feet.—Collinfon's Hiftory of Somerfetfhire, 3 vols. 4to. Maton's Obfervations on the Weftern Counties, 1797. Davis's Concife Hiftory of the Cathedral Church of Wells, 1809.

Wells, a townfhip of New York, in Montgomery county, erected in 1805 from the N. part of Northampton and Mayfield, bounded N. by Franklin county, E. by Effex, Wafhington, and a fmall part of Saratoga county, S. by Northampton and Mayfield, and W. by Johnftown, about fifty-five miles long and eight miles wide. The country is rough and mountainous, and the foil light, fandy, and barren. It has numerous lakes and ponds, which abound with trout and other cold-blooded fifh, affording good food as well as fport for the angler. Pezeeke lake bears the name of an Indian, and lake Pleafant is a pleafant lake, with a fine beach of white fand.

Wells, a fea-port town of England, in the county of Norfolk, with a harbour at the mouth of a fmall river, of difficult accefs, on account of the fhifting fands at the entrance. The chief trade is in corn, malt, and coals; and of late an oyfter-fifhery has been eftablifhed: it has no market. The population in 1811 was 2683. Near on the W. of Wells is Holkham-hall, the magnificent feat of T. W. Coke, efq. M.P. Wells lies 118 miles N.E. from London.—Alfo, a town of Weft Florida, fituated on the W. fide of St. Andrew's bay. N. lat. 30° 25′. W. long. 85° 50′.—Alfo, a town of America, in the diftrict of Maine, and county of York, at the bottom of a bay to which it gives name, between Capes Porpoife and Neddik, containing 4489 inhabitants; 20 miles S.W. of Portland. N. lat. 43° 20′. W. long. 70° 32′.—Alfo, a town of Vermont, in the county of Rutland, containing 1040 inhabitants; 10 miles S.W. of Rutland.

Wells, a river of Vermont, which runs into the Connecticut.

Wells's *Creek*, a river of Kentucky, which runs into the Ohio, N. lat. 38° 47′. W. long. 84° 27′.

Wells's *Falls*, a cataract in the river Delaware; 13 miles N.W. of Trenton.

Wells's *Paffage*, an inlet on the weft coaft of North America, branching off from Broughton's Archipelago.

WELMICH, or Welmenach, a town of Germany, in the circle of the Lower Rhine, on the right bank of the Rhine; 1 mile from St. Goar.

WELMINA, a town of Bohemia, in the circle of Leitmeritz; 5 miles W. of Leitmeritz.

WELOVAR, a town of Croatia; 16 miles S.E. of Creutz.

WELP, a town of Bohemia, in the circle of Koniggratz; 3 miles S.E. of Toplitz.

WELPSHOLTZ, a town of Germany, in the county of Mansfield, memorable on account of a victory which Lothario, duke of Saxony, obtained over Henry V. in the year 1115.

WELS, a town of Auftria, on the river Traun. This is fuppofed to have been an ancient town of the Norici, and by the Romans called *Ovilara*, or *Ovilaba*. Others fay it was built by the emperor Valerian after his expedition againft the Scythians in Pannonia. The emperor Maximilian I. died here; 11 miles S.S.W. of Lintz. N. lat. 48° 10′. E. long. 14°.

WELSBACH, a river of Thuringia, which runs into the Unftrutt, near Thomafbruck.

WELSCHBILLIG, a town of France, in the department of the Sarre; 18 miles N.N.E. of Luxemburg.

WELSCHBIRKEN, a town of Bohemia, in the circle of Prachatitz; 6 miles N.N.W. of Prachatitz.

WELSE, a river of Brandenburg, which runs into the Oder, near Vierraden.

WELSH Glaive, or Bill, in *Military Antiquities*, a kind of bill, fometimes reckoned among the pole-axes, which was formerly much in ufe.

WELSHPOOL, anciently Trallwng, a large and populous market-town, partly in the hundred of Pool and partly in that of Cawrfe, in the county of Montgomery, North Wales, is fituated on the bank of the river Severn, 8 miles N. from the county-town, and 169 miles N.W. by W. from London. It confifts of one long and fpacious ftreet, with another fmaller, croffing it at right angles, and feveral other collateral branches of leffer dimenfions; and is the largeft and beft-built town in the county. From the manners and language of the inhabitants, it has every appearance of an Englifh town; the Welfh being fpoken here by few perfons. An air of urbanity and opulence pervades the place, chiefly owing to the intercommunication with the more polifhed parts of the kingdom, and to the extenfive trade in flannels; great quantities of which are manufactured here, and ftill greater brought from the hill countries. This being the principal mart for that article, a market is held on every alternate Monday for the fole purpofe of expofing it to fale. A weekly market is alfo held on Mondays for provifions; and here are fix annual fairs for horfes, fheep, and cattle. The Severn becomes navigable at a fmall diftance below the town, at a place called the Pool-ftake; and a branch of the Ellefmere canal running near, tends to facilitate carriage by water conveyance. Among the recent improvements made in the town, is the county-hall, erected at the expence of a few private gentlemen. This ftructure, with a colonnade and pilafters of ftone in front, confifts of upper apartments for the adminiftration of juftice, and of lower ones for the accommodation of trade. Beneath is a fpacious place, appropriated as a corn-market; a feparate fpace for the fale of mifcellaneous articles; and an ample court for holding the affizes or great feffions. On the fecond floor is the county-hall room; and a handfome room adjoining is fitted up for the ufe of the grand jury. The church, though in the pointed ftyle, is apparently of no very remote antiquity. It ftands fingularly at the bottom of a hill, and is fo low, that the ground of the cemetery almoft equals the height of the building. Among the facramental utenfils is a chalice of pure gold, brought from Guinea on the coaft of Africa, containing a wine quart: it bears a Latin infcription, ftating that its intrinfic value was 168*l.*, and that it was prefented to the church in the year 1562 by Thomas Davies, fome time governor-general of the Englifh colonies on the weftern coaft of Africa. Welfh-Pool has a very ancient corporation: its original charter was granted by one of the princes of Powys Land, about the end of the eleventh century; the prefent was a grant from Charles II., by virtue of which the town is governed by two bailiffs, a high fteward, recorder, and town-clerk; under whom are two ferjeants at mace. The population of the parifh, which includes nine adjoining townfhips, was in the year 1811 returned to parliament as 2779; the number of houfes as 578. Formerly the town contributed with the borough of Montgomery in fending a member to parliament; but was disfranchifed of this privilege in the year 1728. There are fome encampments in this parifh, one of which is faid to have been the Britifh camp of Caractacus, on the fummit of the Bryddin-hill, where the laft remains of ancient Britifh liberty were loft by the furrender of that brave fovereign: on the centre of this mountain a column was erected, to perpetuate the memory of admiral Rodney's celebrated victory over the French fleet in the Weft Indies, April 12. 1782.

About a mile to the fouthward of Welfh-Pool, is Powys Caftle, formerly the chief manfion of the Convinian Welfh princes of Powys, and now the refidence of the earl of Powys. This venerable pile, fituated in a well wooded park, is built in the ancient ftyle of domeftic architecture, participating of the caftle and manfion. The entrance is by a gateway between two maffy circular towers, into the area or court, round which the apartments range. Several other towers are ftill ftanding, flanked with femicircular baftions. In front, two immenfe terraces, rifing one above another, form the afcent, by means of a vaft flight of fteps. The interior exhibits little worthy of notice, excepting the principal gallery, meafuring 117 feet in length, which was originally much longer; but in the modernizing plan a large room has been taken from it. The park is formed of fpacious lawns, and fwelling hills; the oak, beech, and chefnut, diverfify the views in rich variety; and highly contribute to render the place interefting to the lovers of foreft fcenery. It is, however, to be regretted, that this venerable caftle is verging to decay: the buildings are in a ftate of dilapidation; the gardens and grounds are neglected; and the pride and ornament of the park removing, for the fake of the timber: fo that at no very diftant period, the beauty and magnificence of Powys may be no more.—Beauties of England and Wales, vol. xvii. North Wales. By Rev. J. Evans, 1812.

WELSTEIN, a town of France, in the department of Mont Tonnerre; 7 miles E.S.E. of Creutznach.

WELSUN, a town of the duchy of Guelderland; 6 miles W. of Hattem.

WELT-ROOT, in *Agriculture*, a term that fignifies the dying away or falling off of wheat-crops, in fome cafes, in the winter or early fpring feafons. It has been fuppofed to occur the moft frequently where the wheat-crops have been put in on clover leys. Some incline to think that it depends upon the want of a fufficient degree of clofenefs and firmnefs in the foils on the beds of mould into which the crops have been put; as where they lie too open and in too porous a ftate, due nourifhment and fupport is not fupplied to the young wheat plants from below, that, of courfe, they do not form their roots in a proper manner. See TREADING.

The term is alfo applied to an operation in the harvefting of grain. See ROOT-*Welt*.

WELTENBURG, in *Geography*, a town of Bavaria, on the right fide of the Danube; 20 miles E.N.E. of Ingoldftadt.

WELTERSBURG, a town of Germany, in the county of Leiningen; 1 mile S. of Wefterburg.

WELTZENEN, a town of the duchy of Weftphalia; 5 miles N. of Werl.

WELWARN, a town of Bohemia, in the circle of Schlan; 8 miles N.E. of Schlan. N. lat. 50° 18′. E. long. 14° 24′.

WELWIN, a village of England, in the county of Herts, where the general maffacre of the Danes is faid to have begun in 1012. In this place, Dr. Young, who was the rector, wrote his celebrated Night Thoughts. Here is a chalybeate fpring; 25 miles N. of London.

WELZHEIM, or WELZEN, a town of Wurtemburg, and capital of a lordfhip to which it gives name, on the Lein; 20 miles E. of Stuttgart.

WEM, a market-town of Whitchurch divifion of the north part of the hundred of Bradford, in the county of Salop, England, is fituated near the fource of the river Roden, at the diftance of 7 miles S. from the town of Whitchurch, 10 miles N.E. from Shrewfbury, and 172 miles N.W. from London. From its fituation Horfley infers, that it is the fcite of the ancient Rutunium. The manor was formerly in the poffeffion of the earls of Arundel, but on the attainder of earl Philip, in the reign of queen Elizabeth, it fell to the crown; and James II. conferred it on the lord chancellor Jefferies, of infamous memory, who had the eftate, and was created baron of Wem. On his death, the title defcended to his fon; but on his deceafe, which occurred fhortly after, it became extinct. The town of Wem confifts of one large ftreet, with a few fmaller ones. By the population return of the year 1811, the number of houfes was ftated to be 297, and the inhabitants 1395. A weekly market is held on Thurfdays, and three fairs annually. The church, a rectory of the real value of about 500*l. per annum*, is a handfome edifice, with a lofty tower, and a fine chancel. A free-fchool was founded and liberally endowed by fir Thomas Adams, who was born in this town in the year 1586, and was elected lord mayor of London in 1645. He was an inflexible adherent to king Charles I. in his troubles, and

continued

continued his attachment to Charles II. while in exile, to whom he is ſaid to have made a remittance of 10,000*l*. On the eve of the Reſtoration he was deputed by the corporation of London to go with general Monk to Breda, to conduct the king to England. The munificence and charities of ſir Thomas were exemplary: among other memorials, is an Arabic profeſſorſhip founded by him in the univerſity of Cambridge. He died February 24. 1667, in the 81ſt year of his age. Near this town, in 1640, was born William Wycherley, a celebrated dramatic writer, who died January 1. 1715. In the ſame houſe which gave him birth, was alſo born John Ireland, author of the "Illuſtrations of Hogarth," and otherwiſe well known in the literary world.—Beauties of England and Wales, vol. xiii. Shropſhire. By Rylance, and J. Nightingale, 1811.

WEMBDINGEN, a town of Bavaria; 10 miles E. of Nordlingen. N. lat. 48° 51′. E. long. 10° 40′.

WEMBERG, a town of Bavaria, in the landgraviate of Leuchtenberg; 6 miles S.W. of Leuchtenberg.

WEMDALEN, a town of Sweden, in Hardjeadalen; 107 miles W.N.W. of Sundſwall.

WEMISTITZ, a town of Moravia, in the circle of Znaym; 4 miles S.W. of Krumau.

WEMMERBY, a town of Sweden, in the province of Smaland; 50 miles N. of Calmar.

WEMO, a town of Sweden, in the government of Abo; 22 miles N.W. of Abo.

WEMYSS, a ſea-port town of Scotland, in the county of Fife, on the N. ſide of the Frith of Forth; a burgh of barony governed by bailies and a council: it has a good harbour, and ſeveral veſſels belong to it, chiefly employed in the carrying trade. Coals and ſalt are the only exports; 4 miles N.E. of Kirkcaldy. N. lat. 56° 9′. W. long. 3° 4′.

Wemyss, *Eaſter*, a town of Scotland, in the county of Fife, on the coaſt, but without a ſafe harbour: here are the ruins of a caſtle uſually called Macduff's Caſtle, ſaid to have been built by Macduff, who was created earl of Fife, in 1057, by Malcolm Canmure; 5 miles N.E. of Kirkcaldy.

WEN, in *Surgery*, an encyſted ſwelling, the particular nature of which is deſcribed in the article Tumours. See alſo Atheroma, Meliceris, and Steatoma, which are technical names applied to the three principal varieties of encyſted tumours. Scarpo's obſervations on encyſted ſwellings of the eye-lids, will be found in another place. See Eye-lid.

Wen, in *Animals*, a fleſhy ſubſtance growing out of any part of an animal's body, and which not unfrequently proceeds from blows, bruiſes, ſtrains, and other ſlight accidents of the ſame nature, moſt commonly beginning or taking its origin in the ſkin of ſome part, and gradually enlarging by a continual accumulation in the diſeaſed part, until by time it becomes of a very conſiderable ſize in ſome caſes.

Enlargements of this nature are ſeldom painful, and in many inſtances they are of ſeveral years duration before they ever reach any great magnitude; becoming quite indolent and ſomewhat like the natural fleſh, having rarely any other ſenſible effect than that of cauſing a deformity and weight in the parts where they happen to be ſituated. The ſubſtance of them is, for the moſt part, of a ſort of fleſhy and often ſpongy nature, though, in ſome caſes, there is a kind of ſpongineſs mixed with a degree of hardneſs, and occaſionally a ſcirrhous or cancerous diſpoſition accompanies them, eſpecially when they take place in the neighbourhood of parts which are of the more glandulous kind.

In moſt real caſes of this nature, the wen is contained in a ſort of cyſt or bag, which ariſes from the injured veſſels of the part, and is formed as it ſlowly advances; and which incloſes the whole ſubſtance, augmenting in thickneſs as well as ſize as it increaſes.

In the removal and cure of caſes of this ſort when they make their appearance on any part of an animal's body, trials ſhould firſt be made to diſſolve and diſperſe them by proper means, ſuch as camphorated ſpirituous and mercurial applications: and where this cannot be accompliſhed, as is often the caſe, the uſe of the knife or cauſtic muſt be had recourſe to for the purpoſe of taking them off or deſtroying them. In circumſtances where the wens are of the pendulous ſort, and hang only by a ſmall neck root, they may frequently be eaſily and conveniently removed by the uſe of a ligature of the ſame kind as is employed in taking up large blood-veſſels, applying it ſo as that it may be capable of being gradually made tighter as there may be occaſion, until the ſubſtance drops off; the part being afterwards dreſſed and healed by the common digeſtive ointment or cerate. Bathing and waſhing the part frequently with the tincture for wounds is alſo, in ſome caſes, of great utility. See Tumour, and Wound, in *Animals*.

However, in caſes where wens have large broad-bottom root parts which are of a knotty ſtringy nature, the cure, if practicable, is to be attempted by extirpation, or the uſe of rather mild cauſtics, dreſſing the parts as in the caſe of wounds. It is ſometimes the beſt and ſafeſt practice, however, to meddle as little as poſſible with wens of this ſort.

When enlargements of the wenny kind take place on the legs and heels of animals, as is often the caſe in the horſe, in the more ſimple kinds of them, the cure may be ſometimes effected by the uſe of applications ſuch as hot vinegar and alum; but in caſe bloody matter be extravaſated, ſuppuration ſhould be promoted by the uſe of ſtimulant ointments and waſhes, and the parts be opened when proper by means of a lancet in a ſuitable depending ſituation, the openings being dreſſed by the wound ointment and tincture.

In theſe wenny enlargements, the contents are of different kinds, ſometimes watery, and at others of a ſuety or thick paſty nature; which, if care be not taken to digeſt well out, together with the cyſt, will not unfrequently collect and fill again. In ſome inſtances, the ſhorteſt method would be to extirpate them by means of the knife, which, when well performed, and the ſkin properly preſerved, would leave little deformity. However, ſome of theſe ſorts of enlargements are beſt let alone, as thoſe of the watery kind in particular, which will wear away inſenſibly in many inſtances, without any application except a little camphorated mercurial ointment.

Wens *of Pearl*. See Pearl.

WENBACH, in *Geography*, a river of France, which runs into the Rhine, 3 miles above Druſenheim.

WENCESLAUS, or Winceslaus, in *Biography*, the ſon and ſucceſſor of Charles IV., whom he ſucceeded as emperor of Germany and king of Bohemia, in his 17th year. In the progreſs of his life, he became notorious both for cruelty and debauchery, and for the moſt extravagant profuſion, for the means of which he had recourſe to the moſt flagitious conduct.

His extravagance, however, became at length ſo intolerable, that the Bohemians, in 1396, with the advice of his

his brother Sigifmund, king of Bohemia, put him into confinement; from which he contrived to efcape, and again to affume the royal authority. But as he purfued the fame conduct, his brother Sigifmund, at the requeft of the people, depofed him, and he was declared regent. Wenceflaus, after having been confined fucceffively in various prifons, made his efcape from one of the towers of Vienna, and returning to Prague, recovered his kingdom. After a fecond marriage, his extravagance involved him in new difficulties, fo that, in order to his difembarraffment, he was under a neceffity of felling his imperial rights to John Galeazo, who had feized the fovereignty of Milan, and other cities of Lombardy dependant on the empire. The princes of the empire became indignant, and affembled a diet in 1400, in which they formally depofed him. Profeffing himfelf happy at this event, which would afford him leifure to pay attention to the government of his kingdom, he held the crown of Bohemia for 19 years longer, more tolerable in his vices, though ftill unreclaimed from them. The difturbances of Bohemia, occafioned by the preaching of John Hufs, occurred in his time, and he took pains to compofe them. At length, whilft he was fitting at dinner, he received intelligence of a fudden tumult at Prague, which occafioned a paroxyfm of rage, that was followed by an apoplexy, which terminated his life in 1419, at the age of 58. Mod. Un. Hift. Moreri.

WENDEL, in *Geography*, a town of Sweden, in Upland; 15 miles N. of Upfal.

WENDELEN, a town of Sweden, in Harjeadalen; 18 miles S.E. of Langafchants.

WENDELL, a townfhip of Maffachufetts; 90 miles N.W. of Bofton.—Alfo, a townfhip of New Hampfhire, in the county of Chefhire, containing 447 inhabitants; 30 miles N.W. of Concord.

WENDELSTEIN, a town of Germany, in the principality of Anfpach; 8 miles S. of Nuremberg. N. lat. 48° 18′. E. long. 11° 4′.—Alfo, a town and ruined citadel of Thuringia; 6 miles S.W. of Querfurt.

WENDEN, a town of the duchy of Weftphalia; 4 miles S. of Olpe.—Alfo, a town of Pruffia, in the province of Bartenland; 6 miles N. of Raftenburg.

WENDIA, in *Botany*, a new umbelliferous genus, thus named by profeffor Hoffmann, in honour of Dr. Wendt, profeffor of Phyfic at Erlang, counfellor to the Elector Palatine, and fucceffor to the great Schreber in the diftinguifhed fituation of Prefident of the Imperial Academy *Naturæ Curioforum*. He is celebrated for the numerous obfervations which he has publifhed, refpecting medicinal plants, and for his zeal in the promotion of botanical ftudies in general.—Hoffm. Gen. Plant. Umbellif. v. 1. 136. t. 1. B. f. 8, *a*, *b*.—Clafs and order, *Pentandria Digynia*. Nat. Ord. *Umbellatæ*, Linn. *Umbelliferæ*, Juff.

Gen. Ch. *Cal. General involucrum* none; *partial* of a few fhort, unequal, lanceolate or linear, deciduous leaves. *Perianth* of five unequal teeth, two of them, in the radiant florets, twice as large as the reft, ovate, acute. *Cor. Univerfal* irregular; flowers of the radius perfect, fertile, except a few males which are interfperfed: *partial* of five petals, with long claws; the outer ones in the radius very large, the middle one divided almoft half way down into two divaricated, linear-oblong, obtufe, flightly falcate, equal lobes; lateral ones rather fmaller, unequally cloven, falcate, one lobe three or four times the length of the other; inner ones much the fmalleft, about equal to the petals of the difk, two-lobed from their incurvation, their point ovato-lanceolate, acute, channelled. *Stam.* Filaments five, fimple, equal, fpreading, the length of the fmaller petals longer than the petals in the flowers of the difk; anthers nearly ovate, two-lobed. *Pift.* Germen oval, compreffed, ftriated, hairy; ftyles two, erect, at length widely fpreading, tapering, their bafe conical, winged with a membranous crifped border running down from each ftyle; ftigmas capitate, obtufe, at length fomewhat globular. *Peric.* Fruit almoft perfectly fmooth, obovate, nearly orbicular, compreffed, bordered, ftriated and ftriped, entire at the edges. *Seeds* two, uniform, emarginate, crowned, in the terminal notch, with the conical, winged, feffile bafe of the two deflexed permanent ftyles: dorfal ribs three, flender, flightly elevated, converging at each end; marginal ones two, parallel: ftripes four, defcending from the top of the feed between the ribs, obtufe, club-fhaped, brownifh, not half the length of the feed: border convex, terminating in a thin, flat, fharp edge, which is channelled externally, emarginate at the bottom.

Eff. Ch. General involucrum none; partial obfolete. Flowers radiant. Calyx unequally toothed. Fruit nearly orbicular, compreffed, notched, with three ribs, and four fhort intermediate ftripes; crowned with the ftyles, whofe bafe is winged.

Obf. The want of a general involucrum, and the flightnefs of the partial one, added to the more orbicular form of the feeds, and their fmoothnefs, appear to afford the chief marks of diftinction between this genus and HERACLEUM, (fee that article,) from which we fhould be rather unwilling to feparate it, any more than *Sphondylium*.

The only fpecies mentioned by the author is,

1. W. *Chorodanum*. Long-leaved Wendia. Hoffm. n. 1. (Heracleum longifolium; Marfch. à Bieberft. Taur. Caucaf. v. 1. 223, excluding all the fynonyms.)—Native of the graffy declivities, furrounding the Caucafian mineral waters of Nartfana, flowering in July. The *root* is biennial. *Leaflets* two pair with an odd one. General and partial *involucrum* fcarcely difcernible. *Flowers* fnow-white; thofe of the *radius* remarkably unequal. *Seeds* when bruifed agreeably fragrant. The author of the Flora Taurico-Caucafica fays, he thinks this more akin to *Heracleum Sphondylium*, with which Crantz and Lamarck unite it, than to the *anguftifolium* of Jacquin, to which it is referred by Willdenow. The latter, however, proves to be a different plant, and it is probable that Willdenow had no knowledge of Hoffmann's *Wendia*, any more than Jacquin, Crantz, or Lamarck, all their obfervations referring to the real *H. longifolium* of Fl. Auftriac. t. 174.—The fpecific name, χοροδανον, is an old fynonym of the *Sphondylium*, or Cow-parfnep.

WENDING, at *Sea*, a term for bringing a fhip's head about, and feems only to be a corruption from *winding*. They fay, *How wends the fhip?*

WENDLANDIA, in *Botany*, owes its name, though not its diftinction as a genus to the late profeffor Willdenow, who dedicated it to the author of that diftinction, Mr. John Chriftopher Wendland, curator of the royal garden at Herrenhaufen, "a moft acute botanift, and highly meritorious writer." His name appears in the *Sertum Hannoveranum* of the very eminent profeffor Schrader, as the delineator and engraver of the plates of that work. Thefe difplay great botanical fkill and attention.—Willd. Sp. Pl. v. 2. 275. Purfh 252. ("Androphylax; Wendland Obf. 37.")—Clafs and order, *Hexandria Hexagynia*. Nat. Ord. *Menifperma*, Juff.

Eff. Ch. *Calyx* of fix leaves. Petals fix, fucculent. Styles reclining. Capfules fix, of one cell. Seeds folitary.

1. W. *populifolia*. Poplar-leaved Wendlandia. Willd. n. 1.

n. 1. Purſh n. 1. (Meniſpermum carolinum; Linn. Sp. Pl. 1468. Willd. Sp. Pl. v. 4. 825. Ait. Hort. Kew. v. 5. 404. M. folio hederaceo; Dill. Elth. 223. t. 178. Androphylax ſcandens; "Wendl. Obſ. 38. Hort. 3. t. 16." Cocculus carolinus; De Cand. Syſt. v. 1. 524.)—Found in hedges and woods, from Carolina to Florida, flowering in June and July. *Stem* ſhrubby. *Flowers* very ſmall, greeniſh-white. *Berries* red. *Purſh.* Hardy in the gardens of Europe, where M. De Candolle ſays it is very frequent, flowering in Auguſt. *Stem* twining, with round *branches*, ſtriated and downy when young. *Leaves* alternate, heart-ſhaped, or broadly ovate, entire, tipped with a ſmall point, rarely three-lobed; an inch and a half or two inches long, with three or five radiating ribs; downy beneath. *Footſtalks* round, downy, about an inch in length. *Flower-ſtalks* axillary; thoſe of the male flowers, (which are generally, not always, diſtinct from the female,) racemoſe, ſimple; thoſe of the female three-cleft.

Profeſſor De Candolle has referred this plant to his genus *Cocculus*, ſeparated from MENISPERMUM, (ſee that article,) on account of the flowers being three-cleft, not four-cleft, to uſe the Linnæan language; and the ſtamens only ſix, inſtead of from ſixteen to twenty. We cannot but heſitate to adopt a genus ſo circumſtanced, and therefore ſhall ſay little concerning the name, which its antiquity can hardly authorize. We regret to perceive that our learned friend ſeems inclined to make antiquity paramount to every other conſideration in nomenclature; thus aſſuming a principle ſubverſive of all his own authority, which otherwiſe might be of ſufficient weight to render the moſt important ſervice to this branch of botany. We hope he will ſoon perceive, that ſenſe and learning are as applicable to it as to any other part of the ſcience, and full as neceſſary to preſerve the whole from ruin.

If the name of *Cocculus* ſhould be diſcarded, though the genus be retained, ſtill that of *Wendlandia* can ſcarcely take its place; there being ſeveral others, good or bad, certain or uncertain, which have a prior claim on the ſcore of antiquity. With theſe we will not here encumber our paper. The reader may find them in De Candolle.

WENDLING, in *Geography*, a town of Auſtria; 3 miles W. of Tauffkirchen.

WENDLINGEN, a town of Wurtemberg, on the river Lauter, near the Neckar; 12 miles S.E. of Stuttgart. N. lat. 48° 38′. E. long. 9° 27′.

WENDOVER, an ancient borough and market-town in the hundred of Ayleſbury, and county of Buckingham, England, is ſituated in Ayleſbury Vale at the diſtance of 24 miles S.E. by S. from the county-town, and 35 miles N.W. by W. from London. It conſiſts principally of brick houſes: the inhabitants derive their chief ſupport from lace-making; but as a branch of the Grand Junction Canal has been recently conveyed to the town, it will probably advance in importance. The earlieſt charter for a market at this place is dated in 1403. A ſubſequent charter of the year 1464 confirms the market, and grants two fairs, which are ſtill held. This borough ſent members to parliament in the 28th of Edward I., and again in the 1ſt and 2d of Edward II.; after which the privilege was diſcontinued for above three hundred years: when in the 21ſt of James I. Mr. Hakeville, a barriſter of Lincoln's-Inn, diſcovered, by a ſearch among the parliament writs in the tower, that members had been formerly ſent. A petition was accordingly preferred for the reſtoration of the ancient franchiſe; and though ſtrenuouſly oppoſed by the court, the commons decided in favour of the borough. The right of election is veſted in all the houſekeepers not receiving alms. The voters are not however more than 130, moſt of whom occupy the burgage houſes rent free. The celebrated John Hampden repreſented this borough in five parliaments. In the population return of the year 1811, Wendover is ſtated to contain 283 houſes, and 1481 inhabitants. The pariſh-church ſtands a quarter of a mile from the town, but contains nothing worthy of particular notice. Near the town is a large reſervoir of water, which covers about ſeventy acres: it was made for the ſupply of the canal.—Beauties of England and Wales, vol. i. Buckinghamſhire; by J. Britton, and E. W. Brayley, 1801. Lyſons's Magna Britannia, vol. i. Buckinghamſhire, 1806.

WENFORD, a town of Sweden, in Weſt Bothnia; 25 miles N.W. of Umea.

WENG, a town of the duchy of Stiria; 10 miles N.N.E. of Rottenmann.

WENGIA, a town of Sweden, in Weſt Gothland; 32 miles E.N.E. of Gothenburg.

WENHAM, a townſhip of Maſſachuſetts, in the county of Eſſex, containing 554 inhabitants; 21 miles E.N.E. of Boſton.

WENHOFDORF, a town of Auſtria; 5 miles N.W. of Schwannaſtatt.

WENJAN, a town of Sweden, in Dalecarlia; 44 miles W.N.W. of Fahlun.

WENIGZELL, a town of the duchy of Stiria; 11 miles W.S.W. of Fridberg.

WENINGS, a town of Germany, in the county of Iſenburg; 4 miles N.W. of Birſtein.

WENLOCK, GREAT, or MUCH, a borough and market-town in the hundred of Wenlock, and county of Salop, England, is ſituated 14 miles S.E. from Shrewſbury, and 147 miles N.W. from London. It is but poorly built, and conſiſts of only two ſtreets, but contains an ancient corporation, and is ſaid to have ſent members to parliament, by a writ from Edward IV. in 1478, when it ſent one member; but now, jointly with Broſeley and Little Wenlock, it returns two. The free burgeſſes, who are the electors, amount to one hundred and ten. By a charter from Charles I., the corporation conſiſts of a bailiff, recorder, two juſtices of the peace, and twelve capital burgeſſes. The whole number of the inhabitants, by the population return of the year 1811, is enumerated as 2079, occupying 494 houſes. Four annual fairs are held here; and a weekly market on Mondays. In the reign of Richard II., Wenlock was as famous for copper-mines, as it is now for quarries of limeſtone. The pariſh-church bears ſome marks of Norman architecture. A large round arch ſeparates the nave from the chancel: at the weſt end is a ſquare tower, with circular headed windows, from which riſes a ſlender ſpire of wood, covered with lead. The interior is well fitted up: on the right of the altar are ſome niches; but there is no monument of ſufficient antiquity or ſculpture to attract the notice of the antiquary. Wenlock owes its celebrity principally to the remains of an ancient abbey, which was ſubſequently converted to a priory for Clugniac monks. This houſe was founded about the year 680, by St. Milburga, daughter of Merward, and niece of Wulphere, king of Mercia: ſhe preſided as abbeſs, and died about the year 716. The Daniſh ravagers are ſaid to have reduced this nunnery to a ſtate of utter deſolation, in which it lay until Leofric was appointed to the earldom of Mercia. Soon after the year 1017, that earl, at the inſtance of his pious conſort the lady Godiva, reſtored it; but with ſo little ſucceſs, that, according to Malmſbury, it was found an heap of ruins, by Roger de Montgomerie, the firſt Norman earl of Shrewſbury, who rebuilt it in 1080, and filled it with monks from Clugni.

It

It is certain that none of the exifting remains are older than his time; and thefe are confined to the chapter-houfe; for not a veftige is now to be traced of the pillars of the choir, which are known to have been circular, maffive, and Norman. The parifh-church was indeed rebuilding at, or juft before the time when Malmfbury wrote (about 1127); for it was on the occafion of commencing the building of the new church, that the difcovery was made of the body of St. Milburga, whofe facred relics are faid to have effected many miraculous cures. The parifh-church ftill retains evident marks of having been erected at a period confiftent with this narrative: but no part of the priory, except what has been already mentioned, can lay claim to any fuch antiquity. The remains of the patron faint appear to have been transferred from the church of the parifh to that of the priory, and perhaps fome new works erected with the treafures which poured in from their fortunate difcovery; for when Gervafe Paganel refolved to build a priory at Dudley, which he appears to have done early in the reign of king Stephen, "he placed his deed of gift with his own hand upon the altar of St. Milburga of Wenlock, in prefence of all the convent, to whofe protection he committed his new foundation." Indeed the priory of St. Milburga was in fuch high repute for fanctity of life and ftrictnefs of difcipline during this century, that in 1164 it furnifhed a colony of monks for the abbey of Paifley in Clydefdale. The number of monks maintained within the priory was forty, and the fame appears to have been about the original number of ftalls in the chapter-houfe: though in 1374, when an inquiry was inftituted into the ftate of the alien priories, it was found to contain only feventeen monks. The priory was furrendered January 31. 1539-40, when a penfion of 80*l.* *per annum* was fettled upon the prior, John Creffage, and the manor-houfe of Madeley was affigned for his refidence. The revenues of the monaftery, according to Dugdale, amounted, at the time of the diffolution, to 401*l.* 0*s.* 7¼*d.* The fcite was granted by Henry VIII. to one Auguftino de Auguftinis, who fold it, in 1545, to Thomas Lawley, efq., who made it his refidence, and in whofe defcendants it continued, till Robert Bertie, efq., fon of his great-granddaughter Urfula Lawley, by fir Robert Bertie, K.B., fold it to the family of Gage. Lord vifcount Gage alienated it to fir John Wynn, bart., who devifed this with his other great eftates, to his kinfman fir Watkin Williams, bart., who thereupon affumed the name of the teftator: he was grandfather of fir Watkin Williams Wynn, bart., the prefent proprietor of thefe venerable ruins.

Few of our Englifh monaftic remains, perhaps, are capable of affording more inftruction and amufement to the lovers of ecclefiaftical architecture, than thofe of Wenlock. The ruins are feated in a low marfhy bottom, fouthward of the ancient borough, and adjoining the eaft end of the parifh church-yard. The chief entrance to the monaftery, from the town, was by a gate on the north fide of the precinct, which appears to have been flanked with two plain fquare towers, one of which is ftanding. The moft prominent features of the prefent buildings, are the lofty and extenfive remains of the priory church, which have happily efcaped the ravages of time. From thefe it is apparent that this facred edifice partook of the mixed characters of the round and the pointed arch. Its magnificence fully correfponded with the opulence of the foundation, and was not furpaffed by many of the ftately churches of the mitred abbeys. The plan of the church was cruciform, with a central tower, but probably without towers at the weft end. The extreme length was 401 feet; that of the tranfept 166; the nave 156; the fpace under the fteeple 39; the choir 156; and the chapel of the Virgin Mary 48. A fragment of the fouth angle of the weft front is ornamented with three tiers of fmall arches: a window below is finifhed with a plain round arch. The great weft window is now no more, but from the remains of one of its impofts, which is a taper-cluftered pilafter, bound midway with rings, its form may be conjectured to have confifted of three lofty lancet arches. Three pointed arches on the fouth fide of the nave are perfect, and reft on ftrong octagonal pillars with plain capitals. Over thefe commences a fecond divifion, feparated by an horizontal ftring-courfe; this comprifes a beautiful triforium, or open gallery, formed by lancet arches in couplets. Above thefe is a third compartment, from which rifes a feries of pointed clereftory windows, now mutilated, but evidently in the fame ftyle with the arches of the gallery beneath. A confiderable fragment of the north, and the whole of the fouth wing of the tranfept are ftanding, both in a ftyle coeval with the nave. The latter, a very beautiful ruin, is compofed of three pointed arches on each fide, refting on cluftered columns, with plain but well-executed capitals. The bafes of the four grand piers, which fupported the fteeple over the interfection of the nave, tranfept, and choir, may be traced nearly buried in rubbifh; and evident veftiges of cluftered fhafts indicate that they fuftained pointed arches. Of the choir, fcarcely a wreck remains, yet within thefe few years, the lower members of fix pillars, of plain and maffy Norman architecture, might be difcerned. Further eaftward appears the foundation of the Virgin Mary's chapel, confifting of excellent mafonry, with feveral deep bafement mouldings. On the eaftern fide of the quadrangle was the chapter-houfe, a parallelogram of fixty feet by thirty, of which a very large portion is ftanding; and a more rare difplay of Norman architecture of the eleventh century can hardly be produced. The north fide is almoft entire. A few paces fouth-eaftward of the chapter-houfe are the remains of a fecond quadrangle, the buildings of which, on two fides, are nearly entire. Thofe on the eaftern fide, it is prefumed, belonged to the lodge of the prior, and, at the diffolution, were preferved for a manfion-houfe by the firft lay poffeffors of the monaftery. This confifts of a long range of two ftories, not very lofty, with a highly pitched and tiled roof. Along the whole front runs an elegant cloifter, 100 feet in extent, compofed of a feries of narrow arches in couplets, with trefoil heads, and ftrengthened at frequent intervals with flender fhelving buttreffes. The eaftern front of the houfe is adorned with ranges of rather fingular windows, which have acute triangular heads, and are arranged in couplets united by very flender buttreffes.—Beauties of England and Wales, vol. xiii. Shropfhire; by R. Rylance, 1811. Architectural Antiquities of Great Britain, vol. iv.; by J. Britton, F.S.A. 1814.

WENLOCK, or *Winlock*, a town of Vermont; 90 miles N. of Windfor.

WENLOCK, *Little*, a town of England, in Shropfhire; 8 miles N. of Much Wenlock.

WENMAN, one of the Gallipago iflands, in the Pacific Ocean.

WENNE, a river of Weftphalia, which runs into the Roer, 3 miles below Everfberg.

WENNEL, a river of North Wales, which runs into the Conway, near Llanrwft.

WENNER LAKE, the largeft lake of Sweden, in Weft Gothland; nearly 90 miles long, and 40 wide. This lake is ftored with great plenty of fifh. Twenty-four rivers empty themfelves into the Wenner lake, yet none flows out of it but the large river called Gotha Elbe, by which outlet

let it discharges itself into the sea. There are several islands in this lake. In the year 1744, the diet resolved to make the passage from the Wenner lake and the Gotha Elbe to Gotheborg, and from thence to Orebro, navigable. See CANAL *of Trolhætta*.

WENNERSBORG, a town of Sweden, in West Gothland, at the south-west extremity of Wenner lake. This town was once a fortress, but at present an open town. It is the staple for all the iron sent from the province of Warmeland to Gotheborg; 15 miles E. of Uddevalla. N. lat. 58° 26′. E. long. 12° 9′.

WENOOA-ETTE. See OTAKOOTAIA.

WENSBECK, a river of England, which rises in Northumberland, passes by Morpeth, and runs into the German sea, N. lat. 55° 13′.

WENSYSSEL, a town of North Jutland, anciently the see of a bishop, removed to Aalborg; 18 miles N.W. of Aalborg.

WENT, a river of England, in the county of York, which runs into the Don.

WENTHUSEN, a town of Westphalia, in the bishopric of Hildesheim; 5 miles E. of Hildesheim.

WENTSCHEN, a river of Prussia, which forms a communication between lake Spirding and lake Wentschen. —Also, a lake of Prussia; 20 miles S.E. of Bartenstein.

WENTSUM, a river of Norfolk, which runs into the Yare, below Norwich.

WENTWORTH, THOMAS, in *Biography*, Earl of Strafford, was born at London in 1593, and having finished his education at St. John's college, Cambridge, travelled abroad, and continued more than a year in France. Soon after his return he was knighted, and married the eldest daughter of Francis Clifford, earl of Cumberland. By the death of his father in 1614, he became possessed of a patrimony of 6000*l.* a year, which was considerably incumbered by a provision for seven brothers and four sisters, with the title of a baronet. Upon his entrance into public life he was nominated Custos Rotulorum of the West Riding of Yorkshire. In 1621 he was returned as a member of parliament for the county of York, and during two sessions conducted himself with circumspection and moderation. In opposition to the king's assumption of unwarrantable authority, and of his assertion that the privileges of the commons were enjoyed merely by his permission, Wentworth urged the house explicitly to declare that these privileges were their right by inheritance. In 1622 he lost his wife, and in 1625 contracted a second marriage with a daughter of Holles, earl of Clare, a young lady distinguished for beauty and accomplishments; and in this year he was returned for his county to the first parliament of Charles I. At this time he was a zealous opposer of the arbitrary measures that marked the commencement of this unfortunate reign; but as he was deemed a person of considerable importance and influence, the minister thought proper to make efforts for conciliating his attachment and support. As he was prevented from obtaining a seat in the new parliament which was convoked, by being nominated sheriff in his county, he silently submitted to this arbitrary act, and took no part in the contention that subsisted between the court and the house of commons. Buckingham, the tenure of whose power was becoming precarious, made overtures to Wentworth, and though they parted upon the best terms after a conference, he received a mandate for resigning the office of Custos Rotulorum to sir John Savile, whom he had succeeded on his dismission. This conduct on the part of the favourite was attended with some aggravating circumstances, and very much incensed him; but he still expressed sentiments of unchanged loyalty. Nevertheless he refused to pay his contribution to the forced loan imposed without the intervention of parliament, and for his opposition to the measure he was first imprisoned in the Marshalsea, and afterwards confined to a range of two miles round the town of Dartford. When a new parliament was summoned, in 1628, this restriction terminated, and he took his seat for Yorkshire. In this season of competition between the advocates of an arbitrary and those of a limited monarchy, Wentworth took a decided and conspicuous part with persons of the latter description, and was one of the most active promoters of the famous Petition of Right. By the measures which he then adopted and pursued, he shewed that he was worthy the purchase of the crown, nor had he virtue sufficient to withstand the temptations by which he was assailed. These were a peerage, and future promotion to the office of president of the council of York, or court of the north. He agreed to the proposed terms; and in July 1628 was created baron Wentworth, Newmarsh, and Oversley, by a patent gratifying his vanity by recognizing his claim to an alliance with the blood-royal, through Margaret, grandmother of Henry VII. Soon after he was advanced to the dignity of a viscount, admitted to the privy-council, and on the resignation of lord Scrope nominated lord-president of the north, with enlarged jurisdiction and powers, the exercise of which afterwards exceeded or directly violated the common law, and overwhelmed the country with oppression and arbitrary dominion. From this time Wentworth may be regarded as a minister and statesman, whose influence at court was in a little while freed from controul by the assassination of Buckingham, and in a popular assembly by the dissolution of parliament. Devoted to the faithful and diligent service of the crown, he obtained the confidence and support of government; and thus elevated, he manifested a haughtiness and imperiousness of temper which augmented the unpopularity resulting from a desertion of his former principles and party. Having cultivated an intimate friendship with archbishop Laud, who had succeeded Buckingham in his influence over the king's mind, he was recommended by this prelate for the direction of affairs in Ireland; the peculiar circumstances of which were thought to require the vigour and decision of Wentworth's character. Accordingly his commission as lord-deputy of Ireland was dated in 1632, though he did not remove to that country till July in the following year. The objects which he proposed in the administration of that kingdom were to render the royal authority uncontrollable, to improve the revenues, so as to render them adequate to its own expenditure, and to afford a surplus for the English treasury, and upon the whole, to derive from it every possible advantage to the monarchy. He stipulated also for the uncontrolled exercise of his own authority. Of the various measures which he pursued in his government of Ireland, our limits will not allow us to give a minute and correct detail; but for an account of these we must refer to the history of that period. His talents and industry were unquestionable, and he certainly improved the state of the country in a variety of respects; but in accomplishing some beneficial purposes he was arbitrary and tyrannical, and chargeable with severe and vindictive proceedings, which made him unpopular both there and in England; and which probably induced the king to mortify him by refusing his request of an earldom. In 1636 he visited the English court, and made a speech before the king and the committee for Irish affairs, in which he gave a minute detail of his various measures by which he had promoted the good of that kingdom and the interest of his majesty, artfully apologizing at the same time for the infirmities of his

his temper. As a farther evidence of his merits with the court, he took notice of his zeal in fupporting the impofition of fhip-money in the exercife of his office as prefident of the council of York; and thus he prepared the way for renewing his petition for an earldom, which, notwithftanding his earneftnefs to obtain it, was again refufed. Thus mortified, he refumed his government with ample powers, and purfued meafures fimilar to thofe which had given fo great offence. His indefatigable application to bufinefs, and the irritation occafioned by the complaints and clamours of thofe who had reafon to be diffatisfied with his conduct, fubjected him to fome fevere paroxyfms of the gout. In 1637 he advifed the king not to engage in a war with Spain, and he thus incurred the lafting enmity of the queen, who wifhed for it, as favourable to the intereft of France. In the court conteft between England and Scotland, Wentworth was both an advifer and actor. After the failure of the king's firft expedition againft Scotland, he fent for the lord-deputy of Ireland, who arrived in November 1639. He advifed the immediate renewal of hoftilities, and the fummoning of a parliament to provide fupplies; and in order to fecure his continued attachment and affiftance, he obtained the earldom which he had once and again fought in vain. In January 1640 he was created earl of Strafford, decorated with the garter, and his ftyle of lord-deputy of Ireland was changed into that of lord-lieutenant, which had been dormant from the time of the earl of Effex. Upon his return to Ireland he obtained four fubfidies, and levied 8000 men for reinforcing the royal army. Afterwards the office of commander-in-chief devolved upon him; but though the Scots prevailed, and the northern counties were furrendered to the enemy, Strafford ftill recommended ftrong and arbitrary meafures. His credit at court, however, was now declining, and the king was obliged by his neceffities to call a parliament, which proved eventually to be the "long parliament." Strafford, perceiving his own perilous fituation, requefted leave to retire to his government; but the king refufed to comply, and encouraged him by a folemn promife that "not a hair of his head fhould be touched by the parliament." The fequel fhewed that Strafford's apprehenfions were well-founded; for on November the 18th, 1640, Pym, in the name of the commons of England, appeared with the charge of high treafon at the bar of the houfe of lords; and Strafford was fequeftered from parliament and imprifoned. The fallen minifter was now become the object of accufation in the three kingdoms; but the defertion and hatred of Ireland moft deeply affected him. The articles of accufation againft him were at firft nine, but in the courfe of three months they were multiplied into twenty-eight. The principal object of his accufer was to fix upon him the charge of "having attempted to fubvert the fundamental laws of the country." Againft this charge he defended himfelf with wonderful felf-poffeffion and powers of reafoning. It became neceffary, therefore, to change the original impeachment into the arbitrary mode of proceeding by a bill of attainder, in purfuing which procefs it was only neceffary to pafs an enactment of his having been guilty of high treafon, and having incurred its punifhment. The bill paffed the houfe with no more than fifty-nine diffentient voices; but among thefe were thofe of fome of the firmeft friends of the legal liberty of their country, who thought the principles of juftice fhamefully violated; and in the houfe of lords the bill was carried more by intimidation than conviction. Hopes were ftill entertained from the king's promife, and his attachment to a faithful fervant. But firmnefs was not one of the king's diftinguifhing virtues. His interference to ftop the progrefs of the bill in the houfe of lords had failed; and he even recurred to the plea of confcientious fcruples. But his counfellors urged the danger of refifting the torrent of popular fury; the prelates, Juxon excepted, acted the part of cafuifts; and Strafford himfelf terminated the ftruggle by a letter, in which he perfuaded the king for his own fafety to ratify the bill, thus concluding it, "my confent fhall more acquit you to God than all the world can do befides. To a willing man there is no injury." Love of life, however, feems to have induced him to have placed confidence in the king's promifes: for when fecretary Carleton informed him of his majefty's final compliance with his folicitations, he lifted up his eyes to heaven, and with his hand on his heart, exclaimed, "Put not your truft in princes, nor in the fons of men: for in them there is no falvation!" Strafford, between his condemnation and execution, employed himfelf in adminiftering confolation and advice to his diftreffed family, and making intereft for their protection. On the final day, as he was quitting the tower, he looked up to the windows of Laud's apartment, and obtaining a view of him, received his fervent bleffing, which he returned with "farewell my lord! God protect your innocence!" At the fcaffold he made an addrefs to the people, expreffing entire refignation to his fate, and afferting the good intention of his actions, however they might have been mifreprefented; and then, taking leave of his accompanying friends, with a pathetic recollection of his widowed wife and orphan children, he calmly laid his head on the block, and giving a fignal, received the fingle ftroke that deprived him of life. He fell in the forty-ninth year of his age, lamented by fome, admired perhaps by more, and leaving a memorable, though not a fpotlefs name. The parliament, not long after his death, mitigated the fentence as far as it affected his children; and in the fucceeding reign his attainder was reverfed, and his heir was reftored to his eftate and honours." Lord Strafford was thrice married, and left an only fon and feveral daughters. Biog. Brit. Whitelock's Mem. The Hiftories of the Period.

Wentworth, in *Geography*, a townfhip of England, in the Weft Riding of Yorkfhire, with about 1000 inhabitants; near it is Wentworth-Houfe, a feat of earl Fitzwilliam; 5 miles N.W. of Rotheram.—Alfo, a townfhip of New Hampfhire, in the county of Grafton, containing 645 inhabitants; 3 miles S.E. of Oxford.

WENTZBURG, a town of the duchy of Warfaw; 40 miles E. of Gnefna.

WEOBLEY, an ancient borough and market-town in the hundred of Stretford, and county of Hereford, England, is fituated 11 miles N.W. by N. from the city of Hereford, and 141 miles N.W. by W. from London. Anciently it formed part of the barony of the Lacies, from whom, by a female, it was conveyed in marriage to the Verdons, who, by that alliance, were for fome time hereditary conftables of Ireland. It afterwards paffed through various families to the Devereux, earls of Effex, and formed their principal lordfhip. On the fouth fide of the town ftood an old caftle, which was taken from the emprefs Maud by king Stephen. Leland mentions it as "a goodly and fine building, but fomewhat in decay." Weobly fent members to all the feven parliaments of Edward I.; the privilege was afterwards difcontinued till the year 1640, when it was reftored by order of the houfe of commons. The right of voting is poffeffed by the owners of the ancient burgage houfes, refident at the time of election, or by the inhabitants of fuch houfes who have been refident forty days. The number of voters is about forty-five: the returning officers are the conftables, in whom the government of the town is vefted. The church is fpacious, and

and contains ſome ancient monumental chapels, in which ſome of the Verdon family appear to have been interred. The population of the pariſh, as returned under the act of 1811, amounted to 626; the number of houſes to 160. A ſmall weekly market is held on Thurſdays; and here are two annual fairs.—Beauties of England and Wales, vol. vi. Herefordſhire, by J. Britton and E. W. Brayley, 1805.

WEPFER, John-James, in *Biography*, an eminent phyſician, was born in 1620 at Schaffhauſen, educated at Straſburg and Baſil, and after viſits to ſeveral univerſities in Italy, took the degree of doctor at Baſil, and ſettled in his native place. His reputation was extenſive in Switzerland and Germany, and he attained, by his diſſections and experiments, a high rank among thoſe who have contributed to improve medical ſcience. In 1658 he publiſhed a celebrated work, entitled "Obſervationes Anatomicæ ex Cadaveribus eorum quos ſuſtulit Apoplexia, cum Exercitatione de ejus loco affecto," 8vo., often reprinted, and in ſome editions with the title "Hiſtoria Apoplecticarum." In his "De dubiis Anatomicis Epiſtola," 1664, 8vo., he aſſerts the entire glandular ſtructure of the liver, prior to Malpighi. Another valuable work is entitled "Cicutæ Aquaticæ Hiſtoria et Noxæ," 1679, 4to.

His conſtitution was injured by attendance at an advanced age on the duke of Wurtemburg, and the Imperial army under his command; and he was carried off by a dropſy in 1695. His papers were publiſhed by two of his grandſons, in a work entitled "Obſervationes Medico-Practicæ de affectibus Capitis internis et externis," 1727, 4to. To the Ephemerides Naturæ Curioſorum, of which ſociety he was a member, he communicated ſeveral valuable papers. Haller. Eloy.

WEPOLON, in *Zoology*, the Ceyloneſe name of an Eaſt Indian ſerpent, of a very long and ſlender body, and in ſome degree reſembling a piece of cane.

WERAY, in *Geography*, a river of Wales, which runs into the Iriſh ſea, 7 miles S. of Aberyſtwith.

WERBEN, a town of Brandenburg, in the Old Mark, at the conflux of the Havel and the Elbe. This town was built by Henry the Fowler, on the ruins of the ancient Caſtellum Vari; 33 miles N.N.W. of Brandenburg. N. lat. 52° 53′. E. long. 29° 44′.—Alſo, a town of Pomerania; 9 miles S.S.W. of Stargard.

WERBERG, a town of Weſtphalia, in the biſhopric of Fulda; 12 miles S.S.E. of Fulda.

WERBKA, a town of Ruſſian Poland, in the palatinate of Braclaw; 36 miles S. of Braclaw.

WERD, a town of Carinthia, on a lake to which it gives name; 8 miles W. of Clagenfurt.

WERDA, a town of Saxony, in the Vogtland; 6 miles N.E. of Oelnitz.

WERDAU, a town of Saxony, in the circle of Erzgebirg; 6 miles W. of Zwickau.

WERDEL, St., a town of France, in the department of the Sorre; 40 miles S.E. of Treves. N. lat. 49° 30′. E. long. 7° 11′.

WERDEN, a town of Germany, in the county of Mark, on the Roer; 11 miles N.E. of Duſſeldorp. N. lat. 51° 18′. E. long. 6° 55′.

WERDENA, a town of Pruſſian Lithuania; 18 miles N.N.W. of Tilſit.

WERDENBERG, a town of Switzerland, and capital of a bailiwick, in the canton of Glarus, which was formerly governed by counts of its own, who were at one time very powerful. In the year 1485, it was purchaſed by the canton of Lucerne; and, after changing owners, in the years 1493 and 1498, was purchaſed by the canton of Glarus, in the year 1519, and has remained ever ſince annexed to that canton, though the inhabitants have ſeveral times been mutinous and revolted. The town is fortified; 11 miles S.S.E. of Appenzell.

WERDENFELS, a town and caſtle of Bavaria, which gives name to a county in the biſhopric of Freyſing; 20 miles S. of Weilhaim.

WERDER, a town of Brandenburg, in the Middle Mark, on an iſland formed by the Havel; 4 miles W. of Potzdam.—Alſo, a diſtrict of Pomerania, between the two branches of the Viſtula, about 20 miles long, and 12 in its mean breadth.

WERDING, a town of Auſtria; 4 miles N.N.W. of Schwannaſtadt.

WERDT, or Wert. See Weert.

WERE, or Wear, a river of England, which riſes in Northumberland, croſſes the county of Durham, and runs into the ſea at Sunderland; anciently called "Vedra."

Were, a river of England, which riſes near Warminſter, in Wiltſhire, and runs into the Avon, near Trowbridge.

Were. See Weir.

Were, *Wera*, in our old *Law-Books*, ſignifies as much as *æſtimatio capitis*, or *pretium hominis;* that is, ſo much as was anciently paid for killing a man.

When ſuch crimes were puniſhed with pecuniary mulcts, not death, the price was ſet on every man's head, according to his condition and quality. *Were ſuum*, id eſt, *pretium ſuæ redemptionis*, his ranſom.

WERELADA, among our Saxon anceſtors, the denying of a homicide on oath, in order to be quit of the fine, or forfeiture, called *were*.

Where a man was ſlain, the price at which he was valued was to be paid to the king, and his relations: for, in the time of the Saxons, the killing of a man was not puniſhed by death, but by a pecuniary mulct, called *wera*.

If the party denied the fact, he was to purge himſelf, by the oaths of ſeveral perſons, according to his degree and quality. If the guilt amounted to four pounds, he was to have eighteen jurors on his father's ſide, and four on his mother's: if to twenty-four pounds, he was to have ſixty jurors; and this was called *werelada*. *Homicidium wera ſolvatur, aut werelada negetur.*

WEREGILD, Weregeld, in our *Ancient Cuſtoms*, the price of a man's head: *pretium ſeu valor hominis occiſi, homicidii pretium;* which was paid partly to the king for the loſs of his ſubject, partly to the lord whoſe vaſſal he was, and partly to the next of kin.

This was a cuſtom derived to us, in common with other northern nations, from our anceſtors, the ancient Germans; among whom, according to Tacitus (De Mor. Germ. cap. 21.), *luitur homicidium certo armentorum ac pecorum numero; recipitque ſatisfactionem univerſa domus.*

In the ſame manner, by the Iriſh brehon law, in caſe of murder, the brehon, or judge, compounded between the murderer and the friends of the deceaſed, who proſecuted him, by cauſing the malefactor to give unto them, or to the child or wife of him that was ſlain, a recompence, which they called *eriach*. And thus we find in our Saxon laws, particularly thoſe of king Athelſtan, the ſeveral weregilds for homicide, eſtabliſhed in progreſſive order, from the death of the ceorl, or peaſant, up to that of the king himſelf. And in the laws of king Henry I. we have an account what other offences were then redeemable by weregild, and what were not ſo. The proceſs called *appeal* had probably its rife in the times when weregild was in ufe. Blackft. Comm. vol. iv.

The weregild of an archbifhop, and of an earl, was 15,000 thrifmas; that of a bifhop, or alderman, 8000; that of a general, or governor, 4000; that of a prieft, or thane, 2000; that of a king, 30,000: half was to be paid to his kindred, and the other half to the public. The weregild of a ceorl was 266 thrifmas.

WEREMOUTH, Bishop's, in *Geography*, a parifh of England, in the county of Durham, on the river Were, with 7060 inhabitants; 12 miles N.N.E. of Durham. This parifh is now incorporated in the town of Sunderland. See Sunderland.

Weremouth, *Monk's*, a parifh of England, in the county of Durham, at the mouth of the river Were, oppofite Sunderland, with 5355 inhabitants.

WEREN, a river of Wurzburg, which runs into the Maine, 6 miles below Carolftadt.

WERFEN, a town and fortrefs of the archbifhopric of Salzburg, on the Salza, with a caftle, memorable for having been the retreat of the archbifhop of Salzburg, whom the duke of Bavaria had driven from his capital for having married; 15 miles N.W. of Radftadt.

WERGELA, or Guergela, a town of Africa, in Biledulgerid; 300 miles S. of Algiers. N. lat. 31° 45'. E. long. 4° 10'.

WERINAMA, a town on the fouth coaft of the ifland of Ceram. S. lat. 3° 15'. E. long. 130° 18'.

WERING, or Woringen, a town of France, in the department of the Roer; 2 miles S. of Zons.

WERK. See Wark.

WERL, a town of the duchy of Weftphalia; 13 miles W.S.W. of Lippftadt. N. lat. 51° 33'. E. long. 7° 58'.

WERM, or Worm, a river of France, which runs into the Roer, near Waffemberg.

WERMSDORF, a town of Saxony, in the circle of Leipfic; 36 miles N.W. of Drefden.—Alfo, a town of Bavaria, in the principality of Aichftatt; 4 miles N. of Aichftatt.

WERNBERG, a town of Bavaria; 3 miles N. of Pfreimbt.

WERNBURG, a town of Saxony, in the circle of Neuftadt; 3 miles N.E. of Rahnis.

WERNE, a town of Germany, in the bifhopric of Munfter; 19 miles S. of Munfter. N. lat. 51° 38'. E. long. 7° 48'.

WERNECK, a town of the duchy of Wurzburg, on the Weren; 5 miles S.W. of Schweinfurt.

WERNER, Abraham Gottlob, in *Biography*, a celebrated mineralogift, and profeffor of mineralogy at Freyburg, in Saxony, was born on the 25th of September 1750. His father was infpector of an iron-work in Upper Lufatia, and at an early period intended to educate his fon for the fame employment. The firft fcanty rudiments of his education were received at a fchool at Bunfleur. He was afterwards fent to the Mineralogical Academy at Freyburg, and from thence to the univerfity of Leipfic, where he applied himfelf to the ftudy of natural hiftory and jurifprudence; but the former he found more attractive, and it was here that he employed himfelf in defining the external characters of minerals, for which he was endowed by nature with a fingular quicknefs of perception. At this place, he publifhed, in 1774, his work on the external characters of minerals, which was confidered as the bafis of his oryctognoftic or mineralogical fyftem. (See Systems *of Mineralogy*.) It has been tranflated into various languages, but Werner could never be perfuaded to publifh a new and enlarged edition. "In this work," fays profeffor Jamefon, "he gave the firft example of the true method of defcribing mineral fpecies. In thefe defcriptions, all the characters prefented by the *fpecies fuite* are detailed with a certain degree of minutenefs, and in a determinate order; fo that we have a complete picture of it, and are furnifhed with characters that diftinguifh it from all known fpecies, and from every mineral that may hereafter be difcovered." It cannot be denied, that previous to this time, the defcriptive language of mineralogifts had been much too indefinite to convey accurate information, or to enable mineralogifts in diftant countries to underftand each other. Soon after this publication, Werner was invited to have the care of the cabinet of natural hiftory at Freyburg, and to read lectures on mineralogy.

This fituation, fo well fuited to the peculiar ftudies in which he was engaged, offered abundant materials for the exercife of his talent for obfervation and claffification. In 1780 he publifhed the firft part of a tranflation of Cronftedt's Mineralogy. In his annotations on this work, he gave the firft fketch of his mineralogical fyftem, and publifhed many defcriptions in conformity with the methods propofed in his treatife on external characters. In this fyftem, we find earthy minerals divided into four genera, filiceous, argillaceous, talcaceous, and calcareous; and thefe fubdivided into fpecies, fub-fpecies, and kinds.

In 1791 he publifhed a catalogue of the great mineral collection of Pabft Von Obaine, captain-general of the Saxon mines. In this work, he gave a tabular view of the whole mineralogical fyftem, in which the arrangement of genus, fpecies, fub-fpecies, and kinds, is continued; feveral additions are made to the external characters, and the arrangement of the fpecies is in fome inftances changed, owing to more extended obfervations. Werner, befides his lectures on mineralogy, alfo delivered lectures on the art of mining, which he is faid to have rendered extremely intelligible by his fimplification of the machinery, and by drawings and figures. His fyftem of geognofy, or geology, was delivered in his lectures, but never publifhed by himfelf. (For fome account of this fyftem, fee Geology, and Systems *of Geology*.) "In lecturing," fays a writer in the Literary Gazette of Leipfic, "he ufed to abandon himfelf (as he was accuftomed to fay) to his mineralogical name, and when his fpirit hovered over the waters and the ftrata, he often became animated with lofty enthufiafm." He caufed his lectures to be written out by his approved fcholars, and by revifing them himfelf made them his own in manufcript. Many parts of thefe lectures have been publifhed in different countries by his pupils. Werner alfo publifhed fome mineralogical papers in the Miner's Journal; and in 1791 appeared his new theory of the formation of metallic veins. This work was tranflated into French by Daubuiffon, and into Englifh in 1809.

Werner was appointed counfellor of the mines in Saxony in 1792, and had a great fhare in the direction of the Mineralogical Academy, and in the adminiftration for public works.

The cabinet of minerals collected by Werner was unrivalled for its completenefs and arrangement, confifting of 100,000 fpecimens. This he fold for 40,000 crowns, referving the intereft of 33,000 as an annuity to himfelf and his fifter, who had no children; and at her death, to be paid annually to the Mineralogical Academy of Freyburg.

This illuftrious mineralogift died Auguft 1817, greatly regretted by all thofe who were perfonally acquainted with him, to whom he was endeared by the fimplicity of his manners,

manners, the cheerfulnefs and benevolence of his difpofition, his integrity and difinterefted devotion to fcience. Werner was never married. His favourite purfuit next to mineralogy appears to have been the ftudy of antiquities, one branch of it, the numifmatology of the ancients, had, during the laft eight years of his life, engaged much of his attention ; and he had formed a collection of 6000 Greek and Roman coins, which enabled him to make refearches into the different mixtures of the metals and the arts of adulteration ; and to make the fubject more clear, he arranged entire feries of falfe coins. He was alfo attached to the ftudy of medicine, and had made a humorous table of difeafes from infancy to old age ; and among his peculiarities may be mentioned his defire of offering medical advice to his friends, and his habit of judging of his own fituation, which he often thought precarious. He was greatly averfe to the ufe of vinegar and milk, but a determined beef-eater : in other refpects he lived temperately, drank but little wine, and was anxioufly careful about warm-clothing and rooms, a caution not well fuited to the habits of a geologift. Werner had travelled little from his own country ; his vifit to Paris appears to have been the only diftant excurfion he ever made from Saxony.

Werner may juftly be faid to have contributed more to extend and improve the practical knowledge of mineralogy, than any one who had preceded him. His method of obferving and defcribing the external appearances of minerals, has been introduced by his pupils, with fome modifications, into various parts of the world, and has given a new and more definite form to the fcience. It has indeed been objected to the method of Werner, that confifting principally in the claffification of minerals according to their external characters ; and in the defcription and arrangement of thefe characters, it may be regarded rather as an empiric art, than a fcience. But in the mineral kingdom thofe definite characters are wanting, which ferve to diftinguifh the genera and fpecies in the other departments of natural hiftory ; and he who can but relieve this difficulty, and enable the ftudent moft eafily to gain a knowledge of minerals under all thefe varying forms, is entitled to the higheft praife. This palm may be pre-eminently given to Werner ; and whoever has juftly appreciated his labours will never ftop to inquire, whether his method fhould rank among the fciences or the arts. Mr. Kirwan was the firft who introduced a knowledge of the Wernerian mineralogy into this country ; but for a more complete knowledge of it, we are indebted to profeffor Jamefon, in his Syftem of Mineralogy, firft publifhed in 1804, and in the fecond edition of 1817.

As a geologift, we cannot allow to Werner the fame degree of unmixed praife. His fyftem of geognofie was formed on obfervations made on a very limited portion of the earth's furface in his own vicinity ; and he has laid down a fucceffion of rock-formations as univerfally fpread over the globe, becaufe thefe rocks occurred in this order in a particular part of Saxony. Subfequent obfervations have, however, demonftrated, that even at a little diftance from Freyburg, many of the fuppofed univerfal rock-formations are not to be found, and that other rocks fupply their place. The reader may confult a defcription of the Saxon Erzgebirge by M. Bonnard, in the Journal des Mines for 1815, to convince himfelf of this. It is, we confider, fortunate for Mr. Werner's fame as a geologift, that no work of his on the fubject has appeared, except the " New Theory of Veins." This for fome time enjoyed a certain degree of celebrity from the name of the author ; but the new information which it contains is very fcanty, and the theory which it fupports fo inadequate to explain the phenomena, and fo much at variance with facts, that it was in a great part abandoned by many of the warm admirers of Werner, even fome years before his death. It will now fcarcely meet with a fupporter among thofe who have any practical knowledge of mineral-veins. Mr. Werner contended for the aqueous formation of almoft every kind of rock, even pumice-ftone and obfidian he maintained were the products of water ; and when he was repeatedly invited to vifit the volcanic diftricts of Italy, and the ancient volcanoes of France, he declined an examination which might have greatly endangered his own theory. The followers of Werner as a geologift reft his fame not on his local obfervations, but on his attempt to generalize his obfervations, in order to form a theory which fhould explain the ftructure of the earth and the mode of its formation. Indeed fuch was their admiration, that they would not admit his fyftem to be a theory, but confidered it as an expofition of demonftrated facts. " This great geognoft," fays Mr. Jamefon, " after many years of the moft arduous inveftigations, conducted with an accuracy and acutenefs of which we have few examples, difcovered the manner in which the cruft of the earth is conftructed. Having made this great difcovery he, after deep reflection, and in conformity with the ftrict rules of induction, drew moft interefting conclufions as to the manner in which the folid mafs of the earth may have been formed. It is a fplendid fpecimen of inveftigation, the moft perfect in its kind ever prefented to the world. (Jamefon's Mineralogy, firft edition, vol. i. p. 22.) We believe there are few perfons who will not now admit that the admiration and praife here beftowed were difproportioned to the object, whether we regard the merit of Mr. Werner's obfervations for accuracy as a geologift, or the conformity of his theory with exifting appearances.

The method of inveftigation purfued by Werner in attempting to trace the rocks in a diftrict in fucceffion, from the loweft or fundamental rock to the uppermoft ftratum, and marking the limits of each rock where it terminates on the furface, was confidered by his followers as entirely his own, and was called by them the *method of the Wernerian geognofie*. But this method had been known and practifed in England long before we were acquainted with the name of Werner ; indeed it is the only one which preceding geologifts could practically adopt in furveying a country. On a fmaller fcale, it had been practifed by all intelligent coal-viewers ; and it had been exhibited on a larger fcale by Mr. Whitehurft, in the defcriptions and plates which he has given in his " Theory of the Earth." Sauffure followed no fyftem ; yet wherever the order of fucceffion was apparent, he has not failed to inform us. But the country which he inveftigated, (Switzerland,) prefents enormous maffes, frequently in much apparent confufion, the order of fucceffion being hid by debris or by glaciers. In other inftances, whole mountains compofed of different rocks appear to have been formed cotemporaneoufly. Sauffure, who had no theory of any regular order of fucceffion to fupport, has fimply defcribed facts as they exift. Our own countryman, William Smith, had been long employed in tracing the limits and order of fucceffion of the ftrata in the midland and eaftern counties of England, before the Wernerian geognofie was known either in England or Scotland.

The originality of the Wernerian geognofie confifted more in the invention of a new language adapted to fupport a theory, than in the difcovery of a new and practical method of inveftigation. The language is highly objectionable in many refpects, as the terms are founded on the premature affumption of the relative ages and modes of formation

of

of different rocks; — facts which are far from being yet clearly afcertained.

Whatever may be the defects of the Wernerian fyftem as given us by his fcholars, and however premature many of the generalizations may have been, it was of ufe by directing the attention of obfervers in various parts to an examination of its accordance with facts. Though the different rocks which Mr. Werner has defcribed as univerfal formations neither occur invariably in the order of fucceffion which he has defcribed, nor are univerfally fpread over the earth's furface; yet there is a certain fimilarity between the geological arrangement of diftant countries when viewed on a large fcale, which indicates that fimilar proceffes of formation had taken place, and nearly in the fame order in remote parts of the globe; but we are far from knowing whether thefe proceffes were univerfal and fimultaneous, or local and fucceffive.

In the above obfervations, which it is our impartial duty as biographers to ftate, we have not the remoteft wifh to undervalue the real merits of this eminent mineralogift. His theoretical errors arofe naturally from the infant ftate of geology when he commenced his labours; and his overweaning attachment to opinions too haftily formed, was an infirmity which he fhared in common with many eminent philofophers. His errors will pafs away with time, but his more ufeful labours will remain a durable monument of his talents and perfevering refearch.

WERNERITE, in *Mineralogy*, a mineral regarded by Werner as a fubfpecies of fcapolite, but which has been claffed by other mineralogifts as a diftinct fpecies, to which they have given this name, in honour of the profeffor at Freyburg. The name has been applied to foliated fcapolite, compact fcapolite, and to a mineral which is called Bergmannite by Stevens and Jamefon. (See Scapolite.) Wernerite occurs maffive and cryftallized in octohedral prifms, with four-fided pyramidal terminations. The ftructure is imperfectly lamellar, with joints on two directions, at right angles to each other. The colour is greenifh-grey, with a pearly or refinous luftre, more or lefs fhining; it is tranflucent. Wernerite is fofter than felfpar, yielding to the knife; its fpecific gravity is 3.6. It melts with intumefcence into a white enamel.

This mineral is rare: it has been found at Arendal, in Norway; in the mines of Northbo and Ultrica, in Sweden; and at Campo-Longo, in Switzerland. The conftituent parts are,

Silex - - - - - -	40
Alumine - - - - - -	34
Lime - - - - - -	16
Oxyd of iron - - - - -	8
Oxyd of manganefe - - - -	1.5

WERNERSDORF, in *Geography*, a town of Pomerelia, on the Nogat; 7 miles S.W. of Marienburg.

WERNEUCHEN, a town of Brandenburg, in the Middle Mark; 6 miles E.S.E. of Bernau.

WERNFELS, a town of Bavaria, in the bifhopric of Aichftadt; 4 miles N.W. of Spalt.

WERNHAUSEN, a town of the county of Henneberg; 4 miles N. of Wafungen.

WERNIGERODE, a county of Upper Saxony, bounded on the north by the principality of Halberftadt, on the eaft and fouth by the principality of Blankenburg, and on the weft by the Harz foreft; about twelve miles in length, and eight in breadth. One part is mountainous, and the other level. Amongft the mountains, the moft diftinguifhed of all is the Great Brocken, or Blockfberg, which is one of the higheft; or, according to fome, the very higheft mountain in all Germany. On its fummit fcarce any fmall fhrubs grow, much lefs trees; and the fnow remains frequently there till midfummer, and in fome of the northern parts even yet longer. The levels are very fertile in all kinds of grain, pulfe, turnips, flax, culinary herbs, and other vegetables and fruits. The mountains afford very valuable plants, with berries of various kinds, particularly crown berries, of which great quantities are preferved; game and wild fowl are plentiful. In 1807, it was annexed to the new kingdom of Weftphalia. The inhabitants are Lutherans.

Wernigerode, a town of Weftphalia, and capital of a county of the fame name, fituated on a fmall river, and confifting of three parts: "The Old Town," containing two churches, and about 430 houfes, with a houfe belonging to the county; "The New Town," containing one church, and about 200 houfes; and the fuburbs, called "Nofchenrode," which contain one church, and 150 houfes. On a high mountain, directly above the town, is the caftle, in which the counts' family archives are kept. The principal bufinefs of the town confifts in agriculture, brewing, diftilling, and manufactures of cloth and ftuffs; 12 miles S.W. of Halberftadt. N. lat. 51° 53'. E. long. 10° 52'.

WERNITZ, a river of Germany, which rifes about 5 miles S. from Rotenburg, paffes by Dinkelfbuhl, Waffertrudingen, Oettingen, &c. and runs into the Danube, near Donauwert.

WERNSDORF, a town of Bohemia, in the circle of Saetz; 3 miles N.W. of Kadan.

WERNSTADT, a town of Bohemia, in the circle of Leitmeritz; 10 miles W. of Leypa.

WERO, an ifland near the coaft of Norway. N. lat. 67° 43. E. long. 9° 10'.

WERPE, a river of Germany, which joins the Sieg, near its fource.

WERRA, a river of Germany, which rifes in the principality of Coburg, paffes by Eisfeld, Hildburghaufen, Meinungen, Saltzungen, Vach, Bercka, Gerftungen, Creutzberg, Trefurt, Wanfried, Allendorf, &c. and joining the Fulda at Munden, forms the Wefer.

Werra, a department of the kingdom of Weftphalia, compofed of Upper Heffe, with the principality of Herffeld; with a population of 254,000 fouls. Marburg is the capital.

WERREAR, a circar or diftrict of Hindooftan, lying on the right bank of the Puddar, which feparates it from Guzerat, eaft of Cutch.

WERSALA, a fmall ifland near the coaft of Finland, at the entrance into the gulf of Bothnia. N. lat. 60° 46'. E. long. 31° 6'.

WERSEN, a town of Germany, in the county of Tecklenburg; 8 miles N.E. of Tecklenburg.

WERSHOCK, in *Menfuration*, a long meafure in Ruffia; 16 werfhocks being equal to an arfheen, or 28 Englifh inches; fo that 9 arfheens are = 7 Englifh yards, and 4 werfhocks = 7 Englifh inches.

WERST, or Wurst. See Verst.

WERT, in *Geography*. See Weert.

WERTACH, a river of Bavaria, which runs into the Lech, a little below Augfburg.

WERTENSTEIN, a town of Switzerland, in the canton of Lucerne; 6 miles W. of Lucerne.

WERTER See, a lake of the duchy of Carinthia; 2 miles W. of Clagenfurt.

WERTH, a town of the bifhopric of Ratifbon; 11 miles N.W. of Straubing.

WERTHA,

WERTHA, a river of Bavaria, which runs into the Lech, near Augfburg.

WERTHEIM, a county of Germany, fituated between the electorate of Mentz, and the bifhopric of Wurzburg, watered by the Maine, which here receives the Tauber. The ancient counts became extinct in the year 1556. It was afterwards divided among feveral princes, befides feveral fiefs of the empire, Bohemia, Wurzburg, and Fulda.—Alfo, a town of Germany, and capital of a county to which it gives name, at the conflux of the Maine and Tauber. The magiftrates are principally Calvinifts, but the Roman Catholics and Lutherans have a church in common; 42 miles E.N.E. of Manheim. N. lat. 49° 49′. E. long. 9° 35′.—Alfo, a town of Germany; 22 miles E. of Frankfort on the Maine.

WERTHER, a town of Weftphalia, in the county of Ravenfberg; 5 miles N.N.W. of Bielefeld.

WERTINGEN, a town of Bavaria; 14 miles N.N.W. of Augfburg.

WERVICK, or WARWICK, or *Verwick*, a town of France, in the department of the Lys, on the Lys; 3 miles S.W. of Menin.

WESCHNITZ, a river of France, which runs into the Rhine, oppofite Worms.

WESCHOLOUEN, a town of Pruffia, in Natangen; 12 miles W. of Marggrabowa.

WESE, a river of France, which runs into the Ourt, a little above Chiny.

WESEL, a town of France, in the department of the Roer; transferred in January, 1808, from the duchy of Cleves, on the Rhine. This town was formerly imperial, and governed by its own laws, under the protection of the elector of Brandenburg; 17 miles E.S.E. of Cleves. N. lat. 51° 38′. E. long. 6° 38′.

WESEL, or *Ober Wefel*, a town of France, in the department of the Rhine and Mofelle; 20 miles S. of Coblentz.

WESEL *Bay*, a bay on the fouth coaft of the ifland of Java. S. lat. 8° 21′. E. long. 113° 42′.

WESELICH, or WEISLING, a town of France, in the department of the Roer; 7 miles S.S.E. of Cologn.

WESEN, a town of Switzerland, in the county of Gafter; 7 miles S. of Utznach.—Alfo, a town of Holland, in the department of Guelderland; 4 miles S. of Hattem.

WESENBERG, a town of the duchy of Mecklenburg; 42 miles N. of Spandau.

WESENSTEIN, a town of Saxony; 8 miles S.S.E. of Drefden.

WESEP, a town of Holland, on the Vecht; well fortified towards the eaft. The great bufinefs of the inhabitants is to carry frefh water from hence out of the Vecht to Amfterdam, for brewing and other ufes, for which traffic they have a particular kind of barges; 4 miles S.E. of Amfterdam.

WESER, a river of Germany, formed by the union of the Werra and Fulda, which paffes by Hameln, Rinteln, Minden, Nienburg, Hoya, Bremen, &c. and runs into the German fea, about N. lat. 53° 48′. E. long. 8°.

WESER, a department of the new kingdom of Weftphalia, compofed of the bifhopric of Ofnaburg, and part of the county of Schauenburg; the number of inhabitants is 33,400. Ofnaburg is the capital.

WESLEY, JOHN, in *Biography*, one of the principal founders of Methodifm, was the fon of a clergyman, who, educated under a father who was ejected for nonconformity, became a zealous high-churchman, and compofed the fpeech delivered by Sacheverel before the houfe of lords. John was born at Epworth, in Lincolnfhire, of which his father was rector, in June 1703. Educated under pious parents, he was religioufly difpofed from his youth. From the Charter-houfe, where he received his fchool-education, he was removed to Chrift-church college, Oxford; and after taking his firft degree, was elected, in 1724, fellow of Lincoln college, and, in 1726, proceeded to the degree of M.A. At this time he was reputed as a good claffical fcholar, and particularly converfant with dialectics. He was alfo a poet of no mean talents. Soon after his election to a fellowfhip, he became Greek lecturer and moderator of the claffes, and undertook the inftruction of pupils. In 1725 he was ordained by bifhop Potter. During fome years of his refidence at Oxford, he was much efteemed on account of his own character and conduct, and for his attention to difcipline and good morals. Upon the perufal of fome devotional books, and more efpecially Law's "Serious Call," he became diffident as to his own religious ftate, and determined to pay ftricter regard to what he conceived to be the effentials of a holy life. In 1729 he affociated with a felect number of collegians, who met and read together, firft the claffics on week-days, and on Sundays only divinity; but afterwards their meetings became exclufively religious. They vifited the prifoners and fick poor, converfed together on the ftate of their minds, obferved the ancient fafts of the church, and communicated every week. This fociety, which confifted of fifteen members, attracted notice on account of the ftrictnefs of their manners and deportment; and became the objects of ridicule to fome young men in the univerfity, who denominated them Sacramentarians, the Godly club, and METHODISTS. (See the article.) Some of the feniors of the colleges were alarmed by an introduction of fanaticifm; and others encouraged them to proceed, and they received the approbation of the bifhop of Oxford. Wefley, after his ordination, fettled as affiftant to his father at Epworth, who being defirous of retaining this church preferment in his family, wifhed him to feek intereft for obtaining it; but his attachment to Oxford, and to the fociety which had been there formed, prevailed over every other confideration. In procefs of time he formed a purpofe of going to Georgia, as a miffionary; and accordingly he embarked for this province in the year 1735. The profpect of fuccefs in this miffion feemed at firft to be favourable; but feveral circumftances occurred which changed his views, and induced him to leave Georgia, after a refidence of one year and nine months. Thefe circumftances, as fome perfons have related them, reflect no great honour on Wefley's difpofition and character. It appears, however, upon the whole, more efpecially when we confider Whitefield's fuccefs in the fame part of the world, that he was lefs qualified for a miffionary than his fellow-labourer. After his return to England, he felt diffatisfied about his own ftate, and entertained fufpicions of the reality of his own converfion, though he had undertaken to convert others. Prepared for a fudden converfion, it actually happened at a place and time, and in a manner, which he has recorded. According to his own account, this memorable event is referred to the 24th day of May, in the year 1738, at a quarter before nine in the evening, when fome perfon at a fociety in Alderfgate-ftreet was reading Luther's preface to the epiftle to the Romans. "He felt his heart ftrangely warmed. He felt that he trufted in Chrift alone for falvation; and an affurance was given to him, that Chrift had taken away his fins, and faved him from the law of fin and death." Thefe feelings of affurance, however, were blended with occafional mifgivings; and it feems that, in his cafe, enthufiafm could not inftantaneoufly overpower his philofophical reafonings. His cafe is far from being fingular in the hiftory of perfons of the fame defcription. About this time

time he took a journey to Germany, in order to derive a further confirmation of his faith from intercourfe with congenial fpirits at the head-quarters of the Moravians, at Hernhuth. (See UNITAS *Fratrum*.) After his return to England, in September 1738, he entered on his courfe of labours; and preached or exhorted, frequently three or four times a day, in prifons and other places of the metropolis, as well as in various parts of the country, where the fervour of his zeal bore proportion to the degree of obloquy which he incurred. His difcourfes produced wonderful effects, and occafioned in the hearers fwoonings, exclamations, convulfions, &c. which have been often the accompaniments of violent emotions. At Briftol, where he had been preceded by Whitfield, he collected large crowds of attendants in the open air. But it was now defirable that a building fhould be erected for the accommodation of the followers of thefe popular preachers. In May 1739, the firft ftone of fuch an edifice was laid at Briftol; and with this building commenced the abfolute and unlimited power which Wefley exercifed over his followers. "The direction of the work was firft committed to eleven feoffees of his nomination; but as it became neceffary for him to engage for the payment of the workmen, and to collect money for this purpofe, he vifited London, and upon confulting Whitfield and others, he was told, that they would do nothing in the matter, unlefs he would difcharge the feoffees, and take the whole bufinefs into his own hands. They gave various reafons for this determination; but one," fays Wefley, "was enough, *viz.* that fuch feoffees would always have it in their power to controul me; and if I preached not as they liked, turn me out of the room that I had built." He, therefore, affembled the feoffees, and with their confent cancelled the inftruments made before, and took the whole management into his own hands; and this precedent he ever after followed, fo that all the numerous meetings of his clafs of Methodifts were either vefted in him, or in truftees who were bound to give admiffion into the pulpit either to him, or to fuch preachers as he fhall appoint. Unable to affociate clergymen in the profecution of his plan, which feems to have been his firft defign, he determined to employ lay-preachers as itinerants to the different focieties; and of their talents he formed fome judgment by their performances at the meetings for prayer and mere private exhortation. Referving to himfelf the nomination of his preachers, his authority was extended as his focieties were multiplied. For the ufe of thefe focieties, he and his brother Charles drew up a fet of rules for the direction of their moral and religious conduct, which are faid to have been formed upon the pureft model of primitive Chriftianity. A circumftance occurred which threatened injury to the caufe of Methodifm; but it eventually contributed to its extenfion, and to the eftablifhment of Wefley without a rival at the head of his own body. Whitfield had imbibed a predilection for the doctrines of the Puritan divines, which were in general Calviniftic. Wefley's opinions were Arminian; fo that it was impoffible for thefe two leaders of feparate tenets to unite. "The differences between them turned upon the three points, unconditional election, irrefiftible grace, and final perfeverance, concerning which topics their notions varied fo much, that Whitfield plainly told his brother reformer, that they preached two different gofpels, and that he would not only refufe to give him the right hand of fellowfhip, but was refolved publicly to preach againft him and his brother wherefoever he preached at all." Although they afterwards fpoke of each other with efteem, yet their feparation was entire and lafting.

The fyftem of difcipline formed by Wefley was admirably contrived both for gaining profelytes, and for extending and making permanent his own influence. As he did not profefs to eftablifh a new or diftinct fect, he did not interfere with the regular worfhip either of the eftablifhment or of Diffenters, fo that he and his preachers robbed no other minifters of their hearers; and they availed themfelves of thofe feafons, which gave perfons that were defirous of attending leifure for this purpofe. That he might not be charged with drawing people away from the eftablifhed church, or other focieties of Chriftians, he did not adminifter the facrament of the Lord's Supper in his own chapels, but recommended attendance for this purpofe in the eftablifhed church. (See METHODISTS.) The plan of itinerancy was a political meafure in the fyftem of Mr. Wefley, as variety ferves to excite curiofity, and to increafe the number of his followers. It feems alfo to relieve preachers and hearers, when the ftock of the former is fmall; and it alfo prevents thefe miffionaries, if they may be fo called, from forming permanent connections in any place whither they are fent, and of acquiring an influence, which would be inconfiftent with the fupremacy of the chief. In order to maintain an union between the members of this body, and to exercife a degree of vigilant infpection with regard to their conduct, Wefley has divided each fociety into companies of ten or fifteen, called claffes, to each of which belongs a leader, whofe bufinefs it was every week to fee every perfon of his clafs, and to inquire into his religious ftate. Many of thefe companies were divided into fmaller parties, called bands, in which the married and fingle men, and the married and fingle women, were ranged apart, and they were directed to maintain a confidential intercourfe with regard to their character and ftate with each other. From thefe bands again were formed felect bands, confifting of thofe who had attained to perfection. Of his love-feafts, &c. we have given an account under METHODISTS. Stewards were appointed to receive contributions, which the loweft members were expected to pay, however fmall the fums, and to fuperintend the temporal concerns of the focieties. In order to preferve a connection between the preachers, as well as to maintain their ultimate fubordination to him, Wefley found it ufeful to fummon annually a confiderable body of them, in order to take counfel with him, and with one another, concerning the general affairs of the focieties. Thefe affemblies were called "Conferences;" and the great number of them at which Wefley had to prefide was a principal means of confolidating the whole frame of the fociety, and maintaining his permanent authority over every part. Wefley and his firft followers had many difficulties with which to contend; but their conftancy and fortitude, and the apparently beneficial effects of their endeavours in reforming fome of the moft abandoned members of the community, enabled them ultimately to triumph over all oppofition, and to purfue their labours without moleftation. On account of his fanaticifm and enthufiafm he has fuffered ridicule and reproach; and fome have even fufpected his fincerity in the details which he has given of the extraordinary manifeftations of light that have been communicated to him, and the no lefs extraordinary interpofitions of Providence in his favour; alleging that he poffeffed a degree of underftanding which could not be deluded, and, therefore, charging him with a defign of deluding others, in order to ferve his own purpofes. But thefe are harfh reflections, the juftice of which we cannot be induced eafily to allow. About the year 1759, Wefley, who had long been the eulogift of a fingle life, thought proper to marry a rich widow, whofe fortune he fettled wholly upon herfelf; but this connection proved an occafion of infelicity,

felicity, and therefore they ſeparated. She died in 1781. Weſley ſeems to have adopted his father's high-church principles, and he perſevered in avowing his connection with the eſtabliſhed church, and in preventing, as far as poſſible, a ſeparation between his followers and the profeſſors of the eſtabliſhed religion. During the American war he was a zealous advocate for the meaſures of government, and he inculcated the duty of ſubmiſſion to the tranſ-Atlantic Methodiſts. With this view he publiſhed a pamphlet, entitled "A Calm Addreſs to the American Colonies," which was widely diſſeminated; and though ſome of his followers were diſpleaſed, others were ſupporters of the authority of Great Britain; whilſt, on the other hand, the Methodiſts in the connection of Mr. Whitefield were generally on the ſide of American independence. When the conteſt terminated, it became a matter of ſome importance to determine what kind of connection ſhould ſubſiſt between the American Methodiſts and their Britiſh brethren. Mr. Weſley was induced for this purpoſe to take a ſtep, which appeared to be a renunciation of the principle of an epiſcopal church. By his own authority he ordained, with impoſition of hands, ſeveral preachers who were embarking for America, and conſecrated a biſhop for the Methodiſt epiſcopal church in that country, who, on his arrival, conſecrated another, and ordained ſeveral as preſbyters. He alſo aſſumed the ſame authority with reſpect to Scotland; "Setting apart," as he ſays, "three preachers in 1785 to adminiſter in that country the ſacraments of baptiſm and the Lord's ſupper." In ſelf-defence he alleged, that he had been for ſeveral years convinced by lord King's account of the primitive church, that biſhops and preſbyters are the ſame order, and have the ſame right to ordain; but that he declined exerciſing this right in ordaining his travelling preachers, becauſe he did not wiſh to violate the eſtabliſhed order of the national church to which he belonged. By theſe meaſures he offended many in his own connection, and particularly his brother Charles; and it is ſaid, that before his death he repented of his proceedings, and uſed all his endeavours to counteract the tendency which he then perceived to a final ſeparation from the church.

In a very advanced age, Weſley retained his ability of bearing the fatigue which attended his numerous and extenſive labours; and theſe were continued till within a week of his death, which happened on March 2d, 1791, in the 88th year of his age.

In Weſley's countenance mildneſs and cheerfulneſs were blended with gravity, and in old age it was ſingularly venerable. "In his manners," ſays one of his biographers, "he was ſocial, polite, converſible, and pleaſant, without any of the gloom and auſterity common in the leader of a ſect. In the pulpit he was uſually ſhort and clear, argumentative and ſedate, often entertaining, but never attempting the eloquence of the paſſions. His ſtyle in writing was of a ſimilar caſt; he expreſſed himſelf with facility and preciſion, and even in controverſy ſeldom elevated his tone beyond a temperate medium. He was placable towards his enemies, charitable, and in pecuniary matters extremely diſintereſted. His greateſt failing was a love of power, which rendered him impatient of contradiction with regard to every thing that concerned his adminiſtration as head of his ſociety; yet it is certain that he could not have brought his plans to effect, without a conſiderable ſhare of abſolute authority. It muſt alſo be admitted, that he had much of the politician in his character, and could employ artifice when uſeful for his purpoſes. That he was thoroughly perſuaded of the truth of the ſyſtem he taught, and had at heart the beſt intereſts of mankind, it would be uncandid and unwarrantable to queſtion; and he will be a memorable perſon as long as the fabric which he ſo much contributed to raiſe ſhall endure." Lives of J. Weſley, by Hampſon, Coke, and Whitehead. Gen. Biog. See METHODISTS.

WESLINGBUHREN, in *Geography*, a town and duchy of Holſtein, ſituated near the coaſt of the North ſea; 53 miles N.W. of Hamburg.

WESOWKA, a town of Poland, in Volhynia; 60 miles N.N.E. of Zytomiers.

WESSEL, JOHN, in *Biography*, an eminent philoſopher and divine, was born at Groningen about the year 1409, or 1419; and purſued his ſtudies with incredible ardour both at Zwoll and at Cologne. At the latter place his orthodoxy was ſuſpected, as he propoſed difficulties which his maſters could not ſolve. He taught philoſophy for ſome time at Heidelberg, and after viſiting ſeveral univerſities, went to Paris, where the diſputes ran high between the Realiſts, Formaliſts, and Nominaliſts. He fluctuated between the opinions of theſe different ſects. He predicted the decline of the doctrines of Thomas Aquinas, Bonaventure, and other diſputants of that claſs; and intimated his apprehenſion that they would be exploded by all true Chriſtian divines, and that the irrefragable doctors themſelves would be little regarded. His reputation procured for him the eſteem of Francis delle Rovere, general of the Friars Minors, whom he accompanied to the court of Baſil, and with whom he returned to Paris, where he reſided many years. When his patron was made pope, under the name of Sixtus IV., he paid him a viſit at Rome, and being told that his holineſs would grant him whatſoever he aſked, he limited his requeſt to a Hebrew and a Greek bible from the Vatican. "You ſhall have them," ſaid the pontiff; "but, ſimple man that you are! why did not you aſk a biſhopric?" "Becauſe (anſwered Weſſel) I do not want one;" a reply on which Dr. Jortin has beſtowed juſt applauſe.

This worthy perſon died at Groningen in 1489. On his death-bed he lamented to a friend that he had been diſtreſſed with doubts concerning the truth of the Chriſtian religion; but at his friend's ſecond viſit, he told him with great ſatiſfaction that his doubts were all diſſipated. So extraordinary was his learning, that he was diſtinguiſhed by the appellation of the "Light of the World;" and ſuch was his ſpirit of free enquiry, that his name is enrolled in the Proteſtant Catalogue of Witneſſes of the Truth. Of his liberal opinions ſome were, "that the pope might err—that erring he ought to be reſiſted—that his commands are obligatory only as far as they are conformable to the word of God—and that his excommunications are leſs to be feared than the diſapprobation of the loweſt worthy and learned man." We need not wonder then that the monks ſhould have committed all the manuſcripts found in his ſtudy to the flames. Such as eſcaped conflagration were printed collectively at Groningen in 1614, and at Amſterdam in 1617. Part of them had been previouſly printed at Leipſic in 1522, under the title of "Farrago Rerum Theologicarum," with a preface by Martin Luther. Bayle. Moſheim. Brucker by Enfield.

WESSELY, in *Geography*, a town of Moravia, in the circle of Hradiſch; 5 miles N.N.E. of Straſnitz.—Alſo, a town of Bohemia, in the circle of Bechin; 5 miles S. of Sobieſlaw.—Alſo, a town of Moravia, in the circle of Brunn; 36 miles N.W. of Brunn.

WESSEM, or WESSUM, a town of France, in the department of the Lower Meuſe; 4 miles S.S.W. of Ruremond.

WESSEN, a town of Auſtria; 9 miles N.W. of Efferding.

WESSNITZ. See WEISSENITZ.

WEST, Gilbert, in *Biography*, the fon of the Rev. Dr. Weft, prebendary of Winchefter, and of a fifter of fir Richard Temple, afterwards lord Cobham, was born in 1706, and educated for the church at Eton and Chriftchurch, in Oxford; but preferring a military life, he ferved in the army till he received an appointment in the office of lord Townfhend, fecretary of ftate, with whom he accompanied king George I. to Hanover. In early life he entertained doubts concerning the Chriftian religion, which were inftilled into him and his coufin Lyttelton by lord Cobham. In 1729 he was appointed a clerk-extraordinary of the privy council; and foon after, being married, he fettled at Wickham in Kent. His income was not large, but it was fufficient to entertain his friends Pitt and Lyttelton, who often vifited him for literary recreation at Wickham. As a poet, he was known in 1742 by a piece on a dramatic plan, intitled "The Inftitution of the Order of the Garter," diftinguifhed by pure and elevated morality, and containing paffages of elegant fancy and fplendid diction. Weft's "Obfervations on the Refurrection of Chrift," publifhed in 1747, engaged the particular attention of the public, and even induced the univerfity of Oxford to confer upon the author the degree of doctor of laws. This work was fo well executed, that we may well regret his not having lived to have completed his defign by another work on the evidence of the truth of the New Teftament. In 1752 the circumftances of our author were improved by fucceeding, when Mr. Pitt became paymafter-general, to one of the lucrative clerkfhips of the privy council, and his obtaining the place of treafurer to Chelfea hofpital. In 1755 he loft an only fon, and in the following year his life was terminated by a paralytic ftroke, March 1756, at the age of fifty. "Mr. Weft was a gentleman in manners, agreeable in converfation, and lively though ferious. He was regular in the performance of family devotion and in attendance on public worfhip, and was particularly attached to Dr. Clarke as a preacher."

The other works of Mr. Weft were, "Tranflations of the Odes of Pindar, with a Differtation on the Olympic Games;" "Tranflations from the Argonautics of Apollonius Rhodius, and the Tragopodagra of Lucian;" "The Abufe of Travelling;" and "Education:" poems in the imitation of the ftanza and manner of Spenfer; "Iphigenia in Tauris," from Euripides;" and "Original Poems on Various Occafions." Several of thefe pieces were printed in the collections of Dodfley and Pearch, and alfo in three diftinct volumes, 12mo. 1766; and entitle the author, fays his biographer, to a refpectable rank among the minor poets. Johnfon's Lives. Nichols's Lit. Anecd. Gen. Biog.

West, *Occidens*, *Occafus*, in *Cofmography*, one of the cardinal points of the horizon; diametrically oppofite to the eaft.

Weft is ftrictly defined, the interfection of the prime vertical with the horizon, on that fide in which the fun fets.

To draw a true weft line, fee Meridian.

West, in *Aftronomy*, is chiefly ufed for the place, in or towards which the fun and ftars fink under the horizon. Thus we fay, the Sun, Mars, &c. are in the weft.

The point in which the fun fets when in the equator, is particularly called the *equinoctial weft*, or *point of true weft*.

West, and *Weftern*, in *Geography*, are applied to certain countries, &c. fituated towards the point of fun-fetting with refpect to certain others.

Thus, the empire of Rome, anciently, and of Germany, at prefent, is called the *empire of the Weft*, or *weftern empire*, in oppofition to that of Conftantinople, which is called the *empire of the Eaft*.

The Latin or Roman church is called the *weftern church*; in oppofition to the Greek church.

The French, Spaniards, Italians, &c. are called *weftern nations*, in refpect to the Afiatics; and America, the *Weft Indies*, in refpect of the Eaft Indies.

West-*Afhton Water*, is a chalybeate water, refembling that of Holt. See Phil. Tranf. N° 461. fect. 20.

West *Wind* is alfo called *Zephyrus*, and *Favonius*. See Wind.

West *Saxonlage*, or the law of the Weft Saxons. See Law.

West *India Companies*. See Company, &c.

West *Dial*. See Dial.

West, *Mooring for*. See Mooring.

West, in *Geography*, a townfhip of Pennfylvania, in the county of Huntingdon, with 1698 inhabitants.

West *Bay*, a bay of the South Pacific ocean, in Cook's Straits, between the two iflands of New Zealand.

West *Bay*, a bay of the Englifh Channel, on the coaft of the counties of Dorfet and Devon, of vaft extent. It begins weft of Portland, and ends at Berry Point near Torbay, according to fome; according to others, from Portland to Lyme or Exmouth. The tide is current here nine hours; high water at ten o'clock at new and full moon; an E.S.E. moon makes full fea. The fea off the coaft is reckoned the moft dangerous part of the Channel, efpecially on the weft, where fhips, not aware of the currents, are embayed and driven afhore on the beach. When fhips are fo deeply embayed, that there is no poffibility of getting off, efpecially at the beginning of the ebb, they may run boldly on the beach, and the mariners are to remain aboard for five or fix feas, but may then ftep on fhore with fafety; but if they leave the fhip inftantly it is dangerous and fatal: lighthoufes have been ferviceable for preventing thefe accidents. Where fhips that come from the weft neglect to keep a good offing, or are taken fhort by contrary winds, and cannot weather the highland at Portland, but are driven between the ifland and the main-land, they perifh without remedy; and it has been obferved, that more Dutch veffels are loft here than any other, almoft every year, efpecially in winter, which is thought to be owing to an obftinate adherence to old charts, and not allowing for the true variation of the compafs. When the variation is W. the true channel courfe is W. by S. from Dungenefs to the Cafkets; Portland Bill and the Cafkets are 15 leagues afunder nearly in a meridian. Dr. Halley obferves, that the navigation up and down the Channel is an E. variation: W.S.W. is the true courfe. The Channel between Portland and the Cafkets is 40 fathoms deep, and in fair weather one may fee in that depth the land on both fides: the nearer England the fhoalier, the nearer the Cafkets the deeper.

West *Bay*, a bay at the weftern extremity of lake Superior. N. lat. 46° 45′. W. long. 91° 45′.—Alfo, a bay on the N.W. coaft of Virgin-Gorda, in the Weft Indies. N. lat. 18° 23′. W. long. 62° 48′.

West *Bethlehem*, a townfhip of Pennfylvania, in the county of Wafhington, containing 1849 inhabitants.

West *Boylfton*, a town of Maffachufetts, in the county of Worcefter, containing 632 inhabitants.

West *Bradford*, a townfhip of Pennfylvania, in the county of Chefter, with 1219 inhabitants.

West *Buffaloe*, a townfhip of Pennfylvania, in the county of Northumberland, containing 2523 inhabitants.

West *Caln*, a townfhip of Pennfylvania, in the county of Chefter, with 1003 inhabitants.

West *Cambridge*, a town of Maffachufetts, in the county of Middlefex, containing 971 inhabitants.

West *Cape*, a cape on the W. coaſt of Tavai-poe-nam-moo, the ſouthernmoſt iſland of New Zealand. S. lat. 45° 54′. W. long. 193° 17′.

West *Cappel*, a town of Holland, in the iſland of Walcheren; 6 miles N.W. of Middleburg.

West *Cheſter*, a county of New York, containing 30,272 inhabitants.

The following ſtatiſtical table is founded upon the cenſus of 1810.

Towns.	Population.	Sen. Electors.
Bedford	2,374	241
Cortlandt	3,054	182
Eaſt-Cheſter	1,039	96
Greenſburgh	1,862	137
Harriſon	1,119	66
Mamaroneek	496	28
Mount-Pleaſant	3,119	218
New-Caſtle	1,291	72
New-Rochelle	996	78
North-Caſtle	1,366	119
North-Salem	1,204	102
Pelham	267	19
Poundridge	1,249	124
Rye	1,278	85
Scarſdale	259	15
Somers	1,782	142
South-Salem	1,566	186
Weſt-Cheſter	1,969	105
White Plains	693	68
Yonkers	1,365	93
York-town	1,924	142
	30,272	2,318

It ſends three members to the houſe of aſſembly. It is ſituated on the E. ſide of the Hudſon, N. of New York county; bounded N. by Dutcheſs county, E. by the ſtate of Connecticut, S. by Long iſland ſound and Eaſt river, W. by Haerlem river and the Hudſon; or by New York county, the ſtate of New Jerſey, and the county of Rockland. Its area is about 480 ſquare miles, or 307,200 acres, ſituated between 40° 47′ and 41° 22′ N. lat.; 3° and 32′ E. long. from New York.

West *Cheſter*, a poſt-townſhip of New York, at the S.W. extremity of Weſt Cheſter county, on Eaſt river; 12 miles from New York. Its medial extent from N. to S. may be 4 miles, and from E. to W. about 5, with an area of 20 ſquare miles. It is a valuable tract of land, ſomewhat ſtony, with a large proportion of clayey loam, which, with good huſbandry, may be rendered productive. Weſt Cheſter village, ſituated at the head of the navigation on Weſt Cheſter creek, contains about 25 dwellings, an epiſcopal church, a Friends' meeting-houſe, a ſchool-houſe, a griſt-mill, and about 200 inhabitants. Adjoining to it are a bed of marble and an extenſive common. In the townſhip are ſeveral manufactories, griſt-mills, three houſes for worſhip, one for Friends, one for Epiſcopalians, and one for Dutch Lutherans, and ſix ſchool-houſes, and many elegant country-ſeats. For its population, &c. ſee the preceding article.

West *Cheſter Borough*, a townſhip of Pennſylvania, in the county of Cheſter, containing 471 inhabitants.

West *Creek*, a river of New Jerſey, which runs into the Delaware bay, N. lat. 39° 14′. W. long. 74° 57′.

West *Fallowfield*, a townſhip of Pennſylvania, in the county of Cheſter, containing 1157 inhabitants.

West *Gothland*, or *Weſtrogothia*. See Gothland.

West *Harbour*, a bay on the S. coaſt of Jamaica, formed by a peninſula, called Portland Ridge. N. lat. 17° 48′. W. long. 77°.

West *Indies*, in *Geography* and *Commerce*, comprehends all the iſlands that lie in the Caribbæan ſea, between North and South America; and alſo a few of the neighbouring ſettlements on the continent. (See *Weſt* Indies.) The larger iſlands, or greater Antilles, are, Jamaica, belonging to the Engliſh, Cuba (Spaniſh), Porto Rico (Spaniſh), and St. Domingo (French and Spaniſh). The ſmaller iſlands, or leſſer Antilles, called alſo the Caribbee iſlands, are divided into *leeward* and *windward* iſlands. The former are Tortola, the Saints, Barbuda, Antigua, St. Kitt's, Nevis, Montſerrat, and Dominica (Engliſh), Guadaloupe and Marigalante (French), St. Euſtatia and Martin (Dutch), St. Thomas, Santa Cruz, and St. John (Daniſh), and St. Bartholomew (Swediſh). The latter are, Barbadoes, St. Vincent, Grenada, and Tobago (Engliſh), Martinico and St. Lucia (French). The iſlands on the coaſt of Terra Firma are, Trinidad and Margarita (Spaniſh), Curaſſoa and Bonaire (Dutch). The ſettlements on the continent of South America are, Demerara, Berbice, Eſſequibo, and Surinam (Dutch). In ſpecifying the monies, coins, currencies, and exchanges of the Weſt Indies, we ſhall avail ourſelves of the arrangement of Dr. Kelly in his valuable work, and claſs the iſlands under the five general heads of Engliſh, French, Daniſh, Dutch, and Spaniſh; premiſing, that though the ſeveral iſlands and ſettlements, which we have already enumerated, are ſubject to various political changes, they neverthelefs, for the moſt part, retain the weights, meaſures, and denominations of money belonging to the European nations by which they have been colonized.

In the *Engliſh* iſlands, accounts are kept in pounds, ſhillings, and pence currency; the Weſt India currency being an imaginary money, which varies conſiderably in its proportion to ſterling, ſo that it is in ſome places reckoned at 140, and in others 200, for 100*l.* Engliſh, more or leſs. The principal coin circulating in the Weſt Indies is the Spaniſh dollar, and this ſeems to be the ſtandard by which the value of all other monies is regulated; and with regard to the proportion between ſterling and currency, it ſhould be obſerved, that although it has been declared by different authorities, yet it is chiefly regulated by the courſe of exchange with London. Of the *Engliſh* iſlands, the firſt we ſhall take notice of is Jamaica. The currency of this iſland is 140*l.*, and its proportion to ſterling is as 7 to 5; ſo that 1*l.* ſterling is = 28*s.* currency, and 1*l.* currency = 14*s.* $3\frac{3}{7}$*d.* ſterling. The price of the dollar is 6*s.* 8*d.* currency.

The gold coins current in this iſland, with their value in currency, appear in the following Table.

		Weight		Jamaica Currency.		
		dwt.	gr.	*l.*	*s.*	*d.*
Spaniſh	Doubloon	17	8	5	0	0
	Two piſtole piece	8	16	2	10	0
	Piſtole	4	8	1	5	0
	Half piſtole	2	4	0	12	6
Portugueſe	Johanes (called joe)	18	12	5	10	0
	Half joe	9	6	2	15	0
	Quarter joe	4	15	1	7	6
	Moidore	6	22	2	0	0
	Half moidore	3	11	1	0	0
Engliſh	Guinea	5	8	1	12	6
	Half guinea	2	16	0	16	3
	Seven-ſhilling piece	1	19	0	10	10

The

The deduction for every grain of deficiency of weight is 3*d.* currency.

The silver coins of Jamaica are dollars, with their halves, quarters, eighths, and sixteenths, passing for 6*s.* 8*d.*, 3*s.* 4*d.*, 1*s.* 8*d.*, 10*d.*, and 5*d.* currency. Besides, here are *bits* or *bitts*, being Spanish reals, and passing for $7\frac{1}{2}$*d.* currency; so that 10 bits and 5*d.* currency make a dollar, and 1 bit is worth $5\frac{5}{13}$*d.* sterling. *Pistereens*, or two-bit pieces, which are Spanish pecetas, pass for 1*s.* 3*d.* currency, and are worth $10\frac{2}{7}$*d.* sterling. English shillings and sixpences occasionally pass as pistereens and bits. From the above statement it appears, that the intrinsic par of the currency of Jamaica with respect to sterling is as follows; the calculations being made according to the mint price of gold and silver in England:

		l.	*s.*	*d.*	
According to the	English gold coins, 100*l.* sterling =	154	15	0	currency.
	Spanish ditto - - - - -	156	13	2	
	Portuguese ditto - - - -	155	0	0	
	Dollar - - - - - -	154	11	9	

By a law of the Jamaica assembly, the exchange with England was fixed at 40 *per cent.*; but it has considerably varied: bills being sometimes at a premium of 20 *per cent.* above the legal exchange, and seldom under 10: dollars occasionally bear a premium of 3 or 4 *per cent.*

The currency of *Barbadoes* is sometimes reckoned at 135, and sometimes at 140, for 100*l.* sterling; but it has never been settled by legal authority. The value of the coins has been established by proclamation, and according to these values the par is above 140.

The gold coins current here, with their legal value, are shewn in the following Table.

				Barbadoes Currency.		
		dwt.	gr.	*l.*	*s.*	*d.*
Spanish	Doubloon - -	17	8	4	10	0
	Two-pistole piece -	8	16	2	5	0
	Pistole - - -	4	8	1	2	6
	Half pistole - -	2	4	0	11	3
Portuguese	Johanes (called joe) -	18	10	5	0	0
	Half joe - -	9	5	2	10	0
	Quarter joe - -	4	14	1	5	0
	Moidore - -	6	21	1	17	6
	Half moidore -	3	10	0	18	9
English	Guinea - - -	5	8	1	10	0
	Half guinea - -	2	16	0	15	0
	Seven-shilling piece -	1	19	0	10	0

N.B.—The deduction for light coin is $2\frac{3}{4}$*d.* currency for every grain of deficiency.

The current silver coins are dollars, with halves, quarters, eighths, and sixteenths, passing for 6*s.* 3*d.*, 3*s.* $1\frac{1}{2}$*d.*, 1*s.* $6\frac{3}{4}$*d.*, $9\frac{1}{2}$*d.*, and $4\frac{3}{4}$*d.* currency. Also bits, which are Spanish reals, and which pass for $7\frac{1}{2}$*d.* currency; thus, 10 bits make 1 dollar, and 1 bit is worth $5\frac{1}{3}$*d.* sterling. Pistereens, or two-bit pieces, which are Spanish pecetas, pass for 1*s.* 3*d.* currency. There are also French bits, called *crimbal*, or *isle du vent bits*, which pass for $7\frac{1}{2}$*d.* currency.

The Barbadoes currency compared with sterling is,

		l.	*s.*	*d.*	
According to the	English coins, 100*l.* sterling =	142	17	2	currency.
	Spanish ditto - - -	141	0	0	
	Portuguese ditto - - -	140	13	7	
	Dollar ditto - - - -	144	19	6	

In the English leeward islands the dollar is reckoned at 9*s.*, and this rate is generally called the leeward currency.

A small circular piece cut out of the centre of the dollar, about one-twelfth of its value, in order to prevent its exportation, is allowed to pass for one-eighth, and is stamped by authority with the initials of the island.

The dollar, thus cut, passes for 8*s.* 3*d.* currency; it is called the "cut dollar," by way of distinction from the whole or "round dollar." The piece taken out is sometimes called the "bit," and sometimes the "moco," which moco is, in some places, one-fourth of the dollar, and in others one-eighth. In these islands there are small copper coins, called stampes, dogs, and half dogs, valued as in the following Table.

				Leeward Currency.		
				l.	*s.*	*d.*
2 Half dogs	- make	1 Dog -	=	0	0	$1\frac{1}{2}$
$1\frac{1}{2}$ Dog - -	-	1 Stampe -	=	0	0	$2\frac{1}{4}$
6 Dogs or 4 stampes	-	1 Bit - -	=	0	0	9
$1\frac{1}{2}$ Bit - -	-	1 Moco -	=	0	1	$1\frac{1}{2}$
11 Bits - -	-	1 Cut dollar	=	0	8	3
12 Bits or 8 mocos	-	1 Round dollar	=	0	9	0
5 Round dollars -	-	1 Guinea -	=	2	5	0
8 Cut dollars -	-	1 Joe - -	=	3	6	0
16 Round dollars -	-	1 Doubloon	=	7	4	0

For a deficiency of weight, an allowance is made of $4\frac{1}{2}$*d.* currency for English grain. The exchange with London is generally about 200 *per cent.*

In the English *windward* islands the currencies are nearly the same as the former, allowing for some local regulations and customs.

In the French islands accounts are kept by the French settlers in livres, sols, and deniers; and by the English (particularly in exchanges) in pounds, shillings, and pence currency; the livre and shilling being of the same value.

The currency is the same as that of the English leeward and windward islands: but the names of the coins are different; the dog being called the *noir*, the stampe the *tempé*, the bit the *escalin*, and the dollar the *gourde*.

The value of the coins appears in the following Table.

				Leeward Currency.		
	liv.	sol.	den.	*l.*	*s.*	*d.*
The noir, or dog - - -	0	2	6	0	0	$1\frac{1}{2}$
The tempé, or stampe - -	0	3	9	0	0	$2\frac{1}{4}$
The trois tempés - - -	0	11	3	0	0	$6\frac{3}{4}$
The escalin, or bit - - -	0	15	0	0	0	9
The trois petites pieces - -	1	2	6	0	1	$1\frac{1}{2}$
The piece de trente sols, or pistereen	1	10	0	0	1	6
The moco - - - -	2	5	0	0	2	9
The gourde or dollar - -	9	0	0	0	9	0
The ecu of six livres - - -	9	17	6	0	9	$10\frac{1}{2}$
The Louis d'or - - -	40	10	0	2	0	6
Guinea - - - - -	45	0	0	2	5	0
Napoleon of 40 francs - -	66	13	4	3	6	8
Doubloon - - - -	144	0	0	7	4	0

The following gold coins are taken by weight.

Portugal pieces, at - - - - 22 livres *per* gros
Counterfeit ditto, coined in America, at 20 ditto *per* gros
French and Spanish coins deficient in weight, at - - - - 19*l.* 15*s.* *per* gros
English ditto at 8 livres, 8 sols *per* dwt., that is, 7 sols *per* English grain.

In

In the French part of St. Domingo, or Hayti, accounts are moftly kept in dollars and cents, as in the United States. The monies in circulation here are nearly the fame as in the leeward iflands. Dollars are valued at 4*s.* 6*d.* fterling, with halves and quarters in proportion: 11 efcalins pafs for 1 dollar, and 1 efcalin is reckoned at 9 cents. Doubloons pafs for 16 dollars; joes for 8 ditto; French crowns for 1 dollar 9 cents, and the half-crowns in proportion; French pieces of 5 francs pafs for 9 efcalins, or 81 cents.

In the *Dutch* colonies of St. Euftatia, St. Martin, Curaçoa, accounts are kept in pieces of eight; that is, piaftres current of 8 reals or fchillings, each real being fubdivided into 6 ftivers.

The piaftre gourde or Spanifh dollar paffes for 11 reals or bits; and thus the current piaftre is worth 3*s.* 5*d.* fterling, reckoning the dollar at 4*s.* 8*d.* fterling.

The joe paffes here for 11 piaftres current; the Spanifh fingle piftole for 4½ piaftres, more or lefs; the other Spanifh and Portuguefe gold coins in proportion.

In the fettlements of Surinam, Berbice, Demerary, and Effequibo, accounts are kept in guilders of 20 ftivers; the ftiver being divided by fome into 8 duits, and by others into 12 pennings.

All the coins of Holland circulate here, and are moftly reckoned at 20 *per cent.* above their value in Dutch currency.

The following is their general rate, as well as that of other monies.

		gdrs.	ftiv.			gdrs.	ftiv.
10 Dubbelties	=	1	0	Spanifh dollar	=	3	0
The bit -	=	0	5	Ducatoon -	=	3	3
Seftehalf -	=	0	5½	Gold ducat	=	6	6
Schilling -	=	0	6	Guinea -	=	14	10
Guilder -	=	1	4	Ryder -	=	16	16
Dalder -	=	1	10	Joe - -	=	22	0
Rixdollar -	=	3	0	Doubloon -	=	42 to 44	

The chief circulating medium here is paper, iffued by government.

In 1809 a new filver coinage was minted at the Tower of London for thefe colonies, confifting of pieces of 3, 2, 1, ½, and ¼ guilders. The larger piece weighs 15 dwt.; and is 1 oz. 6 dwt. worfe than Englifh ftandard. Its value therefore is, 3*s.* 5*d.* fterling, or computing it as the dollar is now rated in the Weft Indies (*i. e.* at 4*s.* 8*d.*), its value is 3*s.* 8¼*d.*, and the fmaller pieces in proportion. They are marked on the reverfe, COLONIES OF ESSEQUIBO AND DEMERARY TOKEN; and the king's head is on the obverfe.

The exchange with London fhould be about 12 guilders for 1*l.* fterling, but it varies confiderably above this, even to 20 guilders and upwards.

In the *Danifh* iflands accounts are kept in piaftres or rixdollars current (called alfo pieces of eight), fubdivided into 8 fchillings or bits, and each bit into 6 ftivers: accounts are alfo kept in dollars of 100 cents, as in America. The filver coins ftruck for the Danifh iflands are quadruple, double, and fingle bits, and pieces of 1 and 3 ftivers. The Spanifh dollar paffes for 12½ bits, and each bit for 6¼ ftivers. The leeward currency is ufed in the Danifh iflands in the purchafe or negociation of bills on England: gold is valued at 1 dollar *per* dwt. or 4½*d.* currency *per* Englifh grain.

The monies, coins, weights, and meafures of the Spanifh iflands are the fame as thofe in Spanifh America, or Mexico; accounts being kept in pefos or dollars of 8 reals, fubdivided into 16 parts, and alfo into 34 maravedis de Plata Mexicanos. The gold coins are doubloons of 8 efcudos d'oro, worth 15 pefos; halves and quarters in proportion. The filver coins are, pefos Mexicanos or dollars, with halves and quarters, called pecetas Mexicanas; alfo eighths and reals, and fixteenths, in due proportion.

Trinidad, having been for many years in the poffeffion of the Englifh, has adopted the denominations of money of the Englifh iflands. Accounts therefore are here kept in pounds, fhillings, and pence leeward currency; and alfo in dollars and bits, the bit being the 9th part of a dollar.

There are here filver pieces of half bits and quarter bits.

The Spanifh, Portuguefe, and Englifh gold coins pafs as follows in Trinidad.

	dwt.	gr.	dol.	bits.	Leeward Currency. *l.*	*s.*	*d.*
Doubloon -	17	8	15	8	7	4	0
Half ditto -	8	16	7	8½	3	12	0
Piftole - -	4	8	3	8¾	1	16	0
Half ditto -	2	4	2	0	0	18	0
Joe - - -	7	12	6	8	3	2	0
Guinea -	5	8	4	8	2	4	0
Half ditto -	2	16	2	4	1	2	0
One-third ditto	1	19	1	5¾	0	14	8

Gold here is valued at 8*s.* 3*d.* currency *per* dwt. or 4⅛*d.* *per* grain.

The weights and meafures here are the fame as in England, except that the cwt. is reckoned only 100 lbs. avoirdupois.

The monies and currency of St. Bartholomew ifland are the fame with thofe of the other leeward iflands.

The regulations to which the Weft India exchanges are fubject are as follow. When bills drawn in the Weft Indies on London are not duly honoured, they are returned to the drawer, with the following charges.

	Damages.	Intereft *per* Annum.	Time how charged.
Jamaica	8 *per cent.*	6 *per cent.*	from date of the bill.
Barbadoes	10 ditto	6 ditto	from the time of prefentation with proteft.
Grenada	10 ditto	6 ditto	from the bill falling due.
St. Vincent	10 ditto	8 ditto	ditto.
Tobago	10 ditto	8 ditto	ditto.
Trinidad	10 ditto	6 ditto	from date of the proteft.
Dominica	10 ditto	6 ditto	ditto.
Nevis -	10 ditto	8 ditto	ditto.
Montferrat	10 ditto	8 ditto	ditto.
Antigua -	10 ditto	8 ditto	ditto.
St. Kitt's	10 ditto	8 ditto	ditto.
Tortola -	10 ditto	8 ditto	ditto.
Demerara, Effequibo, Berbice, Surinam	25 ditto	6 ditto	from date of prefentation.
St. Thomas, St. John, Santa Cruz	10 ditto	10 ditto	from date of the proteft.

There are occafionally other charges befides the above, fuch ſuch as poſtage, notarial expences, and difference of exchange.

If a bill, drawn in the Weſt Indies on any part of Great Britain, be noted for non-acceptance, the holder may oblige the drawer, by legal proceſs, to give ſecurity in the iſland for the amount, without waiting for the bill being proteſted for non-payment. See Kelly's Cambiſt, vol. i.

WEST *Iſland*, in *Geography*, one of the ſmaller Philippine iſlands, near the ſouth coaſt of Mindoro. N. lat. 12° 18'. E. long. 121° 12'.—Alſo, a ſmall iſland at the eaſt entrance of the ſtraits of Sunda. S. lat. 5° 27'. E. long. 106° 20'.—Alſo, a ſmall iſland in the Eaſt Indian ſea, near the ſouth coaſt of Cumbava. S. lat. 8° 49'. E. long. 119° 2'.

WEST *Kirk*, a town of the iſland of Weſtra, in a bay on the ſouth coaſt. N. lat. 59° 8'. W. long. 2° 51'.

WEST *Houghton*, a townſhip in the pariſh of Dean, and county of Lancaſter, England, contained, in 1811, 663 houſes and 3810 inhabitants.

WEST *Penn*, a townſhip of Pennſylvania, in the county of Northampton, containing 947 inhabitants.

WEST *Point*, a town of Virginia, on the York river; 35 miles E. of Richmond. N. lat. 37° 30'. W. long. 76° 56'.

WEST *Point*, a town of New York, on the right bank of the Hudſon river, in the county of Orange. This was a poſt of great conſequence, eſpecially with reſpect to the communication between the northern and the middle colonies, and the poſſeſſion very deſirable to the Britiſh general, who entered into a treaty with general Arnold the commander to betray it. The adjutant-general of the Britiſh army, major André, was employed by ſir Henry Clinton as the agent on this buſineſs, and being diſcovered, he was executed as a ſpy; 42 miles N. of New York. N. lat. 41° 23'. W. long. 74°.

WEST *Point*, a cape at the weſtern extremity of the iſland of Anticoſti. N. lat. 49° 50'. W. long. 64° 30'.

WEST *River*, a river of Virginia, which runs into Black bay, N. lat. 36° 30'. W. long. 76° 17'.—Alſo, a river of Maryland, which runs into the Cheſapeak, N. lat. 38° 54'. W. long. 76° 42'.—Alſo, a river of the province of Maine, which runs into Machias bay, N. lat. 44° 45'. W. long. 67° 19'.

WEST *River*, or *Wantaſtic*, a river of Vermont, which runs into the Connecticut, N. lat. 42° 50'. W. long. 73° 31'.

WEST *River Mountain*, a mountain of New Hampſhire, near Weſt river.

WEST *Town*, a townſhip of Pennſylvania, in the county of Cheſter, with 790 inhabitants.

WEST *Wain*, the weſt ſhore of Hudſon's bay.

WESTBROUGH, a town of Maſſachuſetts, incorporated in 1717, in the county of Worceſter, containing 1048 inhabitants; 33 miles W. of Boſton.

WESTBURY, a market-town and borough in the hundred of the ſame name, and county of Wilts, England, is ſituated at the diſtance of 24 miles N.W. by W. from Saliſbury, and 97 miles W. by S. from London. Nothing is known with certainty of its hiſtory, till the reign of Edward I., when it was conſtituted a corporate town by charter, under the juriſdiction of a mayor, recorder, and twelve capital burgeſſes. Weſtbury ſends two members to parliament, and has done ſo regularly ſince the 27th year of Henry VI., who renewed its charter of incorporation, and beſtowed upon it the additional privilege of being repreſented in the national councils. The right of election is in the holders of burgage tenures, being reſident within the borough, and not receiving alms: the mayor is the returning officer. The town conſiſts principally of one long ſtreet, running nearly in a direction north and ſouth. According to the population return of the year 1811, it contained 351 houſes, and 1790 inhabitants, who were chiefly engaged in the manufacture of woollens. A market is held weekly on Fridays; and two fairs annually, when there is uſually a large ſupply of cattle, horſes, ſheep, pigs, cheeſe, &c. The borough and hundred of Weſtbury form only one pariſh: for the former, a court-leet is held by the mayor in November annually; and for the latter, one in May by the ſteward of the lord of the manor, at which two high conſtables are appointed for ſecuring the public peace. The only public buildings in this town which demand particular notice, are the town-hall and the church. The hall is a convenient edifice, in which the borough-courts are held: it is ſituated near the centre of the town, and is alſo appropriated in part as a wool-hall. The church is a large ancient ſtructure of ſtone, with a tower in the middle. In it are ſeveral monuments in honour of perſons of conſiderable note.

About a mile to the ſouth of Weſtbury is the village of Leigh, commonly called Weſtbury-Leigh; ſuppoſed by ſeveral antiquaries to be the place deſignated in Aſſer by the word Æggles, where king Alfred encamped on the night previous to the battle of Ethandune.

Heywood houſe, ſituated about two miles due north from Weſtbury, was built in the reign of king James I., by James, lord Ley, afterwards created earl of Marlborough. It was long poſſeſſed by the family of Phipps; but is now the property and ſeat of Abraham Ludlow, eſq.—Beauties of England and Wales, vol. xv. Wiltſhire. By J. Britton, F.S.A. 1814.

WESTBURY, a village in the hundred of Ford, and county of Salop, England, ſituated 8 miles W. by S. from Shrewſbury. In this village is a reſpectable free-ſchool; and in the church, among other monuments, is one raiſed to the memory of general Severne, who inherited Wallop-hall, in this pariſh. About two miles S.W. of Weſtbury is Cawſe, or Caux-Caſtle, which is ſuppoſed to have been erected by Roger Corbett, who held of earl Roger de Montgomery a tract of land conſiſting of thirty-nine manors. It is conjectured that he gave the above name to this his capital ſeat, in alluſion to a caſtle in the Pays de Caux, in Normandy. As he and his ſon probably joined with Robert de Beleſme in his rebellion, the caſtle is ſuppoſed to have been forfeited to Henry I., who gave it to Paris Fitz-John, from whom it was taken by the Welſh. It was reſtored to the original lords, and in the firſt of king John a weekly market was obtained for it, at the inſtance of Robert Corbett. Its proximity to the Welſh frontiers rendered its tenure uncertain, and we find that it was again ſeized by the Welſh, and reſtored by Henry III. In the reign of Edward III., the male line of the family becoming extinct, the caſtle was transferred, by marriage of a daughter of the houſe, to the Staffords, earls of Stafford; on the execution of the laſt of whom, Edward, duke of Buckingham, it was forfeited to the crown, but was reſtored to his ſon Edward. It was alienated in the reign of Elizabeth to Robert Harcourt, from whom it deſcended to lord viſcount Weymouth. The ſcite of this caſtle is perhaps one of the moſt lofty and commanding in the whole range of the Salopian frontier. It is an inſulated ridge, riſing abruptly from a deep ravine on one ſide, and ſloping towards a vaſt valley, bounded by the Stiper-ſtones on the other. The keep-mount is ſingularly ſteep and towering; it muſt have been aſcended by ſteps, or by a winding path, but no traces of either at preſent remain: part of a well is ſtill diſtinguiſhable;

tinguifhable ; the caftle itfelf is nearly deftroyed. Parts of one of the entrance-gateways, evidently of a more recent date than the original caftle, are ftill to be difcerned.—Beauties of England and Wales, vol. xiii. Shropfhire. By R. Rylance, 1811.

Westbury, a townfhip of Lower Canada, on the river St. Francis.

WESTENBERG, a town of the marggravate of Anfpach ; 6 miles N.E. of Anfpach.

WESTENSEE, a lake of the duchy of Holftein ; 8 miles E. of Rendfburg.—Alfo, a town of the duchy of Holftein, on the fide of the lake of the fame name ; 8 miles S.E. of Rendfburg.

WESTERBURG, a town of Germany, which gives name to a lordfhip, fituated on the Wefterwald. The lords of Wefterburg fucceeded the counts of Leiningen. They are counts of Leiningen and lords of Wefterburg ; 16 miles W.N.W. of Weilburg.

WESTERHAM, a market-town in the hundred of Wefterham and Eden-bridge, lathe of Sutton, and county of Kent, England, is fituated near the confines of the county towards Surrey, at the diftance of 5 miles W. from Seven-Oaks, and 22 miles S.E. by S. from London. The manor was given by Edward I. to the abbey at Weftminfter, for the performance of certain religious fervices for the repofe of the foul of queen Eleanor. He alfo granted feveral privileges to the abbot, which were confirmed by Edward III., who alfo gave permiffion to hold a weekly market at Wefterham, which is ftill continued. After the diffolution, Henry VIII. conveyed thefe eftates to fir John Grefham, younger brother of fir Thomas Grefham, the founder of the Royal Exchange : and his defcendant, fir Marmaduke Grefham, fold this manor to the Wardes of Squerries, a refpectable feat in this parifh, near the weft end of the town ; and John Warde, efq. is now the owner. Wefterham is ftated, in the population return of 1811, to contain 272 houfes, and 1437 inhabitants. The market is now held on Wednefday ; and here are two annual fairs. The church, a fpacious edifice, contains a great variety of fepulchral memorials ; among which is a neat cenotaph in commemoration of major-general James Wolfe, a native of this town, who was flain before Quebec in 1759. This town alfo gave birth to Dr. Benjamin Hoadley, who, in the laft century, was fucceffively bifhop of Bangor, Hereford, Salifbury, and Winchefter.

Some fingular land-flips are recorded by Hafted, as having happened at different periods in this parifh. The firft which is mentioned occurred in 1596, near Oakham-hill, about a mile and a half fouthward from the town ; where about nine acres of ground continued in motion for eleven days ; fome parts finking into pits, and others rifing into hills. A fimilar occurrence took place in 1756, at Toy's-hill, about a mile and a half to the eaft of the town, where a field of two acres and a half underwent confiderable alterations of furface, from an almoft imperceptible motion.—Beauties of England and Wales, vol. viii. Kent. By E. W. Brayley, 1808. Hafted's Hiftory of Kent, 1778.

WESTERHAUSEN, a town of the bifhopric of Halberftadt ; 3 miles E. of Regenftein.

WESTERLEY, a town of America, in Rhode ifland ; 30 miles S.S.W. of Providence.

WESTERLOO, a town of France, in the department of the Two Nethes ; 15 miles E.N.E. of Malines.

WESTERMO, a town of Sweden, in Sudermanland ; 62 miles W. of Stockholm.

WESTERN *Amplitude*, *Church*, *Horizon*, and *Ocean*. See the feveral articles.

Western, in *Geography*, a town of the ftate of Maffachufetts, in the county of Worcefter, containing 1014 inhabitants ; 20 miles W. of Worcefter.

Western *Iflands*. See Azores.

Western *Iflands*. See Hebrides.

Western *Reef*, rocks in the Spanifh Main, near the Mofquito fhore. N. lat. 14° 42′. W. long. 82° 25′.

WESTERNACH, a river of Bavaria, which runs into the Mindel, 2 miles N. of Mindelheim.

WESTEROS, or Westesas, or *Weftern Arofia*, fo called to diftinguifh it from Oftra Aros, or Eaftern Arofia, the ancient name of Upfala, a town of Sweden, and capital of Weftmannland, fituated on a fmall river clofe to the lake Mæler. This is efteemed by the native writers a place of high antiquity ; and they derive its appellation, by a fanciful etymology, from the river Ar, and Os, a mouth, and fuppofe it alluded to by Tacitus, and by Jornandes the Gothic hiftorian. However this be, the name occurs in the earlieft times of Swedifh hiftory. Wefteros carries on a confiderable commerce with Stockholm acrofs the lake Mæler ; particularly in copper and iron from the mines, which abound in the province of Weftmannland. It is a large ftraggling town, compofed of wooden houfes, and contains the ruins of an ancient palace, formerly inhabited by the kings of Sweden. It is a bifhop's fee ; and the cathedral, which is built with brick, is celebrated for the tower, efteemed the higheft in the kingdom ; the lower part of this tower is fquare, and fupports an octagon fpire, covered with copper. Within this cathedral is the tomb of Eric XIV. Wefteros has often fuffered much by fire, particularly in 1714. It is 36 miles W.S.W. from Upfal. N. lat. 59° 36′. E. long. 16° 30′.

Westeros, a townfhip of New York, in Oneida county, bounded N. by Boonville, E. by Steuben, S. by Floyd and Rome, W. by Lee, which was erected from the W. part in 1811. It is watered by fmall head waters of Mohawk river, and has plenty of mill-feats. The foil, furface, and products, are fimilar to thofe of Steuben and the adjoining towns. In 1810, the population was 2416, and the number of electors was 275. The lands are well cultivated and productive. The inhabitants are rich, and are clothed in houfehold manufacture.

WESTERWALD, a diftrict of Germany, in the north part of Wetteraw, or Wetteravia.

Westerwald *Earth*, a kind of earth mentioned by Agricola, of a whitifh-yellow colour, of a like nature to the terra Silefiaca, but preferable to it, as yielding more falt. He tells us, that it diffolves filver fo much better than other menftrua, as to render it potable, and capable of being prepared into a ufeful medicine in cephalic cafes. Boyle's Works, vol. i. p. 501.

WESTERWYCK, in *Geography*, a fea-port of Sweden, in the province of Smaland, fituated in a bay of the Baltic. This bay is called Sparefund ; and near it is a cuftom-houfe, where all homeward and outward bound fhips are fearched. Wefterwyck formerly ftood two Swedifh miles higher up in the country, on the fpot where the market-town of Gammelly now ftands. It has a good harbour, a commodious quay, and a cloth manufacture, and carries a brifk trade in fhip timber, and all forts of naval ftores ; 68 miles N. of Calmar. N. lat. 57° 45′. E. long. 16° 24′.

WESTEY, a townfhip of Ohio, in the county of Wafhington, containing 172 inhabitants.

WESTFIELD, a river of Maffachufetts, which runs into the Connecticut, 4 miles S. of Springfield.—Alfo, a town of the ftate of Maffachufetts, in the county of Hampfhire, containing 2130 inhabitants ; 6 miles W. of Springfield.

field.—Alſo, a poſt-town of New York, on the eaſt ſide of lake George; 6 miles S. of Ticonderoga.—Alſo, a townſhip of New York, in Richmond county, in Staten iſland. At its ſouthern extremity in the S.W. is a ferry of three-quarters of a mile to Amboy, in New Jerſey. It has one church near the centre, and well cultivated land. The whole population in 1810 was 1444, and the number of electors 139.—Alſo, a town of Vermont, in the county of Orleans, containing 149 inhabitants.—Alſo, a town of New Jerſey, in the county of Eſſex, containing 2152 inhabitants; 8 miles W. of Elizabethtown.

WESTFORD, a town of Vermont, in Chittenden county, containing 866 inhabitants.—Alſo, a poſt-town of Maſſachuſetts, in the county of Middleſex, containing 1330 inhabitants; 28 miles N.W. of Boſton.—Alſo, a townſhip of New York, in Otſego county; 8 miles S.E. of Cooperſtown, erected in 1808 from the N.W. part of Worceſter. Its ſurface is broken by hills and valleys, but has much rich mould in the valleys. The hills are adapted to grazing, and it has many tracts of meadow land. Its timber conſiſts of maple, beech, aſh, elm, baſs-wood, and pine; and the whole is irrigated abundantly by ſprings and brooks. In 1810 the whole population conſiſted of 1215 perſons, and the number of electors was 73, and that of taxable inhabitants 177.

WESTGATE Bay, a bay of the Thames, on the coaſt of Kent, W. of Margate.

WEST GREENWICH, a town of Rhode iſland, in the county of Kent, with 1619 inhabitants.

WESTHAM, a town of Virginia; 4 miles N.W. of Richmond.

WESTHAMPTON, a poſt-town of New York, in the ſouth-eaſt part of Long iſland.—Alſo, a townſhip of Maſſachuſetts, in the county of Hampſhire, containing 793 inhabitants; 7 miles W. of Northampton.

WEST HANOVER, a townſhip of Pennſylvania, in the county of Dauphin, containing 2461 inhabitants.

WESTHAVEN, a townſhip of Connecticut; 3 miles W.S.W. of Newhaven.

WESTHOFEN, a town of France, in the department of Mont Tonnerre; 5 miles N.N.W. of Worms.—Alſo, a town of France, in the department of the Lower Rhine; 12 miles W. of Straſburg.

WESTHOVEN, a town of Germany, in the county of Mark, at the foot of a mountain near the Roer; once the domain of the celebrated Witikind, and poſſeſſed of conſiderable privileges; 4 miles S.W. of Schwiert.—Alſo, a town of Vermont, in the county of Rutland, containing 679 inhabitants.

WESTING, in *Navigation*, the ſame with departure.

WESTLAND, in *Geography*, a town of Ohio, in the county of Guernſey, with 250 inhabitants.

WESTMAES, a town of the iſland of Beyerland; 12 miles W. of Dort.

WESTMAN, or Westmonia, an iſland in the North ſea, near the coaſt of Iceland. N. lat. 63° 20′. W. long. 20° 28′.

The Weſtman iſlands ſuffered very much about the commencement of the ſeventeenth century, by the piracies of the Algerines; almoſt their whole population being deſtroyed or carried into captivity. In 1627 a large body of Algerine pirates landed on various parts of the ſouthern coaſt of Iceland; and not ſatisfied with the booty they obtained, murdered between forty and fifty of the inhabitants, and carried off nearly four hundred priſoners of both ſexes. Theſe unfortunate captives, tranſported to Algiers, were expoſed there to ſo much wretchedneſs, that nine years afterwards, when the king of Denmark obtained their liberty by ranſom, only thirty-ſeven out of the whole number were found to be ſurviving; of theſe, thirteen ſucceeded in reaching their native land. A prieſt named Olaus Egilſon, a captive, and releaſed in 1629, left a MS. relation of this event, which has been ſince publiſhed in Daniſh.

Westman, a town on the W. coaſt of the iſland of Stromoe.

WEST MANCHESTER, a townſhip of Pennſylvania, in the county of York, containing 978 inhabitants.

WESTMANNLAND, or Westmania, a province of Sweden, bounded on the north by Dalecarlia, on the eaſt by Upland, on the ſouth by Sudermanland, Nericia, and the Mæler lake, and on the W. by Warmeland; about 110 miles in length, and 80 in breadth where wideſt. The ſoil is fertile, and conſiſts moſtly of arable lands, with meadows, paſtures, and very fine woods in proportion; and it is reckoned the moſt famous province in the kingdom for mines. The iron trade carried on by the inhabitants of Weſtmannland, is the moſt conſiderable in all Sweden: the quantity of iron exported annually from Weſteros, Arboga, and Kioping, is very large. The ſouth part of the province chiefly conſiſts of arable and meadow lands, and ſupplies the inhabitants of the mine diſtricts with corn; and the northern parts abound in mine-works, and fine woods. Weſtmannland is well watered, both with rivers and lakes, which yield a vaſt plenty of fiſh; and the Mæler lake is a great advantage to its commerce, as it opens a paſſage from this province to Stockholm. The chief ſubſiſtence of the inhabitants is derived from agriculture and the mines, breeding of cattle and fiſhing. The wood, hammer-mills, &c. alſo employ a great many hands.

WEST MARLBOROUGH, a townſhip of Pennſylvania, in the county of Cheſter, containing 917 inhabitants.

WESTMEATH, a county of Ireland, which formerly was a part of the kingdom of Meath, but on the diviſion into counties was ſeparated from it, and both now form a part of the province of Leinſter. It has Cavan on the N., Meath on the E., the King's county on the S., Roſcommon, from which it is ſeparated by the Shannon, and Longford on the W. Its greateſt extent from E. to W. is 33 Iriſh (42 Engliſh) miles, and from N. to S. 27 Iriſh (34 Engliſh) miles. Its area meaſures 231,538 acres, or 361 ſquare miles Iriſh, equal to 371,979 acres, or 577 ſquare miles Engliſh meaſure. The number of pariſhes is 62, of which 21 have churches, and all but three are in the dioceſe of Meath. The population was computed by Dr. Beaufort to be 69,000. No part of this country is embarraſſed with mountains, but a great number of acres are rendered unproductive by large lakes and extenſive bogs; yet the convenience of fuel, the abundance of gravelly hills, and the variety of proſpects which ariſe from theſe beautiful lakes, and the undulating form of the ſurface, render it a very pleaſant and healthful country. The ſoil is in general light, but in ſome places deep and rich; and though there is more of it kept under graſs than employed in tillage, yet the plough is by no means neglected; for after ſupplying the home conſumption, the farmers of this county largely contribute to the exportation of oats from Drogheda. The Royal Canal from Dublin to Tarmonbury, on the Shannon, was to paſs through this county, and it has been carried as far as Mullingar; but the difficulties into which the company has fallen make it doubtful when the original deſign will be completed. Weſtmeath is remarkably well watered. Beſides the Shannon, which forms part of its weſtern boundary, the Inny and Broſna, two rivers of conſiderable extent, paſs through its lakes, and inſulate the greater part of it. The Inny riſes in the county of Cavan, and firſt enters Lough Shelin, which ſeparates that county

from

from Weftmeath; then in its courfe paffing through the loughs Derveragh and Iron, it is at length loft in that vaft expanfe of the Shannon, called Lough Ree, or the Royal Lake. The Brofna, rifing in Lough Iron, flows from it to Lough Hoyle, after quitting which it paffes the town of Mullingar; it then expands into Lough Ennel, and when again contracted, flowing by the town of Kilbeggan, it enters the King's county, through which it proceeds to the Shannon. As Weftmeath is nearly central, fo its ftreams flow in both directions. Thofe which have been already mentioned, joining the Shannon, are mixed with the Atlantic ocean; whilft other fmall ftreams, being collected in the river Dele, take an eaftern direction, and being united with the Boyne, flow to the Irifh fea.

Befides Lough Shelin on the north, and Lough Ree on the weftern boundary, there are fix confiderable lakes in this county, and feveral fmall ones. Thefe are well ftored with fifh of various kinds, and afford a number of beautiful profpects; yet it is to be regretted that fo many acres fhould be almoft an unprofitable wafte. The fifh found in thefe lakes are, perch, pike, bream, tench, trout, and very fine eels. The trout are often of ten pounds weight, and as red as a falmon. Such is the abundance, that Mr. Young tells us that a child with packthread and a crooked pin is able to catch perch enough in an hour to fupport a family for a day. This territory once belonged to Mortimer, earl of March, who married the daughter and heirefs of Lionel, duke of Clarence, third fon of Edward III. This nobleman refided much in Ireland, and was probably induced by the beauties of the fituation to build a palace at Fahatty, on the banks of Lough Derveragh, one of the fineft of thefe lakes, the remains of which were faid above a century ago to retain "the lineaments and footfteps of ancient ftate and magnificence." When Richard II. was depofed by Henry of Lancafter, Mortimer was the next in fucceffion to the throne, and he found it neceffary to conceal himfelf, which he did by retiring to Fahatty. By a marriage with his daughter, Richard, duke of York, fucceeded to his Irifh property, and to his right of fucceffion. This nobleman refided in Ireland for fome years as lord-lieutenant, before circumftances enabled him to urge his claim to the crown, which, after a long and bloody civil war, was obtained by his fon. The attachment of the fettlers in Ireland to this family was fhewn in the reign of Henry VII., by their readily embracing the caufe of Simnel and Warbeck.

Mullingar is the fhire town of Weftmeath; but Athlone is a place of more confequence. For an account of thefe, and of Kinnegad, Kilbeggan, Fore, &c. fee their refpective articles in this work. Weftmeath has three reprefentatives in the imperial parliament, two for the county, and one for the borough of Athlone.—Beaufort, Young, Collectanea, &c.

WESTMINSTER, a fpacious, populous, and important city of the county of Middlefex, England, is fituated on the north bank of the river Thames, and conftitutes the weftern extremity of the metropolis. Although in every refpect, local pofition alone excepted, independent of London, Weftminfter conftitutes a moft effential portion of the great metropolis of the Britifh empire. The line of demarcation between thefe two cities has long indeed, by the rapid increafe of buildings, ceafed to be perceptible to general obfervation; but it is not the lefs real and efficient. The inhabitants of Weftminfter, it is true, confider themfelves, in a general fenfe, as belonging to London; but for the purpofe of internal difcrimination, they confine the term Weftminfter to its original fignification, the fcite and the environs of the prefent collegiate, formerly the abbey-church of St. Peter. Confidering the city in this reftricted fenfe, and St. Peter's church as the centre, the latitude of Weftminfter is 51° 29′ 52″ N., and the longitude 0° 7′ 32″ W., from the meridian of the royal obfervatory in Greenwich-park. St. Peter's church bears from St. Paul's in London W.S.W. 2900 yards, or above one mile and five furlongs. The form of Weftminfter, in its prefent extended ftate, is triangular, having the bafe along the line of Oxford-ftreet, which feparates it from Marybourne on the north; and the vertex on the Thames, where the buildings terminate at Millbank on the fouth. The bafe, from Tyburn turnpike, at the weftern extremity of Oxford-ftreet, to the vicinity of Chancery-lane, at Lincoln's-inn, meafures nearly two miles. The fide on the weft from that turnpike to the vertex on Millbank, is alfo about two miles. The remaining fide on the eaft, in a right line from the vertex to Chancery-lane, is one mile and fix furlongs. The ground occupied by the buildings of the city and liberties therefore contains one fquare mile and a half, or about one thoufand acres. Weftminfter and London come into contact at Temple-bar, the boundary of the former city commencing at the Thames on the weft of the Temple-buildings, and running north to Lincoln's-inn. There quitting London, it turns weftward to the eaftern extremity of Oxford-ftreet, excluding the church and parifh of St. Giles-in-the-Fields, which belong to the county of Middlefex.

General View of Weftminfter.—From the extent of ground occupied by the city and liberties, and from the general population, amounting, by the enumeration of 1811, to 162,085 perfons, Weftminfter would, in another pofition, be fully entitled to rank high among the fecondary capitals of Europe. In common language, the great aggregate of Weftminfter is termed a city; bu tthat term belongs only in ftrictnefs to the immediate environs of St. Peter's church, while all the other parts of the community are fpread over the diftrict or liberties belonging to the monaftic eftablifhment, of which that church was a principal member. The city is of great antiquity, in the fenfe in which antiquity is eftimated in Britain; but the occupation of the liberties is of comparatively late date. This portion of Weftminfter may alfo be diftinguifhed, as to its age, into the old and the new towns, by a line running north from Charing-crofs up St. Martin's-lane into Crown-ftreet, Soho-fquare, and terminating near St. Giles's church, at the eaftern end of Oxford-ftreet. On the eaft of this line lies the old town, and on the weft fpreads out the new. The diftribution of the ftreets, and the conftruction of the buildings of the city, fufficiently indicate their early origin; an obfervation not unfuitable to the extremities of the old town. The new town, on the other hand, having been formed when better notions of diftribution and arrangement began to prevail, poffeffes a high proportion of all the advantages which fuch notions were calculated to produce. The abbey-church of St. Peter is diftant from the limits of London at Temple-bar, by the prefent ftreets along the Strand and Whitehall, about 2400 yards, or one mile and three furlongs; but from Temple-bar to the extremity of the Strand, at Charing-crofs, is only 1500 yards, or feven furlongs. The origin of this ftreet is manifeft from its name, having been only a road along the ftrand, or bank of the Thames, leading through the village of Charing to Weftminfter. Without keeping however precifely along the margin of the water, the road, owing to the fteep fall of the bank, was carried forward at fuch a diftance as to permit fpacious houfes and gardens to be formed on the flope between it and the river. The refidence of the court, in early times, was frequently in the Tower of London, or at fome place at a diftance from the capital; but under Henry III., who reigned

reigned from 1216 to 1272, the court ufually refided in Weftminfter. The courts of juftice, which had before accompanied the king in his motions, were, by his confirmation of *Magna Charta* in 1225, made ftationary in Weftminfter, where the parliament alfo generally met. For the convenience of attendance on the king, the courts of juftice, and the parliament, for the enjoyment alfo of good open air, and an agreeable profpect, many of the nobles, and efpecially of the bifhops, erected palaces along the banks of the river. Perfons of inferior ftation, whofe chief dependance for bufinefs and fubfiftence refted on thofe great men, were neceffarily induced to fix their abode in their vicinity. In this way, a chain of dwellings, of various forts, was progreffively raifed between the cities of London and Weftminfter, and united both with the intervening village of Charing. The fituations of thofe palaces, or inns, as they were called, are preferved to the prefent day, in the fucceffion of ftreets retaining their names, which communicate from the Strand on both fides, efpecially to the river. Thus, for inftance, from Temple-bar we come to ftreets bearing the names of Effex, Arundel, Norfolk, Surry, Somerfet, Savoy, Beaufort, Cecil, Salifbury, Durham, York, &c., all calling up perfonages memorable in former times; but of the houfes to which thofe names belonged, no veftige, if we except the fragments of the palace of the Savoy, and the prefent Northumberland-houfe, can now be faid to remain. The oppofite fide of the Strand being cut off from the ufe and the view of the Thames, was of courfe little frequented; but Exeter-change ftill indicates the refidence of the celebrated Cecil, lord Burleigh, whofe fon Thomas became earl of Exeter. Bedford and Southampton ftreets declare the origin of their names. As late as in the year 1353, when Edward III. was on the throne, the Strand was an open highway, croffed and cut up by water-courfes from the higher grounds. It was then repaired, but not before great complaints had been made: for in the petition of the perfons who lived near the palace of Weftminfter to Edward II., "the footway from Temple-bar to the palace" is ftated to be fo bad, that "the feet of horfes, and rich and poor men, received conftant damage, efpecially in the rainy feafon; the footway being interrupted by thickets and bufhes." From Temple-bar to the palace of Savoy, the Strand feems to have been paved, or properly made about 1385, in the reign of Richard II.: but the paving went no further till the latter part of Elizabeth's reign; and in the 35th of Henry VIII. the road was ftated to be "full of pits and floughs, very perilous and noifome." In the year 1533 the Strand took the form of a ftreet, bordered on each fide with houfes and gardens; among which was Covent-garden, corruptedly fo called from the garden of the convent, or abbey of Weftminfter, to which it belonged. Charing was ftill a detached village; St. Martin's church ftood literally in the fields; and St. Giles's, alfo furnamed in the fields, ftood in a diftant hamlet in the country. Such, however, was the increafe of the town in the end of Elizabeth's reign, that in 1600 St. Martin's-lane was built on both fides; and although St. Giles's church ftill ftood detached, the great weft road, now called Holborn, (properly Old-bourne, from the name of a fmall brook running along it,) was formed into a ftreet all the way into London at Fleet-ditch. Covent-garden and Lincoln's-inn-fields were partially built on, as were Drury-lane and Long-acre, and principally inhabited by the gentry. The village of Charing was long before this time, or in 1292, adorned with a crofs by Edward I., being the laft fpot where the body of his queen refted on the way to Weftminfter. In 1647 it was removed, and in part employed in pavement at Whitehall; but foon after the Reftoration, its place was filled, as it now is, by a ftatue of Charles I. on horfeback. From Charing to Weftminfter, the bank of the Thames was occupied by the refidences of royal, or other diftinguifhed perfonages. Firft was a palace for the king of Scotland, when he came to court to attend the parliament, of which, on account of lands he held in England, he was confidered a member. An ancient painting, formerly in the college of arms in London, reprefented Edward I. fitting in parliament, having on his right-hand Alexander III., king of Scotland; and on his left, Llewellyn, prince of Wales. The palace has long been effaced, but its fcite is ftill called Scotland-yard. To this fucceeded in pofition the palace of Whitehall, which will be noticed in another place. The church of St. Martin ftands within the limits of the old quarter, but its parifh originally extended over the whole of the new quarter of Weftminfter; and out of it, as buildings increafed, the parifhes of St. Paul, Covent-garden, St. James, St. Anne, and St. George, have fucceffively been formed.

Among the various improvements lately introduced into the ftreets of Weftminfter, muft be reckoned the fubftitution of gas-lights for oil-lamps, now much in ufe in fhops as well as without doors. The gas, or vapour, is extracted, by a fpecies of diftillation, from pit-coal. Purified from the incombuftible aerial fubftances with which it is extricated from the coal, by tranfmiffion through a body of water, the inflammable or carburetted hydrogen gas is conveyed by pipes, like water, to the places where it is wanted. By the admiffion of flame to the orifice of the pipe, the gas takes fire, producing together with a ftrong heat, a lively light of peculiar force and brilliancy. The coals from which, in London and Weftminfter, the gas is obtained with the greateft effect, are the Lancafhire cannel, and the Scotch fplint coals. Newcaftle coal is found to be much lefs pure, but from its cheapnefs is now moftly ufed.

Origin and Hiftory of Weftminfter.—Much learning and more fancy have been employed in devifing an etymology for the name of London; but the name of Weftminfter is too obvious to afford exercife for the fkill or the ingenuity of the philologift or the antiquary. The Saxon terms compofing the latter name evidently refer to the church of St. Paul, in London, in the eaft. Stowe indeed, and fome later writers, carry the reference to a monaftery, not far from the Tower of London, called the Eaft-minfter. But that eftablifhment was founded only by Edward III., in the middle of the fourteenth century, long pofterior to that of Weftminfter, and could not therefore have given origin to the latter inftitution. The hiftory of Weftminfter is founded on, and clofely interwoven with that of the monaftery of St. Peter: for to the exiftence and importance of the latter, the rife, progrefs, and profperity of the former muft be attributed.

The fcite of the church and monaftery of St. Peter was in early times an ifland, inclofed by the main channel of the Thames on the eaft, and by a collateral branch of that river on the weft. Hiftory furnifhes no information concerning the limits or the extent of this infulated tract; but by a careful examination of the ground, even under all its alterations, the courfe of the collateral branch may ftill be difcovered. This branch feems to have broken off from the Thames to the eaft of Chelfea hofpital, to have paffed northward, along the natural hollow in which the water ftill flows to fupply Chelfea water-works, and thence over a fhort interval, now covered with the houfes of Pimlico, into the depreffion occupied by the canal in St. James's park, acrofs the fcite of Whitehall into the Thames. In this cafe the ifland was in length from S.W. to to N.E. about one mile and three-quarters, and in breadth in the middle about half that diftance. Of this fpacious tract, by far the greateft portion muft, in former times, have been regularly overflowed by each returning tide of the river; as it would be at the prefent time, were not the embankments bordering the Thames carefully preferved. The age of thefe mounds is unknown; but to no others than the heads of the monaftery to whom the ifland belonged can their formation be reafonably afcribed; and to them is Weftminfter therefore indebted for the many advantages derived from the lands refcued from inundation. The embankments muft have been conftructed, and the ground within them well improved in 1386: for in that year abbot Litlington died in the manor-houfe of *Neyte*, fituated within that fpace. So defirable was that fituation, that the duke of Lancafter, ftyling himfelf king of Caftille, had requefted leave to refide in the houfe during the fitting of a parliament. The name of this place ftill furvives, although abfurdly corrupted into *Neat-houfes*. In an authentic charter, dated in 785, Offa, king of Mercia, grants certain lands to the monaftery of St. Peter: its fituation is defcribed to be in "Torneia in loco terribili ad Weftmunfter." In the writings of Sulcardus, a monk of this monaftery who wrote in the eleventh century, the name is Thorneia. Both thefe names are fuppofed to be formed from the Saxon *Thorn-ey*, the ifle of thorns and briars, expreffing the wild uncultivated ftate of the "terrible fpot" noticed by Offa. Forbidding as fuch a fituation now would be, it bore a different afpect in ancient times; for it poffeffed alike fecurity from attack, and feclufion from the world. To the religious eftablifhment on Thorney, the rife, progrefs, and profperity of Weftminfter are to be afcribed; but the origin and the date of that eftablifhment itfelf are involved in obfcurity. The probability, however, is, that it was founded by Sebert, king of the Eaft Saxons, who died in 616. That it had in 785 acquired celebrity, is evident from the charter before-mentioned, granted by Offa. From Sebert's time the monaftery feems to have been only a priory; but by Offa it was changed to an abbey, of which the abbots arofe, in the courfe of a few years, to the higheft dignity of which their rank was fufceptible. To demonftrate more fully his attachment to the patron of the abbey, St. Peter, Offa in it depofited his coronation-robes and regalia. From this circumftance, perhaps, as much as from fubfequent papal authority, St. Peter's church afterwards became, and ftill is ufed for the inauguration of the Englifh fovereigns; and to the dean, as fucceffor of the abbot, are intrufted many of the implements and ornaments employed in that important function, which was firft there performed on William the Conqueror, in 1066. After fuffering feverely in common with other works of the fame character, by the ravages of the Danes, the abbey was reftored by Edgar, who began to reign in 957, on the inftigation of Dunftan, who removed thither, probably from Glaftonbury, twelve monks of the order of St. Benedict. It is neverthelefs to Edward the Confeffor that the inftitution is principally indebted for its fplendour. Sulcardus informs us that Edward had vowed to go to Rome, there to exprefs his pious gratitude to heaven for his unexpected eftablifhment on the Englifh throne. The many inconveniences, however, by which the performance of this engagement muft have been attended, induced him to fubftitute in its ftead fome other mode of teftifying his thankfulnefs. He therefore undertook to rebuild the church and monaftery of St. Peter in a magnificent manner, and endow them with ample revenues. Of the ftructure itfelf we only know from Matthew Paris, that "it was conftructed in a new kind of arrangement, from which many perfons in erecting churches took a pattern, and ftrove to imitate it." Speaking of the fame edifice, fir Chriftopher Wren refers to an account printed from an ancient manufcript. This account he tranflates into language proper for builders, in this way. "The principal area or nave of the church being raifed high, and vaulted with fquare and uniform ribs, is turned circular to the eaft. This on each fide is ftrongly fortified with a double vaulting of the aifles in two ftories, with their pillars and arches. The crofs-building, contrived to contain the choir in the middle, and the better to fupport the lofty tower, rofe with a plainer and lower vaulting; which tower then fpreading with artificial winding-ftairs, was continued with plain walls to its timber-roof, which was well covered with lead." The ftriking novelty in this ftructure was probably the introduction of an imitation of a crofs in the plan: for the earlier Saxon churches are fuppofed to have had no tranfepts. The grants of lands, and of relics, beftowed by Edward on his new foundation, were ample beyond all precedent. He likewife invefted it with peculiar privileges, exempting it from all fecular fervices and authority, even from epifcopal fuperintendance. But this laft exemption brought on each new abbot the trouble and expence of a journey to Rome, to be confirmed by his holinefs in perfon. Edward died on the 5th of January, 1066, having furvived but a few days the fplendid ceremony of the confecration of the new ftructure. From thefe privileges, afterwards extended to a confiderable fpace connected with the abbey, may be traced in a great meafure the prefent civil conftitution of Weftminfter. While Laurence was abbot in 1163, in the reign of Henry II., the power was obtained from pope Alexander III. for his ufing the mitre, ring, and gloves, diftinguifhing marks of epifcopal dignity. But this privilege became, in the fequel, of ftill higher importance; for mitred abbots came to fit in parliament as well as bifhops, and to enjoy every honour to which bifhops, as lords of parliament, were entitled. Laurence dying before the papal approbation of the meafure was formally announced, his fucceffor Walter was the firft abbot of Weftminfter who actually enjoyed the honours of the mitre. The reign of Henry III., of great importance in the hiftory of England in general, is not lefs fo to that of Weftminfter abbey in particular. In it the greater part of the edifice was rebuilt, in the lofty elegant ftyle by which it is chiefly characterized; a ftyle which about that time began to be adopted in ecclefiaftical buildings throughout Europe. As early as 1220, although then only a youth, Henry laid the firft ftone of the chapel of the Virgin, which was afterwards fuperfeded by the gorgeous ftructure of Henry VII.; but it was not until 1245 that he directed the church to be enlarged, and the tower, with the eaftern part, to be conftructed anew. In 1269 the building was opened for divine fervice, and the body of Edward the Confeffor was depofited in a fplendid fhrine erected behind the high altar.

The abbey of Weftminfter is entitled to the peculiar veneration of every friend of literature, of fcience, and of civil and religious liberty; for within its bounds was erected the firft apparatus for printing books employed in this ifland. William Caxton, a mercer of London, during a long refidence on the continent as agent for the affairs of his company, and in 1464 as minifter from Edward IV. to the duke of Burgundy, became acquainted with the art of printing, then very recently practifed in Lower Germany. In 1471 he printed at Cologne a work which he had tranflated from the French into Englifh; and returning home in the following year, he, under the patronage of the abbot of Weftminfter, commenced printing in the almonry, or eleemofynary adjoining to the abbey. In March 1474 appeared his book on the "Game at Chefs," which may be regarded as the firft production of the Englifh prefs. (See PRINTING.) The honour of being the firft protector of printing in England has been frequently affigned to John Iflip: but this muft be erroneous; for he became a monk only in 1480, and arofe to be abbot only in 1500. To one of his predeceffors, therefore, to Efteney, elected in 1474, or rather to Millyng, elected in 1469, is the introduction of printing to be attributed. The abbacy of Iflip is however memorable on another account. In it was founded, on the 24th of January, 1502-3, the celebrated chapel of Henry VII. Having obtained the crown as heir to Henry VI., he refolved to erect a fumptuous monument for his remains, in the expectation of his canonization. The firft part of the project was carried into effect: but the court of Rome requiring a greater fum for compliance with his folicitation than the prudent Henry of Richmond cared to beftow, the laft part of the project was relinquifhed. Weftminfter-abbey was now on the eve of great alterations. The fchemes of Henry VIII. began to be put in practice. On the 16th of January, 1539-40, a furrender of the whole eftablifhment was executed by abbot Benfon of Bofton, and twenty-four of the monks. The annual revenue is ftated to have then been nearly 4000*l*.; a fum of great real value, when the pound of beef was regulated at one halfpenny, and that of veal and mutton at three farthings.

Prior to the diffolution of the monafteries, Henry had refolved to convert fome of them into epifcopal fees, to be endowed with a portion of the lands or the revenues which that diffolution would place at his difpofal. Of the projected fees, Weftminfter was to be one; and on the 17th of December, 1540, the abbey-church was, by letters patent, conftituted a cathedral, with a bifhop, a dean, twelve prebendaries, and other inferior officers. The new bifhop was Thomas Thirleby, then dean of the chapel-royal. The late abbot Benfon was, for his ready compliance with Henry's wifhes in the change of the abbey, appointed dean of the new cathedral: certain monks became prebendaries, minor canons, and ftudents in the univerfity: the others were difmiffed with penfions, decreafing from ten pounds down to five marks. The abbatial manfion was converted into a palace for the bifhop, whofe annual revenue is varioufly ftated from fix hundred to eight hundred pounds. The diocefe included the whole county of Middlefex, with the exception of Fulham, the rural refidence of the bifhops of London. The endowment of the dean and chapter was not completed till the 5th of Auguft 1542, when lands, in various parts of the kingdom, were affigned, of the yearly value of 2598*l*., out of which, however, the fum of 400*l*. was to be paid for the falaries of five profeffors of divinity, law, phyfic, Hebrew, and Greek, in each of the univerfities. A farther fum of 166*l*. 13*s*. 4*d*. was to fupport 20 ftudents in the univerfities; and two mafters, with 40 grammar fcholars, were to be maintained in the fchool of Weftminfter. The new bifhopric was, however, but of fhort duration; for on the 29th of March 1550, bifhop Thirleby was required to furrender it to Edward VI., and it was foon afterwards reunited to that of London. Part of the poffeffions of St. Peter's cathedral were appropriated to the repairs of St. Paul's in London; whence arofe the proverb of "robbing Peter to pay Paul." In the edict for fuppreffing the fee of Weftminfter, no mention was made of the eftablifhment of a dean and prebendaries, &c.; it became confequently a queftion whether they were to be continued. To remove all doubt on this head, an act paffed in parliament, declaring the church ftill to remain a cathedral, with the former eftablifhment, but within the diocefe of London. On the acceffion of Mary to the throne, the reftoration of the monaftery to its priftine condition was carried into effect. The abbot, John Fackenham, furviving Mary, was the only ecclefiaftic of his rank who fat in the firft parliament of Elizabeth in 1558; and he took the loweft place on the bifhops' bench. But on the 21ft of May 1560, the monks were again difplaced, and the church again rendered collegiate, on a bafis very fimilar to that which had been eftablifhed by her father, Henry VIII. The laft dean of Elizabeth's appointment was the learned Lancelot Andrews, afterwards bifhop of Winchefter, dean of the chapel-royal, and a fpecial favourite of James I. Since the reftoration by Elizabeth, if we exclude the general diforganization of fimilar inftitutions, in confequence of the internal diforders which commenced in the reign of Charles I., the collegiate eftablifhment of the abbey-church of Weftminfter has undergone no material alteration.

Abbey-Church.—Such is briefly the hiftory of the religious eftablifhment on Thorney, to which modern Weftminfter is indebted for its origin and profperity. Of this eftablifhment, the church remains in a great meafure entire: the buildings appropriated for the abbot and the monks have undergone great alterations; but their general arrangement may ftill be traced, and they are ftill allotted for the refidence of the perfons attached to the fervice of the church and the dependent fchool. For a fully detailed defcription of this celebrated church, of its architectural beauties and defects, of the fepulchral monuments it contains, of the ceremonies performed within its walls, and for a recapitulation of the important tranfactions connected with its hiftory, recourfe muft be had to the various works publifhed fpecially on the fubject. This church is a diftinguifhed fpecimen of that mode of architecture, commonly but abfurdly ftyled Gothic, a term which, however improper, moft writers ftill continue to employ, though no fpecific ftyle or clafs of building is defined by it. Erected in the 13th century, when buildings in this ftyle of architecture were well underftood, and fkilfully conftructed, it would doubtlefs have poffeffed, if not the fpacioufnefs, at leaft the light and airy and elegant appearance for which fuch ftructures are generally remarkable. But by the introduction of fepulchral monuments, elevated above the level of the choir, many of them magnificent indeed in themfelves, but certainly mifplaced as far as regards the internal arrangement of the building, that attractive appearance muft very early, perhaps from the beginning, have been injured. Owing to thofe encroachments, it has been neceffary to bring forward the prefent choir much beyond its ufual ftation, not only intercepting the tranfepts, but advancing a confiderable way into the nave, or body of the church. The building confifts of a nave and two fide aifles, feparated by ranges of tall, flender, clustered columns, fupporting the roof raifed to a great elevation, ftill further increafed in appearance by the narrownefs of the fpace between the columns. The length of the whole edifice within the walls is 360 feet, the breadth of the nave and aifles 72 feet, the length of the crofs or tranfept 195. The infertion of St. Edward's chapel in the choir is particularly unfavourable; for that important divifion of the building was from the beginning very fhort: nor is it eafy to difcover the reafon of this deviation from general ufage. On entering the great weftern door, the whole body of the church difplays itfelf to view in a very ftriking manner. Loftinefs, lightnefs, and elegance, are its marking features; but thefe features are much obfcured, and diftracted by the numerous difcordant monuments, which fill up the open fpaces, and cover the walls. The nave is feparated from the choir by a fcreen; and eaft of the latter is a chapel, raifed raised above the level of the pavement, appropriated to the shrine of Edward the Confessor, but also occupied by several monuments to royal and noble persons. At the east end of this is a sumptuous architectural chantry to the memory of Henry V. Still more to the east is the splendid and interesting chapel, called Henry the Seventh's, because begun by him, and founded for his mausoleum. On the north and south sides of the choir are aisles, and also some small chapels, dedicated to different saints.

From the time of Henry VII. little was done, although very requisite, to the exterior of Westminster church, till that of George II., when many parts of it were coated over with stone, and otherwise repaired at the public expence. Some time before this, the two towers at the west end were completed from designs of sir Christopher Wren, as they now appear. In covering the outside of the church, the rich sculpture, and the statues which formerly adorned the buttresses, could not be restored. Those parts seem now, therefore, unsuited to the highly ornamented building to which they are attached : nor do the western towers assimilate with the style of the fabric to which they belong. The paintings in the great west window were executed in 1735 : the window in the south transept was also renewed in 1705. In the interior of the church, the pillars dividing the nave from the side aisles guide the eye to the fine painted window at the extremity of the choir, which, in former times, when the altar-piece was low, must have had a fine effect in giving a lighter air to that part of the building. The altar-piece was brought hither by queen Anne in 1706 : it had formerly belonged to Whitehall chapel. The marble columns of the Corinthian order, however elegant in themselves, but ill accord with the style of the structure around them ; an incongruity but too often sanctioned in other edifices of the same kind in England. In front of the communion-table is still to be seen, although woefully mutilated, a curious Mosaic pavement of lapis lazuli, porphyry, jasper, serpentine, touch-stone, &c. placed there by abbot Ware in 1272, who brought it from the continent, where he procured the materials during a mission to Rome. The black and white lozenged marble pavement of the choir was the gift of the celebrated Dr. Busby, master of the school annexed to the church. In the centre of Edward the Confessor's chapel, stands the mutilated body of the shrine, containing, in a wooden case, the ashes of St. Edward ; and around the sides of the chapel are ranged the monuments of several kings, queens, and princesses, from Henry III. to Elizabeth, the daughter of Henry VII. ; all of which are extremely curious and interesting. In this chapel are preserved the chairs, one very ancient, the other made for the last queen Mary, in which our kings and queens are seated within the choir at their coronation. In the frame of that used by the king is the fatal stone, to the position of which the sovereignty of Scotland, or rather of the Scotch nation, was attached.

The choir of the church, in the form of a semi-octagon, was surrounded by eight chapels, now reduced to seven, by the appropriation of the central chapel to be the porch of that of Henry VII.

The cross-aisles or transepts of the church, as well as the nave, have long been consecrated to the interment of persons in various ways distinguished in the world. The south transept has only an eastern aisle, the west being occupied by part of the cloisters. This transept, named Poets'-corner, contains many interesting memorials of men whose genius and talents in science, literature, and the arts, entitle them to the honourable recollection of posterity. Of these monuments, many are highly interesting as memorials of eminent characters, and others as specimens of the sculptor's art. No small number of them, however, and those not the least sumptuous and obtrusive, are entitled to no regard on either account, being vast masses of marble devoid of beauty and taste. It is, however, to be remembered, that to be "numbered among the illustrious dead," within the walls of the abbey-church of Westminster, now is and long has been purely a question of finance with the officers attached to the foundation.

Chapel of Henry VII.—In ancient cathedrals and other churches of considerable extent, it was the practice to appropriate to the peculiar service of the Virgin, the chapel situated immediately behind the high altar, and in the eastern recess of the building. Such a chapel originally belonged to the abbey-church ; and on its scite with some adjoining space, under the same patronage, but now best known by his own name, Henry VII. constructed his magnificent and admirable chapel. When we contemplate this most curious specimen of English architecture, and consider the expence which must have been encountered to complete it, we are utterly unable, on any rational grounds, to reconcile its erection with the acknowledged disposition and character of the founder. In perusing the history of nations, we must be struck with the frequent recurrence of this fact, that men of all degrees, particularly of the highest, have acted on the vain supposition, that, by a single ostentatious act of beneficence or munificence, not unfrequently posthumous, they could acquire immortal fame, and even secure the favour of heaven, however unworthily they may have performed their duty in life. Of this fact, the chapel of Henry VII. stands a memorable example ; for in no one act of his life and reign, did that prince give evidence of any one of those feelings from which the construction of this superb structure could be expected to proceed. Of benevolence, however, in a certain sense, no sovereign ever had a better conception than Henry. The vast sums he exacted under this specious title, far exceeded the demands for which they were required : he accordingly amassed great wealth, and at his death his treasury was enormously rich. Towards his end, Henry, sensible of a mis-spent reign, endeavoured to atone for his offences by various charitable works, by bestowing a large sum on King's-college chapel in Cambridge, and in particular by founding, erecting, and endowing his chapel in Westminster. From the elegance and richness of the design, and from the skill and labour necessary to complete it, we are warranted to conclude that the most eminent artists and artificers of the country were employed. The first stone of the new chapel was laid by the hands of abbot John Islip, and other persons of the court, in the presence of Henry, on the 24th of January 1502-3. How much of the work was executed at the king's death, on the 21st of April 1509, is unknown ; but most probably the masonry must have been nearly, if not altogether, completed. Towards the finishing of the whole, Henry left, in the hands of the abbot, 5000*l.* with provision for more if required. The superb tomb for the king is particularly described in his will ; but a different plan was followed, and the work was finished by his son Henry VIII. The ground-plan of the building consists of a body nearly a square, terminated at the east end by a semicircular part, composed of five sides of an octagon. The extreme length of the whole chapel, including the porch, is 134 feet, and the corresponding breadth 82 feet 6 inches. On viewing the exterior of the building, we are struck by the apparent slightness of the work ; for instead of walls, the principal weight and quantity of the whole rests on a few detached piers and lateral buttresses. This peculiar character of

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ancient ecclefiaftical buildings, manifefts great fcience and fkill in the architects; for to raife lofty walls, and poife ponderous wide-fpreading roofs on piers and columns, requires the niceft geometrical accuracy. The fides are fupported by five octagonal piers; thofe of the femicircular end are united to wedge-fhaped maffes, entering fo far into the chapel, as to correfpond with the pillars feparating the aifles from the nave. The interftices between the external piers are filled by windows of a peculiar plan and great delicacy of workmanfhip. The roof over the nave refts on perpendicular walls, fupported by very flender internal pillars, and is ftrengthened all around by flying buttreffes or femi-arches from the external piers. Within, the chapel is divided by two ranges of pillars into a nave 33 feet 6 inches in width, and fide-aifles each 11 feet 3 inches wide. The internal roof is executed in ftone, with pendants and numerous ribs. By the advance of the piers in the circular part, that end is formed into five fmall chapels or oratories; but the fide-aifles in their original had no feparation from the nave, except the ranges of pillars. They are now, however, unfortunately cut off by a row of ftalls on each fide, on the line of the pillars, and fhooting up with their fretted and frittered canopies as high as the roof of the aifles. What tends to heighten the deformity of thefe ftalls, is the number of gaudy flags of the knights of the Bath, who are inftalled in this chapel, fufpended all around, at once concealing many beautiful parts of the architecture and fculpture, and utterly at variance with the elegance and the defign of the edifice. The entrance to the chapel is by a flight of fteps to a magnificent gateway, but from its fituation dark in itfelf, and darkening the extremity of the adjoining church. The chief object within the chapel is the tomb of the founder, inclofed by a fcreen of gilt brafs: it is a piece of admirable workmanfhip, executed by Torregiano of Florence, a rival of Michael Angelo. There alfo, ftill in oppofition, lie the jealous and vindictive Elizabeth and her unfortunate victim Mary Stuart. Thus in a corner of the abbey-church, a few feet only of earth now feparate the once formidable political antagonifts William Pitt and Charles James Fox. The bronze figure of Margaret Tudor, mother of Henry VII., is one of the fineft pieces of fculpture in the whole building. In viewing this chapel, two fubjects always excite regret; the fituation in which it ftands, and the materials of which the exterior is conftructed. Attached to the end of the abbey-church, with which its mode of conftruction has but a very diftant relation; although in itfelf, if furnifhed with a fuitable frontifpiece, worthy to be a feparate and independent work, it now finks into a mere appendage. The exterior furface of the chapel is in many parts corroded and confumed; and moft of the fculpture is now quite defaced. Some years ago parliament voted a confiderable fum of money, to be annually applied to defray the expence of new-cafing the whole edifice with Bath ftone, and the work has been carried on under the directions of Mr. T. Gayfere, with fcrupulous attention to the form and manner of the original workmanfhip. Beneath the chapel is the vault prepared on the death of Caroline, queen of George II. in 1737, and containing the remains of feveral members of the prefent royal family. The cloifter of the abbey, ftill fufficiently entire, and containing numerous fepulchral infcriptions, communicates with the ancient chapter-houfe, which is of octagonal form, and the roof is fupported by a branching central column. It was erected, according to Matthew of Weftminfter, in 1250, by Henry III. This building, which, till the time of Edward VI., ferved as a houfe for the commons of England, is now employed to preferve public records; amongft them, the celebrated *Liber de Wintonia*, as it was called by the compilers, or *Domefday-book*, as it was not unaptly named by thofe perfons whom it regarded. This work, the moft ancient and venerable record, or ftatiftical account, as we now fpeak, of which this or any other country can boaft, was completed about 1086, in the end of the reign of William the Conqueror. (See Domesday-*Book.*) In the fame chapter-houfe are alfo preferved the recorded proceedings of the notorious ftar-chamber, fo called from the ftar-like ornaments of the roof.

School.—The cloifter alfo communicates with the celebrated fchool of Weftminfter, which was refounded by Elizabeth in 1590, with an eftablifhment for the claffical inftruction of forty boys. After a certain time, the fcholars, if duly qualified, are felected alternately for their refpective inftitutions, by the dean of Chrift-church, Oxford, and the mafter of Trinity college, Cambridge. Befides the youths on the foundation, from three to four hundred, others ufually receive their education in the fchool, at the expence of their refpective parents.

Parifh Churches of Weftminfter.—The city and liberties are now diftributed into ten parifhes. Within the city are St. Margaret's and St. John the evangelift's; within the liberties, St. Martin's, St. James's, St. George's, St. Anne's, St. Paul's, St. Clement's, St. Mary's, and the Savoy. St. Margaret's, the original church of the city, is a fimple plain ftructure. It is handfomely fitted up to accommodate the commons of the kingdom on certain folemn occafions; as the choir of the neighbouring abbey-church is allotted to the peers of parliament. One peculiar ornament of St. Margaret's church is a magnificent painted window reprefenting the crucifixion. This very interefting piece was executed in Holland as a prefent for Henry VII. St. John's church, belonging to a parifh formed out of St. Margaret's, furnifhes an admirable example of what imagination, unreftrained by judgment and tafte, can produce. It ought however to be known, that Mr. Archer, and not fir John Vanburgh, who has been oftener blamed than underftood, was the architect of this fabric. St. Martin's and St. George's churches are remarkable for their noble porticoes; but both are fo unfortunately, not to fay abfurdly fituated, that it is impoffible to have a view of them in any way fatisfactory. St. Paul's, Covent-garden, is noted for its fimplicity, and its plain, heavy, Tufcan portico. In erecting the latter at the *eaft* end of the church, where it can be feen, Inigo Jones effayed a bold deviation from eftablifhed practice; but to change the interior diftribution of parts was perhaps beyond his power. The portico therefore ftands where no entrance can be opened, for there within ftands the communion-table; and the entrance is opened at the *weft* end, where there fhould be, but is not, a portico. The church of St. Mary, like that of St. Clement, is ftrangely placed in the midft of the Strand, a moft public and noify ftreet; and inftead of poffeffing the fimple dignity of a Chriftian temple, feems rather a model contrived to fhew the fkill of the architect in comprifing the greateft quantity of ornament devoid of utility, within the narroweft bounds. But Mr. Gibbs the architect followed his inftructions in adorning an edifice to be fo oftentatioufly exhibited. He had befides but juft returned from Italy, where fimilar ftructures abound. It is no wonder, therefore, that, in both the interior and the exterior of the New church of St. Mary, he was led to imitate the buildings he might, as a mere ftudent of architectural defign, long have admired.

Befides the churches and chapels of the eftablifhment, Weftminfter contains places of worfhip for Chriftians of all denominations, and of profeffions the moft contradictory, from the myfterious Swedenborgian, who maintains the fole

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and abfolute *divinity*, to the fimple Unitarian, who afferts the pure *humanity* of the great founder of the Chriftian religion. French, Swifs, Dutch, and German Proteftants, have proper places where the fervice is performed in their own languages. The Society of Friends or Quakers have a refpectable place of affembly in St. Martin's-lane; and various chapels are open for the members of the church of Rome. In Denmark-court, in the Strand, is a well-frequented Jewifh fynagogue.

Civil and Political State of Weftminfter.—The firft dwellings conftructed around the monaftery in Thorney, ftood on the lands of the eftablifhment, which confequently had full authority to govern the inhabitants. Thefe were rapidly increafed in numbers by the privilege of fanctuary granted to the abbey for offenders; but the great caufes of the growth, population, and importance of Weftminfter, were the refidence there of the kings, and the tranfaction of all public bufinefs within its precincts. Although the Strand, Whitehall, and a few other parts were inhabited, at the elevation of the abbacy into an epifcopal fee in 1540, yet the quarter only immediately inclofing the cathedral church was honoured with the title of city. The whole of this quarter was included in the original and ancient parifh of St. Margaret; but in order to accommodate the increafed body of inhabitants, efpecially in the fouthern parts, a new parifh was formed out of the old in 1728, and named after St. John the evangelift. All the other quarters of the prefent Weftminfter, erected on the liberties of the abbey, are contained within the following eight parifhes, arranged in the order of their eftablifhment. St. Clement's Danes, St. Martin's in the Fields, and St. Mary's in the Strand, all of uncertain antiquity. St. John the Baptift's, in the Savoy, alfo ancient, St. Paul's, Covent-garden, St. James's, St. Anne's, Soho, and St. George's, Hanover-fquare; the laft four all formed within the laft 200 years. In defignating Weftminfter in the aggregate, the city and the liberties are neceffarily mentioned; but in no refpect does any diftinctive rank, right, or privilege exift between the inhabitants of thofe different quarters, who are all equally citizens and members of the fame community. On the public change of religion, and the converfion of the abbey of St. Peter into a collegiate eftablifhment of a dean and chapter in 1560, the latter were placed, as to all their civil rights and authority, in the fituation poffeffed by their predeceffors; but the fanctuary was, with all other fimilar privileges, fuppreffed in the 21ft year of James I. The dean and chapter of St. Peter's have, therefore, continued ever fince to be the fupreme magiftrates and adminiftrators of the inhabitants of the city and liberties of Weftminfter. Since the Reformation, however, the exercife of all civil powers has always been vefted in lay perfons, elected or confirmed by the dean and chapter. Of this fingular and anomalous fyftem of government, which, how applicable foever to the original, feems wholly unfuitable to the modern Weftminfter, the following are the principal members, as fettled by an act of the year 1585:—The firft is the high-fteward, ufually a refident nobleman of diftinction (the prefent is the duke of Northumberland), who is elected by the chapter of St. Peter's; the dean acting as high-fteward during and previoufly to the election. By this principal officer a deputy fteward is nominated; but his appointment muft be confirmed by the dean and chapter. This deputy acts as a fheriff, holding the court-leet with the other magiftrates: he is always chairman of the quarter-feffions of Weftminfter, which are independent of thofe of Middlefex. Next in rank is the high-bailiff, nominated on the other hand by the dean and chapter, but confirmed by the high-fteward. He is the returning officer in the election of the reprefentatives in parliament for the city and liberties; and to him all the other bailiffs are fubordinate. He fummons juries, and has a right to all fines, forfeitures, and ftrays, within his jurifdiction: he alfo, on due requifition, calls together and is prefent in affemblies of the electors, for the purpofe of petitioning parliament or the crown, or of tranfacting any other public bufinefs in which they are all concerned. The high-conftable, chofen at a court-leet of the magiftrates, has all the other conftables under his fuperintendance. In addition to thefe officers, fixteen houfeholders, ftyled burgeffes, are chofen, with their affiftants out of the different parifhes. Thefe refemble the aldermen and common-council of London, each having a particular ward or diftrict under his infpection; and of their number two head burgeffes are chofen, who, at the court-leet, fit next to the high-bailiff. The inhabitants of Weftminfter form no corporation, nor do they poffefs as fuch any exclufive privileges; neither do any companies of trade or profeffion exift within the jurifdiction. The various courts of juftice belonging peculiarly to Weftminfter are, 1. The court of the duchy of Lancafter, a fupreme court of record, held in Somerfet-place, for deciding by the chancellor of the duchy all matters of law or equity concerning the eftates belonging to the county-palatine of Lancafter. 2. The quarter-feffions of the peace, a court of record, held by the juftices of the peace at the Guild-hall, near the abbey-church, for all trefpaffes, &c. committed within the city and liberties. 3. The court-leet, held by the dean, or his fteward, for choofing parochial officers, preventing and removing nuifances, &c. 4. Courts of requefts, or of confcience, as they are called, for deciding without appeal by commiffioners, all pleas for debt under forty fhillings. 5. Courts of petty-feffions, held every lawful day at the offices in Bow-ftreet, Marlborough-ftreet, and Queen-fquare, for matters of police, mifdemeanor, or offence. 6. To thefe muft be added the court of St. Martin-le-grand, in London, but belonging to Weftminfter. The jurifdiction of the dean and chapter of St. Peter's, widely extended as the liberties are, is not confined to their bounds. In the very heart of London, under the walls as it were of St. Paul's, is the precinct, as it is termed, of St. Martin-le-grand, an integral part of Weftminfter, and wholly independent of London. This precinct took its name from a collegiate church founded in 1056, dedicated to St. Martin and qualified *le-grand*, on account of the great privilege of fanctuary conferred on it. By Henry VII. it was beftowed on the abbey of St. Peter; but on the furrender to Edward VI. it was pulled down, and houfes were built on the ground. Being let out to ftrangers not freemen of London, they claimed the privileges before enjoyed by the canons of the fuppreffed inftitution. Thofe claims produced many contefts which were never definitively fettled; and the exemption of St. Martin's precinct from the jurifdiction of London feems now to be eftablifhed, rather by long-continued ufage than by any regular or authoritative declaration of right. This fmall precinct (a term in London fignifying fpecifically a fubdivifion of a ward) confifts of one fhort ftreet of its own name, leading north from the eaft end of Newgate-ftreet to the beginning of Alderfgate-ftreet, and a few lanes and courts on each fide. In this precinct perfons not freemen of London, exercife their feveral trades or profeffions without controul; the inhabitants alfo concur in the election of reprefentatives for Weftminfter, in the fame way with thofe who actually dwell within that city. A very material change is now (1818) in progrefs in St. Martin-le-grand. The chief office of the general poft, domeftic and foreign, fituated in Lombard-ftreet, in London,

don, has long ceafed to be either central in pofition or commodious in diftribution, for the prodigious bufinefs tranfacted in it. After many attempts, chiefly on the part of the inhabitants of the weft end of the town, where many of the principal men of bufinefs refide, parliamentary fanction has at laft been obtained for the erection of a new poft-office, properly adapted, in fituation and internal arrangement, to the purpofes of the eftablifhment. The fituation felected is in St. Martin-le-grand; and the neceffary preparations in removing houfes and clearing the ground, have made confiderable progrefs. The expence of this enterprife muft be great; but the edifice may be rendered highly ornamental as well as ufeful to the metropolis. Mr. Kay is the architect. The jurifdiction of the dean and chapter of Weftminfter extends alfo over fome places in Effex, on that account independent of the diocefan bifhop of London, and even of the metropolitan of Canterbury; for while the Roman Catholic religion prevailed, the abbey was immediately under the pope. If the jurifdiction of the abbey thus extended over places remote from its bounds, it on the other hand comprehended within its bounds, a diftrict exempt from its jurifdiction. This is what is commonly called "the liberties, or the duchy of Lancafter." The diftrict comprehends all the fouth fide of the Strand, from the Temple to Cecil-ftreet, with nearly the fame extent on the north fide. The palace and diftrict of the Savoy having been a part of the poffeffions of the houfe of Lancafter, which were feparated from the crown by Henry IV., that part of the Strand belonging to the Savoy became a diftrict or liberty of itfelf. It has a fupreme court under the chancellor of the duchy of Lancafter, as already mentioned; and formerly no inhabitant of this diftrict voted for the reprefentatives of Weftminfter. But at the election in March 1795, thofe of the duchy-liberties who lived within the parifhes of St. Mary in the Strand, and St. Martin's in the Fields, were admitted to give their fuffrages. Until after the diffolution of the abbey, Weftminfter fent no reprefentatives to parliament; being virtually reprefented by the abbot, who fat with the bifhops in the houfe of peers. In the records of the laft parliament of Henry VIII. no mention appears of any fummons or returns relative to Weftminfter, Peterborough, or any other abbey-town. The firft parliament of Edward VI., therefore, is, that in which the members for Weftminfter began to take their place. The two reprefentatives of the city and liberties are elected by the inhabitant houfeholders, or thofe paying fcot and lot, who are now eftimated at about 17,000; the number being confiderably increafed by the enlargement before-mentioned in 1795. The elective franchife being thus widely diffufed among all ranks of the inhabitants, and the popular favour being commonly in the inverfe proportion of that of the court, one if not both of the reprefentatives of Weftminfter may generally be expected to be decidedly hoftile to the meafures of the exifting adminiftration. So well is this underftood by minifters, that, to have at leaft one member favourable to their views, they have frequently encouraged fome diftinguifhed naval commander to offer his fervices to the electors.

Having for many years been the ordinary refidence of the fovereign, Weftminfter has of courfe contained the principal departments of every branch of legiflative and executive adminiftration. The parliament, originally ambulatory and attached to the perfon of the king, was rendered ftable in Weftminfter on the confirmation of Magna Charta by Henry III. in 1216. Long before that period, the royal palace was erected adjoining to the abbey; and as in thofe early times juftice was often adminiftered by the king in perfon, or in his prefence, the various courts of judges were of courfe eftablifhed in or near his refidence. When the palace of Weftminfter ceafed to be occupied by the monarch, and Henry VIII., in 1512, tranfported his court to Whitehall, the parliament and the judges ftill retained their original ftation; but the executive branches of adminiftration, relative to financial and military affairs, accompanied the court. Hence we fee thofe departments all eftablifhed in what is ftill called Whitehall; although the king has long ceafed to refide in that quarter, and that a very fmall portion of the old palace is either occupied by public offices, or even in exiftence. Hence alfo it is that all public acts of government are dated from Whitehall. From the prodigious multiplication and fubdivifion of all public affairs relative to juftice, finance, and military and naval operations, the details of various branches have neceffarily been carried on in other convenient quarters of the metropolis. Such are the Temple, Lincoln's-Inn, Guildhall, the Bank, the Cuftom-houfe, the Excife-office, the Tower, &c.; ftill it is in Weftminfter alone that the general arrangement of the whole is conducted

Public Buildings.—Of the ancient refidence of the kings of England in the vicinity of the abbey of Weftminfter, the name, the general pofition, and a few mutilated apartments, are all now remaining. According to a furvey and plan of the whole buildings and veftiges of this palace, it extended along the bank of the Thames from north to fouth, and then turned weftward near to the buildings of the abbey. Of the general arrangement, it is impoffible to difcover more than that the walls and foundations feem to have been all parallel to the correfponding walls of the prefent great hall, the only part ftill remaining in its original ftate. Compofed of parts erected at different periods, no balance or fymmetry of plan feems to have been regarded in their diftribution.

Weftminfter Hall, memorable in itfelf as a building, as the fcene of many important tranfactions, and for the ufes to which it is applied, was erected by William Rufus, or William II., about 1097, as an appendage to the old palace, or a part of a new project. Having fuffered much from accidental fires, as well as from the lapfe of time, the hall, juft three centuries after its conftruction, was completely reftored by Richard II., who heightened the walls, altered the windows, adding a new roof, and built a ftately gateway. The hall is a vaft parallelogram, ftanding north and fouth, in length, within the walls, 249 feet, and in breadth 66 feet, not 74, as is generally ftated. The walls, although maffive and plain, are externally ftrengthened by buttreffes. The roof, rifing to a high pitch, is ingenioufly and firmly conftructed, not of Irifh oak, as ufually faid, but of chefnut brought from Normandy. This room is faid to be of greater magnitude without pillars than any other known. In this hall parliaments have been held; Richard II. was depofed in it in 1399, and for many ages it has been employed in the coronation-feafts of the fovereigns. In it affembled the court for the trial of Charles I., in January 1649. It is ftill the place of inquiry, before the houfe of peers, into the conduct of perfons impeached by the houfe of commons. In the middle of the right or weft fide of the hall, is an opening into the court of common pleas. The fouth end of the hall is occupied by wooden ftructures, to contain on the right-hand the court of chancery, and on the left the court of king's bench; fo called becaufe the king in ancient times actually fat, as he is at prefent afferted, by what is ftyled a legal fiction, actually to fit, on the bench to adminifter juftice. Between thefe two courts ftairs conduct to the apartments occupied by the two houfes of parliament. That employed by the peers was towards the fouth end of the old palace; but on account of the additional number of 32 peers entitled

tled to ſeats on the union with Ireland, over and above the unexampled augmentation of the peerage in the preſent reign, their meetings were transferred to what was the court of requeſts; ſo called becauſe the maſters of the court, in ancient times, received the requeſts or petitions of the people, and gave their opinions on the ſubjects. This room, conſiderably larger than the former, is alſo within the old palace; and is now ornamented with the celebrated tapeſtry, repreſenting the diſcomfiture of the Spaniſh Armada, or fleet and army, deſtined for the invaſion of England in 1588. At the upper end of the room is the throne, a highly enriched arm-chair; and at the lower end is an open ſpace, termed the bar. The commons of England, when they formed a ſeparate body from the peers, were, by an agreement with the abbot of St. Peter's, allowed to meet in the chapter-houſe already mentioned. But when, at the Reformation, the eſtabliſhment of the collegiate chapel of St. Stephen in the old palace was ſuppreſſed, to that place their meetings were transferred by Edward VI. This chapel, originally conſtructed by king Stephen, was rebuilt by Edward III. in 1347. The commons, before the union with Ireland, were accommodated within the chapel; but their number being by that meaſure augmented from 558 to 658 members, it became neceſſary to enlarge the place of aſſembly. At the eaſt, or upper end of the room, is the ſpeaker's chair; before it is the table with the clerks, and at the bottom is the bar. The ſeats for the members riſe one behind another, as in a theatre. Thoſe on the floor, on the ſpeaker's right-hand, are called the treaſury-benches, and occupied by the members of adminiſtration: the bench in front is uſually occupied by the leading members of the oppoſition. St. Stephen's chapel, highly adorned by Edward III., ſuffered greatly by its firſt adaptation for the commons; but much more by the late alterations. By removing the wainſcot, a great part of the ancient decorations was diſcloſed, and a very important fact in the hiſtory of the fine arts was, for the firſt time, aſcertained. On the 11th of Auguſt, 1800, was diſcovered a ſeries of ſculpture and painting, the latter exhibiting portraits, ſcripture-ſcenes, and other decorations, intereſting in themſelves, and peculiarly ſo as ſpecimens of the ſtate of the arts, as they exiſted nearly five hundred years ago. It has been uſual to aſcribe to John Van Eyck, of Bruges, in Flanders, the invention of painting in oil-colours, in 1410. This opinion has, however, of late years, been much invalidated; by the diſcovery in St. Stephen's chapel it is completely overthrown. From original records of the expences incurred in the conſtruction and decoration of that building, it now appears that the renovation was begun in the fourth year of Edward III., or about 1329, and not in 1347, as ſtated by Stowe and others: that the painters had not begun in 1345, but were at work in 1350, and ceaſed to be mentioned in 1364: that thoſe who painted on glaſs had begun in 1350, and finiſhed in 1352: that the paintings were unqueſtionably in oil: and that, of ſeventy-ſix painters employed in the chapel, the whole, with the exception perhaps of two, and they not the maſters, were natives of England. From theſe authentic documents it is therefore fully aſcertained, that *pictures*, in the uſual ſenſe of the term (not *houſe-painting*), in *oil* were executed in Weſtminſter palace in 1350, or ſixty years before Van Eyck's ſuppoſed diſcovery of the art. But the ſame genuine records go ſtill farther back: they prove oil to have been employed in painting pictures in the chapel before the rebuilding by Edward III.; that is, in the 20th year of Edward I., or in 1272, which was one hundred and eighteen years prior to Van Eyck. (See PAINTING.) Under the old houſe of lords are the cellars which were prepared for the famous powder-plot, of the 5th of November, 1605.

Whitehall Palace.—This royal manſion occupied a conſiderable ſpace on the bank of the Thames, including Privy-Garden, and extending to Scotland Yard, ſtretching out in breadth from the river quite acroſs the ſtreet ſtill called Whitehall into St. James's-park. It was originally the property of Hubert de Burgh, earl of Kent, and grand juſticiary of England under Henry III. The ſituation was low and marſhy, owing to the concourſe of the branch on the weſt of Thorney iſland with the main channel of the Thames. In 1248 the palace belonged to the archbiſhops of York, who poſſeſſed it until, on the fall of cardinal archbiſhop Wolſey, it was, in 1529, ſeized, with his characteriſtic love of juſtice, by the inſatiable Henry VIII. Poſſeſſion being obtained, many alterations were made in the building, of which a portion, commonly called the Cock-pit, adjoining to the Treaſury, ſtill exiſts. Falling into decay, James I. reſolved to rebuild Whitehall in a ſuitable manner; and for ſuch a deſign the ſpacious ground between the Thames and the park, and commanding both, offered every facility excepting that of elevation of ground, without a proper degree of which dignity is hardly attainable in architecture. Of the magnificent, although in many parts faulty, project of Inigo Jones, prepared for the intended work, one portion only was executed. This is the Banqueting-houſe, ſo called from its ſucceeding, in deſtination as in ſcite, to a part of the old palace appropriated to royal entertainments. The preſent edifice, one of the few ſpecimens of noble and regular architecture in the metropolis, conſiſts of two ſtories, on a ruſtic baſement, ornamented with Ionic and Corinthian columns and pilaſters. This edifice, containing ſeven windows on a floor, was only one of the angular pavilions of the intended grand ſtructure. It is ſufficiently enriched, but not overloaded with ornament; and being conſtructed on a ſcale of very large dimenſions in the parts, had the whole, even with all the defects of the project, been carried into effect, no ſovereign in Europe could have exhibited a place of reſidence to be compared with that of the king of Great Britain. Magnitude of parts was in that project held to be indiſpenſable for grandeur of effect. The interior of the Banqueting-houſe has long been converted into a royal, and lately into a military chapel; *adorned*, as is ſtill moſt incongruouſly imagined, with trophies of war. The ceiling is peculiarly worthy of obſervation, being the production of the ſplendid pencil of Rubens; exhibiting the allegorical hiſtory of his patron, James I. This maſterly performance ought to have diſſuaded the adviſers of George I. from converting the room into a place of Chriſtian worſhip; for "its contents are in no way akin to devotion; and the workmanſhip is ſo very extraordinary, that, in beholding it, the ſpectator muſt either poſſeſs an uncommon meaſure of zeal, or be utterly deſtitute of ſkill and taſte, who can attend to any thing beſides." From a window of the Banqueting-houſe the unfortunate Charles I., unfortunate in living in times when the art of managing parliaments was either unknown, or perhaps thought unworthy of a prince, paſſed to the ſcaffold erected in the public ſtreet in the front of his own palace. In a court behind the building ſtands one of the ſmall number of public ſtatues of the metropolis meriting examination. It is the work of Gubbins, and exhibits James II., indicating, as he would do in his deſtined ſituation, with an air and attitude full of expreſſion, the ſpot where his father ſuffered. At no great diſtance, on the former ſcite of the croſs in the village of Charing, is erected another fine equeſtrian figure of Charles himſelf.

St. James's Palace.—That the fovereign of the Britifh empire was far lefs fuitably lodged in his capital than are numbers of his fubjects, has by foreigners been often remarked, and by natives been fometimes converted into a compliment to the fovereign and to the nation. But the fact is, that St. James's palace was in its origin an hofpital, of part of which Henry VIII. availed himfelf to conftruct the prefent buildings, as an appendage to the palace of Whitehall, with which it was connected by St. James's park. Having been allotted for the refidence of the princefs, afterwards queen Anne, and her hufband George of Denmark, St. James's has ever fince continued to be occupied for court or ftate purpofes. The buildings are neither grand nor regular: the front, overlooking the park, has alone a certain air of dignity: and the ftate apartments, although they contain nothing peculiarly magnificent in the furniture or the decorations, are commodious and handfome.

Connected with this palace is the park of the fame name, ornamented with a long canal in the middle, and with broad walks, feparated by rows of trees on the fides, the only fpecies of improvement of which its flat fituation is well fufceptible. Near the centre of the canal, a wooden bridge, in the Chinefe ftyle, has been built acrofs the water. On the north-weft of St. James's-park is an open fpace, called the Green-park, capable, from its elevation and variety of ground, of much greater improvement: but its principal recommendation is that, being in fact a wide extended green field, it furnifhes a delightful promenade in all directions, and welcome relief from the hard pavement of the ftreets.

Buckingham-Houfe.—This edifice, now fettled on the prefent queen in lieu of Somerfet-houfe, and hence called the Queen's palace, poffeffes peculiar attraction, as much from its very favourable fituation, as from its hiftory. It was built by John Sheffield, duke of Buckingham, about the year 1700, and its gardens were adorned with terraces, canals, &c. The building is of brick, and moft of the apartments are fmall. In this palace for feveral years were held his majefty's levees, while his health permitted his appearance. Annexed to the palace are an octagon and other apartments, containing the king's library, rich in various works of value, particularly in early editions of books. Interior views of the chief rooms, with an ample hiftory of this edifice, &c. are given in Pyne's Hiftory of the Royal Palaces.

Carlton Houfe, the refidence for a number of years of the prince of Wales, regent of the united kingdom, as formerly of the princefs dowager of Wales, his majefty's mother, occupies a fituation in between Pall-Mall and St. James's park. The chief front towards the ftreet prefents the fingular incongruity of a lofty and highly enriched Corinthian portico, giving entrance into a low rufticated edifice. Between the houfe and the ftreet is a court-yard, bounded by a low wall, fuftaining an open colonnade, with an entablature. The interior has undergone many changes, and is fitted up in the moft coftly and fumptuous manner. The library, confervatory, and the armoury, are very fine and fplendid. The work juft referred to contains feveral beautiful prints of the different rooms; alfo a particular account of the houfe and its contents.

The ancient palace of *Somerfet-houfe* has now difappeared, being fuperfeded by the magnificent ftructures compofing Somerfet-place. Of the Savoy a few portions ftill exift, but much changed from their original deftination; and in a few years, perhaps, even the whole may be effaced.

The plan of Somerfet-place, as formed by fir William Chambers, was to comprehend within one vaft edifice proper apartments for tranfacting many branches of the national bufinefs; and to this purpofe, incomplete as it is, it is now applied. Befides thefe departments, Somerfet-place contains handfome fuites of rooms for the Royal and Antiquarian Societies, and for the Royal Academy of the Fine Arts. The front towards the Strand, of regular architecture, is fpacious and lofty; but, on the whole, having the air, as in fact it is, of the entrance to a ftructure of great extent and magnificence. The front confifts of nine arcades on the ground-floor, the three in the middle forming the entrance, by three colonnades fupported on coupled columns. Above the bafement is a range of ten Corinthian femi-columns extending over two ranges of windows. Above the three centre windows rifes an attic, with ftatues. The whole is, however, a very great work, and cannot fail, when beheld from the river, or the new bridge adjoining, to have a powerful effect on the fpectator. Situated on a rapid defcent to the river, the labour and expence of raifing the fquare to the level of the ftreet has been prodigious; and the fkill fhewn in conftructing the whole edifice well merits admiration.

Part of the old palace of Whitehall, as already noticed, may be traced in the building ufually called the Treafury; but that part which faces the parade in the Park is comparatively modern, and conftructed in a ftyle announcing ftrength as well as dignity and accommodation for bufinefs. Clofe to this edifice ftands that called the Horfe-Guards, becaufe a party of that clafs of troops daily do duty there. Conftructed on a plan and elevation intended to recal the idea of an antique fortrefs, it contains the chief departments of bufinefs comprehended under the title of the War-Office. The neighbouring office of Admiralty, fpacious and lofty, is greatly indebted to the fkreen erected by the Adams, by which the enormous portico is brought to bear apparently fome degree of proportion to the building.

The theatres of Drury-lane, Covent-garden, the Haymarket, and Opera-houfe, have been all noticed in the defcription of London. See LONDON.

At no great diftance from the magnificent pile of Somerfet-place, and fimilarly fituated over the Thames, ftands an extenfive range of buildings called the *Adelphi*. The erection of thefe, a vaft enterprife for private individuals, is the work of the celebrated architects, Meffrs. Adam. The terrace, which commands the river and furrounding buildings, and the ftreets and buildings, are elevated on arcades rifing from the edge of the water, adapted for warehoufes, and opening into roads leading up to the Strand. In the Adelphi is a handfome edifice, belonging to the Society for the Encouragement of Arts, Manufactures, and Commerce. The great hall exhibits a feries of paintings, unique in modern times, by James Barry. An eftablifhment of a peculiar character has lately begun to appear on the bank of the Thames, a fhort way above the extreme buildings of Weftminfter. This is the *Penitentiary*, defigned for the punifhment, employment, and reformation of offenders of fecondary criminality. When, by the emancipation of the Britifh colonies in North America, tranfportation of offenders to that country neceffarily terminated, the plan was adopted of removing them, to contribute to the colonization of the newly-acquired territories in the Afiatic feas. The fyftem, however, when applied to cafes of limited expatriation, being highly objectionable, the fcheme of the rifing eftablifhment has been approved, and its execution begun. The criminals are confined in circular buildings, fo conftructed that the overfeers may, from a central fituation, unfeen, obferve every room. The edifice will, when complete, form externally a hexagon, con-

confifting of fix of thefe circular divifions; the whole encompaffed with a wall, inclofing 18 acres of ground, and calculated to contain altogether from 1000 to 1200 prifoners. Some of them are already placed, and the beneficial effects of the inftitution on their general conduct has already been very perceptible. As a part of Middlefex, the proper prifons for criminals are thofe belonging to the county; but in Tothill-fields is a bridewell for the detention and temporary punifhment of petty offenders, under the charge of the magiftrates of the city and liberties. The charitable eftablifhments of Weftminfter for the education and maintenance of youth and the confolation of age, for the relief of difeafe and accidental calamity, are much more numerous and ufeful than fplendid. St. George's and the Middlefex hofpital, (not, however, properly within the town,) the Weftminfter infirmary, &c. are excellent inftitutions, fuperintended by medical gentlemen of the higheft profeffional reputation. Of the diftinguifhed private manfions of noblemen and others, it is impoffible here to do more than point out a few of the moft remarkable. Among thefe are Northumberland-houfe, the only refidence now remaining of our ancient nobility in the Strand; the duke of Marlborough's in Pall-Mall, erected by the nation for the great duke John; the duke of Norfolk's, St. James's fquare; earl Spencer's in St. James's place; Burlington-houfe; the duke of Devonfhire's and earl of Egremont's in Piccadilly; the marquis of Lanfdowne's in Berkeley-fquare; the earl of Chefterfield's in South Audley-ftreet; earl Grofvenor's in Upper Grofvenor-ftreet; the marquis of Anglefey's in Burlington-ftreet; the marquis of Stafford's, Cleveland-houfe. Thefe are fome of the beft, as far as the exterior is concerned; but many others might be noticed highly deferving of attention, particularly for the admirable paintings by the beft mafters with which they are enriched.

Bridges.—It is a remarkable fact, that, great and important as Weftminfter is, until the conftruction of the noble bridge of its own name, of 15 arches, and in total length 1223 feet, completed in 1750, it poffeffed no other mode of communication acrofs the Thames than by ferries, or by the embarraffed circuit of London-bridge. The opening of Blackfriar's-bridge was certainly a great accommodation for an extended portion of the town; but ftill fomething more was wanted, in a fpace between thofe bridges of no lefs than 3100 yards, or one mile and three quarters, of a moft populous and active metropolis. About mid-way of this interval was opened, on the 18th July, 1817, a new bridge, leading from the Strand between the Savoy and Somerfet-place, called the *Strand* or *Waterloo* bridge: it is a ftructure of a novel defcription in this country. The idea of it is not, however, new, having been frequently fuggefted, particularly by Gwyn in 1766. (For a particular defcription of this bridge, and the dimenfions of its various parts, we refer to the article WATERLOO.) The road-way is ftrictly horizontal on the level of the ftreet in the Strand, but much above the furface of the Surrey fhore, to which it defcends by a long and gentle flope. Each pier, as in Blackfriar's-bridge, is externally ornamented with two Tufcan columns fupporting a fquare projection. The bridge was opened on the anniverfary of the horrible carnage of Waterloo, and from this event it has been attempted to give it a name. In this cafe, however, as in that of what was formerly ftyled Pitt's-bridge, in London, in 1760, the public, unable to difcover even the moft diftant relation between the ftructures and the propofed appellations, know them only, as they muft naturally do, by their fituation, as Blackfriar's and the Strand bridges. This admirable work does great honour to the engineer and architect Mr. John Rennie, and to the judgment of the managers of the enterprife; and is, all circumftances of pofition, form, and materials confidered, without a parallel in Europe. Befides the Strand-bridge, another of a different kind has lately been conftructed over the Thames, juft a mile above Weftminfter-bridge, leading over from Tothill-fields to Vauxhall, and thence properly named *Vauxhall*-bridge. The architect, Mr. Walker, has divided the breadth of the river into nine apertures, covered by frames of caft-iron, refting on ftone piers. The road is not horizontal, but forms two gently inclined planes, meeting in a very obtufe angle in the middle. The length of this light and elegant bridge is 809 feet. A third bridge, not indeed immediately connected with Weftminfter, but of great importance to the metropolis, is now in progrefs. This is the Southwark-bridge, commencing between that portion of the town and the city of London, on the line of Queen-ftreet and King-ftreet to Guildhall. This extraordinary ftructure, defigned alfo by Mr. Rennie, confifts of three grand arches of caft-iron, in fegments of very large circles: the centre arch 240 feet in fpan, and the two others of 210 feet, each. To enable the reader to form a comparative idea of the bridges now mentioned, the following dimenfions of fome other remarkable bridges are fubjoined. London-bridge, (fee BRIDGE,) confifts of 19 very unequal arches; Southwark-bridge (the iron part), 730 feet long, and of three arches; Blackfriar's-bridge, 995 feet long, of nine arches; Strand-bridge, 1280 feet long, of nine arches; Weftminfter-bridge, 1223 feet long, of 15 arches; Vauxhall-bridge, 809 feet long, of nine arches. On the continent, the moft remarkable ftructures of this defcription are the celebrated horizontal bridge over the river Loire, at Tours, in the weft of France, in length 1335, and confifting of 15 elliptic arches; the bridge over the Moldaw, at Prague, in Bohemia, 1700 feet long. Thefe, however, are all far outdone by the antique bridge over the Rhone, at St. Efprit, in the fouth of France, confifting of a multitude of fmall arches, fupporting a very narrow road-way, extending in all nearly to 3000 feet. This bridge has the peculiarity, that, inftead of being ftraight, it is compofed of two lines forming an obtufe angle, turned againft the current, as if the better to withftand its violence.

Literary and fcientific Inftitutions.—Thefe have already been noticed in the article LONDON, to which the reader is referred. It will always be a peculiar honour for the Britifh nation in general, and to the metropolis in particular, that, with very few exceptions indeed, all thofe valuable inftitutions for the promotion of learning, fcience, and the arts, which add fo much fplendour to the capital, owe their origin, their maintenance, and their reputation, to the voluntary exertions, perfonal and pecuniary, of private individuals. The two principal exceptions in London and Weftminfter are the *Britifh Mufeum*, and the *Academy of Painting, Sculpture, and Architecture;* but from their nature, without public aid, neither of thefe inftitutions might ever have been eftablifhed. (See MUSEUM.) The Britifh Mufeum is in regular and rapid progrefs, in the acquifition of ftores of high importance in the departments of natural hiftory, literature, and art, to which it is devoted. The *Elgin marbles*, or the venerable monuments of Grecian fculpture, refcued by the earl of Elgin, during his embaffy at the Ottoman porte, from barbaric neglect and deftruction, in their original pofition in Athens, are objects of attraction and importance unparalleled in Weftern Europe. Of the Britifh Mufeum, in general, it is but juftice to obferve, that, in no fimilar eftablifhment, can more attention be fhewn to facilitate the refearches, literary or fcientific perfons, of all who refort to the treafures it contains.

The population of Weftminfter very fenfibly fluctuates, according to the feafon of the year. From October to July, while the parliament is affembled, the courts of law are fitting, and the places of amufement are open, the town is fully inhabited. During the other months, even thofe whofe bufinefs is ftill tranfacted in town retire to their villas or quarters, in the furrounding villages and country. A hundred years ago, the inhabitants were computed, but furely overrated, at 130,000: by the laft returns to parliament in 1811, they amounted to 62,085, occupying 17,555 houfes.

The books examined for the foregoing account, and to which the reader is referred for more minute particulars, are, Antiquities of Weftminfter; the literary part by J. S. Hawkins, efq.; plates from drawings by J. T. Smith; 1 vol. 4to. 1807. The Hiftory of Henry VII.'s Chapel, by J. Britton, with plan, views, elevations, &c.; in vol. ii. of Architectural Antiquities of Great Britain. The Hiftory and Antiquities of the Abbey Church of St. Peter at Weftminfter, 4to. 1818, &c., by E. W. Brayley; with numerous plates from drawings by J. P. Neale. The Hiftory of the Abbey Church of St. Peter's, Weftminfter, its Antiquities, and Monuments; in 2 vols. 4to., with 63 engravings; publifhed by Mr. Ackermann. An Inquiry into the Time of the firft Foundation of Weftminfter Abbey, &c., by R. Widmore, 4to. 1743. Alfo, The Hiftory, &c. of the Abbey Church, by the fame author, 1751. Weftmonafterium, or the Hiftory and Antiquities of the Abbey Church of St. Peter, Weftminfter, by John Dart; 2 vols. fol. 1723. The general hiftories have been already referred to in the article LONDON.

WESTMINSTER, a town of Maffachufetts, in the county of Worcefter, containing 1419 inhabitants; 55 miles N.W. of Bofton.—Alfo, a poft-town of Vermont, in the county of Windham, containing 1925 inhabitants; 18 miles N. of Brattleborough.—Alfo, a town of Maryland, with a poft-office; 26 miles N.W. of Baltimore.

WESTMINSTER-*Hall*, an ifland in the ftraits of Magellan, fituated to the N.E. of Cape Pillar. S. lat. 52° 34'. W. long. 76° 16'.—Alfo, an ifland in the Mergui Archipelago. N. lat. 10° 42'.

WESTMORE, a town of the ftate of Vermont, in Effex county, containing 71 inhabitants; 65 miles N. of Norwich.

WESTMORELAND, WESTMORLAND, or *Weftmereland*, a northern county of England, furrounded by parts of Durham and Yorkfhire to the N., N.E., and E.; by Lancafhire to the S. and to the S.W.; and by Cumberland on the W. and N.W. The greater part of the boundary line is artificial; but at the S. and S.W., rivers and lakes conftitute natural lines of demarcation. This diftrict is fuppofed to have derived its name from being a weftern moorifh country; perhaps it was the land of the moors or lakes in the weft. It formed a part of the territory of the *Brigantes* in that diftrict occupied, according to Richard of Cirencefter, by the *Voluntii* and the *Siftuntii*. The *Brigantes* were the principal inhabitants of the Roman province *Maxima Cæfarienfis;* and during the heptarchy were included in the extenfive kingdom of Northumberland. In the time of Edward the Confeffor, this kingdom was divided into fix fhires, of which one was called "*Appulbifchire*, to which belonged the land of Weftmoreland." In this divifion, however, Kendal and its diftrict were not included; for long after the Norman Conqueft, they were reckoned to belong to the hundred of Lonfdale, in Lancafhire. Of the Roman eftablifhments in Weftmoreland, many noticeable veftiges are to be found in ftations, forts, roads, infcriptions, and other remains. Among the ftations, or towns, may be mentioned *Amboglana*, a name fuppofed to be ftill preferved in Amblefide, at the N. end of Windermere; but Horfley places *Dictis* at that town. At any rate, bricks, urns, coins, and other relics, fufficiently prove it to have been occupied by the Romans. *Verteræ*, another Roman ftation, was fituated where now ftands Brough-under-Stanmore, a name announcing an ancient fortification. *Aballaba* feemed naturally to have given rife to the modern name of Appleby; but no Roman remains have ever been found at that place, although it be undoubtedly of confiderable antiquity. *Galacum* is by Camden placed at Whellep; but by later writers near Appleby. *Brovacum* is probably Brougham caftle, near Penrith. This ftation has often been confounded with *Brovonacæ*, of which remains exift in Kirkbythore. This ftation Whellep or Whelp caftle lies in the middle of the village, and is commonly called High Burwens. It occupies an advantageous pofition; the extent from weft to eaft is about 160 yards. The foundations of the vallum are very plain. Among the infcriptions found in it is one *Fortunæ Servatricæ*. A branch of the great Roman road, called the Watling-ftreet, paffed through the county from Stanemore to Brougham caftle; and until the modern turnpike-road was made, the former was very confpicuous almoft all the way. Between Brough and Kirkby, parts of it are ftill to be obferved; keeping, as was the practice of the Romans, a ftraight courfe, regardlefs of difficulties. This road meafured about fix yards in width, and is defcribed to have been formed, in many places, by three courfes of large fquare ftones. Near the northern border of the county, and not far from Kirkbythore, is a large encampment, attributed to the Romans, and meafuring about 300 yards in length, by 150 in breadth. It is reprefented as having twelve entrances, with baftions to each; but this is improbable. Some topographers defcribe a few of the antiquities of the county as of Celtic, or Druidical origin; particularly "a fort of Druidical place of worfhip near Shap." Maybrough caftle, and Arthur's Round Table, near Penrith, are referred to the Britifh era. There are alfo feveral cairns, or heaps of loofe ftones, in the county. At Kirkbythore, a Roman road, called the Maiden-way, branched off, and paffing over the lower end of Crofs-fell, terminated at Caervorran, in Northumberland. Roman infcriptions have been found in various parts of the county. One in particular was difcovered at Kirkbythore, infcribed *Deo Belatucadro*, a local divinity probably of the original Britons. In 1739, at the fame place, was found a ftone infcribed *Jovi Serapi*. In the manor of Milbourne was found an altar to *Silvanus*, within a round fort furrounded by deep ditches, called Green-caftle. This county is divided into the two baronies of Kendal and Weftmoreland, the latter of which is occafionally called the barony of Appleby; and thefe again fubdivided into the four wards of Eaft, Weft, Kendal, and Kirkby Lonfdale. In ancient times, the Kendal barony was deemed part of the county of Lancafter. In the Domefday furvey, an account is taken of fome places in the barony of Kendal, with fome neighbouring property in Lancafhire and Yorkfhire; but the Weftmoreland diftrict is unnoticed in that record, and thence fuppofed to have been uninhabited and wafte at the time of the Conqueft. The Kendal barony is in the diocefe of Chefter, and confifts of two rural deanries; whereas the other barony is within the diocefe of Carlifle, and confifts of

 one

one rural deanry. The whole county contains only thirty-two parishes. According to the census of 1811, these contained 9064 houses, and 45,922 inhabitants.

The general appearance of Westmoreland is marked with some of the strongest features in nature; immense tracts of mountains, beautiful but contracted valleys, extensive lakes, and large rocky districts, which contain many high, steep, and bulging crags. The county is not only encircled with mountains, but the greatest part of its interior surface is swelled into hills. A long range of heavy-looking hills bounds the eastern side of the county; in front of which is an extensive tract of tolerably level ground. The rest of Westmoreland is almost wholly hill and dale. The farm-houses and those of the small villages, covered with blue slate and whitened with lime, are seated about the bases of the hills, with their small irregular fields spreading up the sides of the mountains, and almost universally divided with stone-walls. This last circumstance gives the country a naked appearance; but the numerous tracts of woodland interspersed tend to enliven the scene. Every dell or hollow has its little brook, and the smallest of these are plentifully supplied with fish. Several low heathy commons are seen towards the eastern side of Westmoreland; and the western part is characterised by high rugged prominences, and even some rocky plains, small coppices, and a large extent of low flat peat-moss; on the north, the fine woods about Lowther add a striking feature to the landscape. Such are the brief but general outlines of the picture: we proceed to particularise some of its peculiar characteristics, the most prominent of which are its *Mountains*. These are provincially called fells, of which the following are the most noted.

Farlton-knot, near the borders of Lancashire, is a very protuberant lime-stone rock; from the Kendal road, near Burton, it is said to have very much the appearance of the rock of Gibraltar.

Whitbarrow-scar is also a very high rock, and in some parts presents a perpendicular face of solid lime-stone. It rises its grizzly front between Milnthorp and Cartmel. The high road leads along its base, whence it presents a grand, and in some places a tremendous aspect.

Langdale-pikes, in the western corner of the county, are conical hills of great height, with pyramidal rocky tops, and are situated in the interior parts of a very mountainous district; their sides and bases are verdant, and have formerly been covered with wood.

Hill-bell is also a high conical-topped mountain, about four miles east from Ambleside.

Harter-fell, High-street, and Kidsey-pike, are stupendous heights, within a few miles of the southern end of Hawswater. From the top of High-street, thirteen lakes, and the sea in several directions, may be seen.

The chain of hills on the east, which is continued north and south through other counties, presents a heavy and regular appearance; and they have mostly mossy and heathy tops, except two or three conical green hills opposite Appleby. They are in general picturesque; some with abrupt declivities, or rocky fronts, form high precipices, or in bulging shattered crags project over the vales in a frightful manner; while others shew smooth, verdant, and swelling surfaces, beautifully spotted with flocks of sheep and herds of cattle.

There are few Caves in Westmoreland; one, however, is to be found at Dun-fell, bordering on Cumberland, and is of considerable extent. So intricate are the different passages and chambers of this capacious cave, that the Rev. William Richardson is said to have been seven hours in examining its varied parts. He describes the roof in some parts to resemble pointed arches, in others flat surfaces: he found in some places the *stalactites*, and pieces of *rhomboidal spar*. He travelled nearly two miles in a right line, and discovered evident marks of some of the chambers having been filled with water. The highest part of the vault is rather more than 25 yards; the breadth in some places about 150 yards; in other parts there was scarcely height sufficient to creep through the hollow. Some other visitors have mentioned the astonishing lustre of the spar with which these vaults are encrusted. Nicholson and Burn, in their "History of Westmoreland," mention three pits, one of which is generally considered unfathomable. In the season of salmon smelts, these pits abound with those smelts, when they are to be seen also in the river Kent, which induces a belief that they arrive from thence in subterraneous passages.

Rivers.—Although the rivers or streams, (provincially called becks,) are numerous, they are but small, and mostly rise within this district. Only three of these are sufficiently important to retain their original names from their sources to the sea. These are, the Eden, the Lune, and the Kent, or Ken. The first springs in Mallerstang, and runs north, and having received in its course, besides many lesser streams, the conjoined rivers of Lowther and Eamont, enters Cumberland, which county it traverses in its course to the sea, at Rowcliff. The Lune, or Lun, hath its source in Ravenstonedale, and passing to the south, through a fine vale, to which it gives name, enters the county of Lancaster, formerly called Loncaster. The Ken, or Kent, has its origin in Kent-mere, and runs through a valley, called Kendale; passes the town of Kendal, and empties itself in the sea at Cartmel bay. The different rivulets from the eastern district empty themselves into the Eden, which, during its course through this county, receives its principal supplies. An irregular line, drawn east and west through the centre of Westmoreland, divides the direction of its several rivers: those on the north falling into the Eden, either before or at its entrance into Cumberland, except two or three small branches of the Tees, which rise on the eastern ridge of hills on the borders of the county of Durham. The rivers on the southern parts take a contrary direction, and enter the sea at different places.

The Lowther has its source in the Moors, above Wetsladdale, and passing Rosgill-hall, there unites with Swindale-beck, which rises near the slate-quarries; with the augmentation of a few other streams, it joins the Eamont.

The Eamont emerges from Ulls-water, and forms a boundary to parts of this county and Cumberland; and after being augmented by the waters of the Lowther river, which descends from the centre of the county, it joins the Eden as it enters Cumberland.

The Loyne, or Lune, has been described in a previous volume of this work, under LANCASHIRE.

The Crake, a brook or rivulet, descending in several heads from a variety of dells on the side of Brackenthwaite-fell, passes through a very extensive peat-moss to the Ken, just before its influx to the sea.

The Winter, or Winster-beck, forms the boundary between the lower part of Westmoreland and Lancashire. It rises on the hills about two miles east from Windermere lake, and directs its course southwards, when it discharges itself in an estuary of the sea.

The Trout-beck is a brook issuing from the mountain High-street, and unites itself with Windermere lake.

Rothay springs on the borders of Cumberland, among a number of high mountains; it runs several miles westward, and receives various streams in its progress to Grasmere.

Lakes.—Westmoreland is deservedly celebrated for its fine

fine lakes. Among thefe, Windermere, or Winandermere, and Ulls-water, merit particular attention for fize, and for the picturefque beauty of the fcenery which furrounds them. They may be, and are by competent judges, regarded as unequalled in the kingdom.

Winandermere is a large lake of about ten miles and a half in length, by a breadth of from one to two miles; including an area, or fheet of water, of nearly 4534 acres. Its depth is in one place 23 fathoms, in a fecond 29, and in a third 31 fathoms. Four mountain ftreams, or rivers, fupply this lake, and it is fingular that its waters fcarcely ever appear to be augmented or decreafed. "Even in the moft violent rains, when the country is drenched in water, when every rill is fwelled into a river, and the mountains pour down floods through new channels, the lake maintains the fame equal temper; and though it may fpread a few yards over its lower fhores, (which is the utmoft it does,) yet its increafe is feldom the object of obfervation; nor does the feverity of the greateft drought make any confiderable alteration in its bounds." In this lake are thirteen iflands, the largeft of which is now called Curwen's ifland. It contains about 27 acres of land, which are laid out in pleafure-gardens, walks, &c. around a very handfome manfion belonging to Mr. Curwen.

Ulls-water, part of which is known by the name of Oufemere, is a large and long lake, fituated at the north-weftern extremity of the county, and partly in Cumberland. Next to Windermere, it is the largeft fheet of water in this part of England. It covers an area of about nine miles in length from N.E. to S.W. by two in the broadeft part, though the general width rarely exceeds a mile. Its fides are very irriguous, and from its fhores the mountains rife in various bold, picturefque, and romantic forms; occafionally ftarting abruptly from the lake, and in other places afcending by gradual flopes. Towards the fouth-weftern end the mountains are on the grandeft fcale. On the northern and weftern fides the fcenery is moftly rocky and woody. In fome places its waters are from 29 to 35 fathoms deep. It abounds with trout, perch, fkellies, and eels; alfo fome char, and a large fpecies of trout, fome of which have been caught of ten pounds weight. In its higheft part are a few fmall rocky iflands.

Haws-water, in beauty and extent, ranks next. This lake is fituated between Shap and Ulls-water, in a mountainous diftrict; it is about three miles in length, and in breadth from a quarter to half a mile. The hills on the eaft fide are high and rocky, and partially covered with wood. Thofe on the weft are alfo high, but have a portion of low cultivated ground along the margin, which is divided into fmall farms. The narroweft part of this lake is faid to be fifty fathoms deep.

Grafmere lake is a fmall but beautiful fheet of water, about a mile in length, and nearly half a mile broad, having its margin indented with numerous fmall bays with lofty and rocky eminences. Its fituation is a few miles north of Amblefide. Near its centre is a fmall green ifland. The poet Gray defcribes this lake and its fcenery in terms of high panegyric. "After paffing the romantic mountain of Helm-Crag," he fays, "opens one of the fweeteft landfcapes that art ever attempted to imitate. The bofom of the mountains here, fpreading into a broad bafon, difcovers in the midft Grafmere-water; its margin is hollowed into fmall bays with bold eminences, fome of rock, fome of turf, that half conceal and vary the figure of the little lake they command. From the fhore a low promontory pufhes itfelf far into the water, and on it ftands a white village, with the parifh-church rifing in the midft of it."

South of this, in the fame vale, is Rydal-water, a fmall lake nearly a mile in length, and interfperfed with wooded iflands. Its water is fhallow, and abounds with reeds.

On an elevated fituation, nearly two miles weft from Amblefide, is a fmall lake called Elter-water.

Broad-water is a fmall lake half a mile long, and a quarter of a mile broad, fituated a few miles above Ulls-water.

Kentmere-tarn, a piece of water upwards of a mile long, and nearly half a mile broad, is fituated in Kentmere-dale.

Skeggles-water, a very fmall lake, three miles north-eaft of Kentmere-tarn, is embofomed in the mountains of Longfleddale.

Sumbiggin-tarn, and Whin-fell-tarn, are fmall pieces of water; the former four or five miles eaft from Orton, well fupplied with eels and a red trout, refembling char; and the latter about five miles north-eaft from Kendal.

The *foil* of Weftmoreland is moftly dry and gravelly; but in the eaft and north, fand and hazel-mould are found. Clay prevails on a few farms towards the Eden and the eaftern hills; and a moift foil appears in fome northern diftricts. Peat-mofs abounds on the tops of fome high mountains, confifting of a dry foil upon a hard blue rock, provincially called *rag*. The foil that lies upon a ftratum of lime-ftone is efteemed the moft profitable.

The Roads in Weftmoreland, from the rocky nature of the country, are very firm and good. They are generally formed to wind gradually round the fides of the hills and along the vales, in fuch a manner, that the declivities of the former are moftly avoided. The principal roads leading through this county are thofe from Scotland and Cumberland to London, and the fouthern parts of England. Thefe roads are united through Cumberland, but divide near Penrith, on the confines of Weftmoreland: one turns eaftwards, over Stainmoore, and through the centre of Yorkfhire, to London, &c.; the other proceeds directly fouth, through Kendal, Lancafter, &c. to Manchefter, Liverpool, Wales, the weftern counties of England, and alfo to London. A branch from this road goes through Kirkby-Lonfdale to the manufacturing towns in the Weft Riding of Yorkfhire, and other fouthern diftricts.

Before the rebellion of 1715, the public roads of this county were almoft impaffable; but in that year the government planned feveral new roads: very little, however, was done to them before the more ferious infurrection of 1745. This event impelled the government to direct fome effectual repairs to be made. In 1774 an act of parliament was obtained to make a turnpike-road from Bowes to Brough. In this year, the firft ftage-coach from London to Glafgow was eftablifhed to run this road. A mail began to travel through Kendal, &c. from London in 1786. Since which time the great roads have been kept in very good repair.

With the exception of fome trifling veins of lead ore, few minerals have been found in the eaftern part of this county. Coal is obtained only in the fouth-eaftern extremity of Weftmoreland, except an inferior quality called *crow-coal*, procured in the neighbourhood of Shap.

The county affords various forts of valuable ftone; particularly lime-ftone, marble, gypfum, blue flate, and free-ftone. There is great abundance of lime-ftone, except among the weftern hills.

Marble of a beautiful kind was difcovered a few years ago on the banks of the river Kent, near Kendal, and has been worked with fuccefs. The fame vein has alfo been found on the oppofite fide of the river.

Blue flate of various forts is dug from the rocky hills on the

the weftern fide of the county; though great quantities are ufed in the country, yet much of the better fort is fent to London, Liverpool, Hull, and other large fea-ports. Beds of lime-ftone are generally incumbent on beds of flate.

The buildings of Weftmoreland are diftinguifhed for their neat appearance. The houfes are moftly built with lime-ftone, or blue rag; thatched roofs are common, but flate is more generally ufed. In farm buildings, the barn is ufually built upon the cow-houfe and ftable, a method which requires the flope of a hill, as carts are carried along a level on one fide into the barn. As very little corn or hay is ftacked without, the barns are neceffarily very fpacious. There are many noblemen's and gentlemen's feats in this county; and alfo fome pleafant villas which ornament the borders of the lakes.

The commerce of Weftmoreland is not extenfive. Its exports are chiefly a coarfe woollen cloth, ftockings, flates, tanned hides, gunpowder, hoops, charcoal, hams, wool, fheep, and cattle.

The manufactures of the county confift of filk and worfted waiftcoat-pieces, knit worfted ftockings, flannels, tanned leather, and gunpowder.

Formerly the whole county was governed by military tenure, *i. e.* by homage, fealty, and cornage, "which laft drew after it wardfhip, marriage, and relief; and the fervice of this tenure was military fervice." Cornage appears to have been peculiar to the border-fervice againft the Scots. Cornage, horngeld, and noutgeld, were probably fynonymous, and implied annual payments of horned cattle, to provifion the garrifons. The lord's rent was called white-rent, probably from its being paid in filver. Scutage, or fervice of the fhield, was another compenfation in money, inftead of perfonal fervice againft the Scots.

Some veins of *copper* ore have been found and worked in different parts of the county; but the product has not been found fufficient to defray the expence of workmanfhip. Before the year 1704, great quantities of *lead* were found near Hartley. Some mines at Dunfell have proved very productive of this metal for many years, but latterly there has not been much ore found. At Dufton are fome rich and productive lead mines, belonging to the earl of Thanet. There are fome confiderable mines at Greenfide, near Paterdale, and at feveral other places in the county. This metal is obtained in various quantities.

Crofs-fell, the higheft of the chain of mountains which extend along the eaftern frontiers of the county of Weftmoreland and Cumberland, is faid by Robinfon, in his Natural Hiftory of the County, to have been formerly called Fiend's-fell, from evil fpirits which are faid in former times to have haunted its fummit, and continued their haunts and nocturnal vagaries upon it until St. Auftin, as is reported, erected a crofs, and built an altar upon it, whereon he offered the Holy Eucharift, by which he countercharmed thofe hellifh fiends, and difturbed their haunts. Since that time it has been named Crofs-fell; and unto this time there is a heap of ftones on the fummit, which bears the name of Crofs-fell.

Upon this and the adjoining mountains occurs the phenomenon, called the Helm-wind; which, in fpite of St. Auftin's charms, continues its vagaries on its ancient haunts. It is peculiar to this diftrict, and the confines of Lancafhire and Yorkfhire, about Ingleborrow, Pendle, and Penigent. It alfo occurs on Wildboar-fell, in Ravenftonedale; and is moft prevalent in the months from October to April. The appearances attending it are a whitifh cloud hanging half way down the mountains, but keeping an exact parallelifm with every plane, depreffion, and elevation of their tops, which it covers as with a helmet. Above this appears the blue fky, and then a white cloud, called the helm-bar, from an idea that it repreffes the fury of the ftorm: it continues in a tremulous agitated motion till it difperfes; and then the hurricane iffues forth, roaring along the fides of the hills, and frequently extending two or three miles from their fides. The following are the heights of the principal mountains, as afcertained by Mr. Dalton. Helvellyn is 1070 yards high. A deep drift of fnow was feen on this mountain on the 12th of July, 1812. Bowfell and Rydal-head are each 1030 yards in height. The High-ftreet is 912 yards high. On its fummit are annual horfe-races, and other fports, on the 10th of July, to which every one brings the fheep that have ftrayed into their heathing-ground, for their owners to challenge.

It appears that different grammar-fchools were eftablifhed in this county previous to the diffolution. Edward VI. was patron of the fchool at Kendal; and queen Elizabeth founded fchools at Appleby, Kirkby Stephen, and Kirkby Lonfdale. From thefe feminaries many learned men have been diftributed over England, fome of whom have obtained eminence in the literary world. They have alfo contributed towards the eftablifhment of other public fchools in the county. Seminaries are, therefore, eftablifhed in nearly every village in Weftmoreland.—The Hiftory and Antiquities of the Counties of Weftmoreland and Cumberland, by Jofeph Nicholfon, efq. and Richard Burn, LL.D. 2 vols. 4to. 1778. An Effay towards a Natural Hiftory of Weftmoreland and Cumberland, by the Rev. Thomas Robinfon, 8vo. 1709. General View of the Agriculture of the County, by Andrew Pringle, 4to. 1794. Obfervations relative chiefly to Picturefque Beauty of the Mountains and Lakes of Weftmoreland and Cumberland, by the Rev. William Gilpin, 2 vols. 8vo. 1788. A Survey of the Lakes, by James Clarke, folio.

Westmoreland, a poft-townfhip of New York, in Oneida county; 10 miles W. of Utica, and 107 miles from Albany. Its waters are fmall; its furface very level, but the foil is very rich and fertile. It has a church for Congregationalifts, and a competent number of common fchools. In 1810, the population was 1135, and the fenatorial electors were 141.—Alfo, a county of Pennfylvania, containing 26,392 inhabitants, of whom 20 are flaves.—Alfo, a county of Virginia, containing 8102 inhabitants, of whom 4080 are flaves.—Alfo, a townfhip of New Hampfhire, in the county of Chefhire, on the E. bank of the Connecticut, containing 1937 inhabitants; 5 miles N. of Chefterfield.

WEST NANTMILL, a townfhip of Pennfylvania, in the county of Chefter, with 1188 inhabitants.

WEST NORTHERN LIBERTIES, a town of Pennfylvania, in the county of Philadelphia, containing 9795 inhabitants.—Alfo, a townfhip of the fame, containing 168 inhabitants.

WEST NOTTINGHAM, a townfhip of Pennfylvania, in the county of Chefter, with 642 inhabitants.

WESTOE, a townfhip of Durham, with 2900 inhabitants; 2 miles S. of Shields.

WESTON, a townfhip of Connecticut, in the county of Fairfield, with 2618 inhabitants; S. of Fairfield.—Alfo, a town of Vermont, in the county of Windfor, containing 629 inhabitants; 30 miles N.N.E. of Bennington.—Alfo, a town of the ftate of Maffachufetts, in the county of Middlefex, containing 1008 inhabitants; 12 miles W. of Bofton.

WEST PENNSBOROUGH, a townfhip of Pennfylvania, in the county of Cumberland, with 1264 inhabitants.

WESTPHALIA, a circle of Germany, bounded on the

the N. by the Dutch ſtates, on the W. by the Netherlands, and elſewhere by the circles of the Rhine, Upper and Lower. The ancient Saxons were divided into Weſtphalians, Angrians, and Eaſtphalians. The people inhabiting between the Weſer and the Rhine, were called *Weſtphalians*, and the tract of country inhabited by them, has from thence been called *Weſtphalia*. The duchy of that name, in the electoral circle of the Rhine, conſtituted a part of this country; but the circle of Weſtphalia compriſed alſo under it other countries, which never belonged to the above-mentioned Weſtphalia. And thus we muſt carefully diſtinguiſh from each other the three denominations, which are, the circle of Weſtphalia, Weſtphalia itſelf, and the duchy of that name. Formerly, not only certain ſtates were reckoned in this circle, which at preſent no longer belong to it, as Utrecht, Guelderland, Zutphen, the biſhopric and city of Cambray; but in other reſpects, alſo, the ancient and the modern liſts of the countries of the Weſtphalian circle differ greatly from each. The following appeared to be ſtates of the Weſtphalian circle before the peace of Luneville, *viz.* the biſhoprics of Paderborn, Munſter, Liege, and Oſnabruck; the duchy of Verden; the principality of Minden; the abbeys of Corvey, Stablo, Werden, Cornelius Munſter, Eſſen, Thorn, and Hervorden; the duchy of Cleves, with the county of Mark; the duchies of Juliers and Berg, Naſſau Siegen, and Naſſau Dillenburg; the principalities of Eaſt Frieſland and Meurs; the counties of Sayn, Wied-Runkel, Schauenburg, Oldenburg, Delmenhorſt, Lippe, Bentheim, Tecklenburg, Hoya, Virnenburg, Diepholz, Spiegelberg, Rietberg, Pyrmont, Gronsfeld, Reckheim; the ſigniories of Anhalt and Winneburg; the county of Holzapfel; the ſigniories of Witten, Blankenheim, Geroldſtein, Gehmen, Gimborn and Neuſtadt, Wickerad, Mylendonk, and Reichenſtein; the county of Kerpen and Lommerſum; the ſigniory of Schleiden, and the county of Hallermund, to which in the matricula are reckoned moreover to belong the ſigniories of Dyck, Severn, Kniphauſen, Keyl, Mechernick, Eyſs, Schlenacken, Wylre, Richold, Dreyz, and Schonau, together with the cities of Cologne, Aix-la-Chapelle, and Dortmund. The ſummoning princes, and directors of the circle, were the biſhop of Munſter, and with him alternately the electors of Brandenburg and Palatine, as dukes of Cleves and Juliers, both of whom in this directory enjoyed together but one voice. The diets of the circle were uſually appointed at Cologne. The archives belonging to it were kept at Duſſeldorf. The contribution of this circle in men and money, to the aids of the empire, was made equal to the contributions of Upper and Lower Saxony, Burgundy, and Swabia, and rated at ſomewhat more than the ninth, but leſs than the tenth part of the whole ſum granted by the empire. With reſpect to religion, this circle was one of the mixed. Indeed the Catholic ſtates uſed to nominate two, and the Proteſtant alſo the like number of aſſeſſors, to aſſiſt at the Imperial and chamber court of the empire. By the peace of Luneville, all that part of the circle which lay on the left bank of the Rhine, was ceded to France.

Westphalia, (*Duchy of*,) a country of Germany, bounded on the N. by the biſhopric of Munſter and county of Lippe, on the E. by Paderborn, Waldeck, and Heſſe; on the S. by Witgenſtein, Naſſau, and Berg; and on the W. by Berg and Mark; about forty miles in extent from N. to S. and thirty-two from E. to W. Agreeably to its natural ſituation, this county is divided into three parts. The firſt of theſe, called the *Hellwege*, is low, and produces plenty of corn and other neceſſaries, with a ſufficient breed of cattle and ſalt-ſprings. The ſecond is the *Haarſtrank*, which ſtands ſomewhat higher, between *Hellwege* and the *Sunderland*, and has indeed a good, but not ſo fruitful a ſoil as the *Hellwege*. The third is the *Sunderland*, commonly called the *Surland*, or *Saurland*, which conſiſts of hills and vales. This tract indeed is neither of great, nor even a ſufficient fertility in corn; but, on the other hand, it has fine woods and meadows, together with a good breed of cattle, game, and fiſh, in particular trout, as alſo plenty of iron ore, calamy, lead, copper, ſilver, and gold. The principal rivers are, the Ruhr, the Lenne, the Dimel, and Lippe. The duchy of Weſtphalia contains in it thirty-five towns. Henry, duke of Bavaria and Saxony, being put under the ban by the emperor Frederic I. in the year 1180, the latter made a donation of the duchy of Weſtphalia, as alſo a part of the duchy of Engern, which belonged to the former, to the archbiſhopric of Cologne, and inveſted therewith the archbiſhop Philip; concerning which donation, in the ſame year, a record, or inſtrument, was executed at Gelnhauſen, and the ſaid donation confirmed afterwards in the year 1200, by the emperor Otho IV., as alſo in the year 1204, by the emperor Philip. In the year 1368, Godfrey, the laſt duke of Arenſberg, and his conſort Anne, ceded the county of Arenſberg to the archbiſhopric of Cologne; and, in the year 1371, the emperor Charles IV. inveſted the archbiſhop Frederic therewith. The county was afterwards added to the ſhare of the duchy of Engern. The archbiſhops and electors of Cologne governed this duchy, till the year 1442, by marſhals, but afterward under the direction of an electoral bailiff. Brilon is the capital. In 1802, the duchy of Weſtphalia was given to the prince of Heſſe Darmſtadt.

Westphalia, a kingdom formed of ſeveral principalities, taken from the king of Pruſſia, after the battle of Friedland, and acceded to at the peace of Tilſit. Weſtphalia is divided into eight departments. 1. That of the Elbe; conſiſting of the greater part of the duchy of Magdeburg, with the Old Mark of Brandenburg. Its population is 253,000 ſouls: the chief place Magdeburg. 2. That of Fulda: the chief place Caſſel. It is compoſed of a part of Lower Heſſe, of the countries of Paderborn, Corvey, Minden, &c. Its population 239,502 inhabitants. 3. That of the Harz: chief place Heiligenſtadt. It conſiſts of Eichsfeld, of the cities of Mulhauſen and Nordhauſen, of the principalities of Hohenſtein, Grubenhagen, Blankenburg, &c. Its population is 210,989 ſouls. 4. That of the Leine: chief place Gottingen. It is compoſed of a part of the principality of Grubenhagen, and of the countries of Hildeſheim, Brunſwick, and Heſſe. Its population is 145,537 ſouls. 5. That of the Ocher: chief place Brunſwick. It is compoſed of the greater part of the duchy of Wolfenbuttel, and the biſhopric of Hildeſheim. Its population is 267,878 ſouls. 6. That of Saal: chief place Halberſtadt. It is compoſed of the principalities of Halberſtadt, Wernigerode, Quedlinburg, &c. The population is 206,222 ſouls. 7. That of the Werra: the chief place Marburg. It conſiſts of Upper Heſſe, the Hersfeld, &c. The population is 254,000 ſouls. 8. That of the Weſer: the chief place Oſnabruck. It conſiſts of the biſhopric of Oſnabruck, a part of Schaumburg; and its population is 334,000 ſouls.

Westphalia-*Ham*. See Ham.

WESTPOND Plantation, in *Geography*, a town of the diſtrict of Maine, in the county of Kennebeck, containing 481 inhabitants.

WESTPORT, a townſhip of Maſſachuſetts, in the county of Briſtol, incorporated in 1787, with 2585 inhabitants; 60 miles S. of Boſton.

Westport, a sea-port and post-town of Ireland, in the county of Mayo, situated on a beautiful bay, wooded to the water's edge, in the S.E. angle of that large haven called Clew bay, founded by the late marquis of Sligo, whose residence was within half a mile of it. Westport is a neat regular well-built town, 123 miles W.N.W. from Dublin, and $8\frac{1}{2}$ S.W. from Castlebar. The following account, extracted from a late report to the Linen Board by Peter Bernard, esq. shews what judicious indulgence and liberal protection on the part of a landlord, assisted by the exertions of an industrious individual, may do. Were the example universally imitated, many squalid and decayed villages would quickly assume a more comfortable and exhilarating aspect. "The establishment and success of the linen manufacture in Westport, is due to the persevering attention of the marquis of Sligo and Robert Patten, esq. The latter, most fortunately for the neighbourhood, settled here in the year 1787; at that period Westport was a very inconsiderable town, containing but few houses, and its general market attended only by two or three hundred persons; now it is a beautiful well-built town, with 3700 industrious inhabitants, and many gentlemen of the highest respectability residing in it. Its market at present (1817) is attended by from 4000 to 5000 persons, whose manners, appearance, and dress, bespeak most strongly the happy effects of a well-regulated system of industry." "The first linen-market was held in 1790. For the first five years it produced only eight webs *per* week, and Mr. Patten was the only buyer; but he, by giving fair and liberal encouragement to the weavers, gradually but firmly advanced the trade, which now stands on a foundation not likely to be shaken. An accession of settlers from Ulster in the years 1797, 98, and 99, who brought their looms, some capital, and their accustomed habits of industry, completed what Mr. Patten had so fortunately begun." At present the market is held every Thursday in a spacious linen-hall built by the marquis of Sligo, where the goods are measured by a machine. The linens are all seven-eighths of three different qualities, and are all brought to market in a brown state. There are sold weekly about 200 webs, the value of which is estimated at above 20,000*l.* *per annum*. There are about 150 weavers and about 20 buyers, two of whom have bleach-greens at Westport. Mr. Patten has also successfully introduced at Westport the provision and corn-trade, and also the oil business, which is carried on to a considerable extent, and gives employment in the season to a great number of fishermen and boats. In March and April a number of fish appear off the coast, which, from their appearing only on a sunny day, the inhabitants call *sun-fish*, though they differ from the fish usually so called. The fishermen strike these with harpoons, then cut out the liver, and abandon the rest of the fish, the liver being sufficient to load one boat of four tons burden. A large fish yields eight barrels of oil and two of sediment. This trade amounts to some thousands annually, and Mr. Patten's house has often bought in one year near 3000*l.* worth. The oil is esteemed as good as spermaceti oil, and is particularly well-suited for lamps, as it has no offensive smell. The price of the present day is five shillings *per* gallon; the dregs are used by tanners. Bernard's Report to the Linen Board in 1817.

WESTRAY, one of the Orkney islands, terminating the cluster on the N.W. quarter, is situated 20 miles N. from Kirkwall, and 347 miles in the same bearing from Edinburgh. Its shape bears some resemblance to that of a cross; of which the longer part extends about eight miles, the arms or transverse part not more than five, and comprehends in the whole about fourteen square miles. The island comprises two parishes, St. Mary's and Cross Kirk; and in the population return of the year 1811 was stated to contain 248 houses, and 1396 inhabitants. The only manufacture is that of kelp, of which are produced on an average 300 tons annually. Much corn is raised, but of an indifferent quality; the grass is excellent for the dairy, and for the pasturage of black cattle; and the boisterous seas which surround the island afford great plenty of fish, of a very superior kind. On the east and south are two bays; but the only harbour that can be depended on is on the north-east, and this is fit for small vessels only: formerly it received ships of much greater burthen; but from the blowing of the sand the water has become so shallow, they are now compelled to anchor in a more open road. In two extensive plains near the sea-side, one on the south, the other on the north part of the island, a multitude of graves have been discovered, all formed in nearly the same manner; and, though tradition is silent, they were probably formed after a sanguinary conflict at some remote period: some of these graves, on the north side, have been opened, and were found to contain skeletons in a reclining posture, with weapons, domestic utensils, and several other articles, the use of which could not be ascertained.—Beauties of Scotland, vol. v. Orkneys, 1808. Carlisle's Topographical Dictionary of Scotland, 1813.

WESTRINGIA, in *Botany*, was so named by the author of the present article, in honour of Dr. John Peter Westring, physician to the king of Sweden, member of the Royal Society of Stockholm, and author of several learned papers on the *Lichen* tribe, published in the Transactions of that body. He has also published seven numbers in 8vo. on the dyeing properties of many Swedish lichens, comprehending a full history of the modes of applying them to use, and accompanied with most elaborate and complete coloured figures, drawn by the celebrated professor Acharius himself. —Sm. in Stockh. Transf. for 1797, 171. Tracts relating to Nat. Hist. 277. Mart. Mill. Dict. v. 4. Brown Prodr. Nov. Holl. v. 1. 501. Ait. Hort. Kew. v. 3. 372.—Class and order, *Didynamia Gymnospermia*. Nat. Ord. *Verticillatæ*, Linn. *Labiatæ*, Juss. Brown.

Gen. Ch. *Cal.* Perianth inferior, of one leaf, tubular, somewhat bell-shaped, with five sides and five prominent angles, but no furrows, divided about half way down into five equal, erect, lanceolate, beardless segments, permanent. *Cor.* of one petal, ringent, twice as long as the calyx: tube the length of the calyx, hairy in the throat: limb two-lipped; the upper lip flat, erect, divided, rather the longest; lower in three oblong, equal, spreading, entire segments. *Stam.* Filaments four, shorter than the limb, divaricated, the two upper ones longest; anthers of the two upper stamens roundish, halved, those of the two lower deeply divided, imperfect. *Pist.* Germen in the bottom of the calyx, four-lobed; style thread-shaped, the length of the longer stamens; stigma small, cloven, acute. *Peric.* none, except the hardened calyx. *Seeds* four, obovate, naked.

Eff. Ch. Calyx five-cleft half way down, five-sided. Upper lip of the corolla flat, cloven; lower in three deep equal segments. Stamens distant; the two upper with halved anthers; two lower with divided abortive ones.

A genus of New Holland shrubs, chiefly from the colder parts of that country, having the appearance of our rosemary, destitute of glands, but mostly downy. *Leaves* whorled, entire. *Flowers* axillary, solitary, on short stalks, with a pair of *bracteas* close to the *calyx*. *Corolla* white, sometimes dotted with purple or violet. One species only was, for a long time, known to us, but Mr. Brown has ascerafcertained feven more, one of which, it feems, was brought home by the famous old navigator Dampier, and is preferved in the Sherardian herbarium at Oxford, if we remember right. They all very much refemble each other in habit, and prove the genus to be perfectly natural, though it has been confounded with *Cunila* by fome very eminent botanifts.

1. W. *rofmariniformis*. Rofemary-leaved Weftringia. Sm. in Stockh. Tranf. for 1797, 175. t. 8. f. 2. Tracts 282. t. 3. Brown n. 1. Ait. n. 1. Donn. Cant. ed. 5. 141. (W. rofmarinacea; Andr. Repof. t. 214. Cunila fruticofa; Willd. Sp. Pl. v. 1. 122.)—Leaves four in a whorl, lanceolate, revolute; fhining and nearly fmooth above; filky beneath. Calyx filky; its teeth longer than the tube.—Native of New South Wales, near Port Jackfon, from whence fpecimens and feeds were fent by Dr. John White, in 1791. The *ftem* is fhrubby, feveral feet high, very much branched; *branches* either oppofite, or four together, fquare, filky with white clofe hairs, denfely leafy. *Leaves* fpreading, an inch or fomewhat lefs in length, acute, fingle-ribbed, entire; dark green, and polifhed above; white with filky hairs beneath. *Footftalks* broad and very fhort, filky, without *ftipulas*. *Flowers* about the upper part of the branches, fhorter than the leaves; their *corolla* fpreading nearly an inch, white, dotted about the mouth with violet fpots. *Anthers* violet. The *calyx* is filky on the outfide of the tube, its fegments naked with revolute margins; they appear to us variable in length. The plant is flightly bitter, not aromatic; nor have the *flowers* any fcent.

2. W. *Dampieri*. Dampier's Weftringia. Br. n. 2. Ait. n. 2.—" Leaves four in a whorl, linear, ftrongly revolute; nearly fmooth above; hoary and opaque beneath. Calyx hoary and opaque; its teeth half the length of the tube."—Gathered by Mr. Brown on the fouthern coaft of New Holland. Sent to Kew in 1803, by Mr. Peter Good. It flowers in the greenhoufe, from May to July. *Aiton*.

3. W. *rigida*. Rigid Weftringia. Br. n. 3.—" Leaves three in a whorl, linear-lanceolate, divaricated, fharp-pointed, revolute; fmoothifh above; hoary beneath. Calyx hoary; its teeth half the length of the tube."—Difcovered by Mr. Brown, in the fouth part of New Holland.

4. W. *cinerea*. Grey Weftringia. Br. n. 4.—" Leaves three in a whorl, linear, fpreading, pointed, revolute, hoary on both fides. Calyx hoary; its teeth fcarcely a quarter the length of the tube."—This was found by Mr. Brown, in the fame country as the laft fpecies.

5. W. *anguftifolia*. Narrow-leaved Weftringia. Br. n. 5.—" Leaves three in a whorl, linear, fpreading, revolute; roughifh on the upper fide; hoary beneath. Calyx hoary; its teeth half the length of the tube."—Found by Mr. Brown, in the ifland of Van Diemen.

6. W. *longifolia*. Long-leaved Weftringia. Br. n. 6.—Leaves three in a whorl, linear, revolute; rough with minute points on the upper fide; flightly hairy beneath. Calyx fomewhat hairy; its teeth equal to the tube.—Gathered near Port Jackfon by Mr. Brown. We have fpecimens, gathered in that country by Dr. White, which anfwer to the fpecific character, except that the back of their *leaves*, as well as the *calyx*, are rather hoary than, as Mr. Brown fays, green, and the *leaves* are four, or even five, in a whorl. The *corolla* is externally downy; but this laft character is, perhaps, not peculiar to the prefent fpecies.

7. W. *glabra*. Smooth Weftringia. Br. n. 7.—" Leaves three in a whorl, linear-lanceolate, flat, fmooth on both fides, as well as the calyx."—Gathered by Mr. Brown, in the tropical part of New Holland.

8. W. *rubiæfolia*. Madder-leaved Weftringia. Br. n. 8.—" Leaves four in a whorl, elliptic-lanceolate, nearly flat, very fmooth and fhining. Calyx nearly fmooth."—Found in the ifland of Van Diemen, by Mr. Brown.

The two laft fpecies feem to differ remarkably from all the foregoing, in the flatnefs and fmoothnefs of their *leaves*.

WESTRIZ, in *Geography*, a river of the duchy of Stiria, which runs into the Luffnitz, near Furftenfeld.

WESTS, a town of Virginia; 4 miles S.W. of Leefburg.

WEST SALEM, a townfhip of Pennfylvania, in Mercer county, with 660 inhabitants.

WEST SOUTHWARK, a town of Pennfylvania, in the county of Philadelphia, containing 6443 inhabitants.

WEST SPRINGFIELD, a town of Maffachufetts, in the county of Hampfhire, containing 3109 inhabitants.

WEST STOCKBRIDGE, a town of Maffachufetts, in the county of Berkfhire, containing 1049 inhabitants.

WEST WHITELAND, a townfhip of Pennfylvania, with 636 inhabitants.

WEST WINDSOR, a town of New Jerfey, in the county of Middlefex, containing 1714 inhabitants.

WET AIR. See MOISTURE.

WET *Couch*, a term ufed by the maltfters for one of the principal articles of malt-making.

In the making of malt, the ufual way is to foak the grain in water two or three days, till it becomes plump and fwelled, and the water is brown; the water is then drained away, and the barley is removed to a floor, where it is thrown into a wet couch, that is, an even heap of about two feet thick.

In this heap the barley fpontaneoufly heats, and begins to grow, fhooting out firft the radicle, and, if fuffered to continue growing, foon after the blade; but at the eruption of the radicle, the procefs is to be ftopped fhort, by fpreading the wet couch thin over the floor, and turning it once every four or five hours for two days, laying it thicker each time; after this it is thrown into a large heap, and there fuffered to grow hot of itfelf, and afterwards fpread abroad again and cooled, and then thrown upon the kiln to be dried crifp, without fcorching. Shaw's Lectures, p. 186.

WET *Dock*. See DOCK.

WET-*Glover*, a dreffer of the fkins of fheep, lambs, goats, &c. which are flender, thin, and gentle.

WETA, or WINDAU, in *Geography*, a river of the duchy of Courland, which runs into the Baltic, a little below Windau.

WETERFELD, a town of Bavaria, on the Regen; 21 miles N.E. of Ratifbon.

WETHER-GETTER, among *Sheep-Farmers*. See RAM.

WETHER-*Sheep*, in *Rural Economy*, a term applied by ftock-farmers to a caftrated male fheep of more than one year old; but before that time it is called a wedder-lamb. The wedders of the improved breeds of fheep, efpecially thofe of the new Leicefter fort, are much more early than the old kinds. See SHEEP.

WETHERBY, in *Geography*, a market-town in the upper divifion of the wapentake of Claro, Weft Riding of the county of York, England, is fituated on the river Wharfe, 7 miles N.W. from Tadcafter, about the fame diftance S.E. from Knarefborough, and 194 miles N.N.W. from London. The courfe of the river forms an angle, whofe fides are each about one mile in length; at the point of this angle the town is feated. It affords nothing worthy of notice, but a handfome bridge croffing the Wharfe. Above this bridge the river forms a beautiful cafcade, by falling

falling in a ſheet of water over a high dam erected for the convenience of the mills. Over this caſcade, the ſalmon, in their way up the river from the ſea, are ſeen to leap with wonderful dexterity. Wetherby has a weekly market on Thurſdays, and three annual fairs. In the population return of the year 1811, the town is ſtated to contain 1140 inhabitants, occupying 243 houſes. In the time of William the Conqueror, this manor was poſſeſſed by two Norman lords, William de Percy and Erneis de Burun. It was afterwards given to the knights templars; and, together with all their eſtates in England, was forfeited on the abolition of their order, in the year 1312. In the civil war of Charles I. this town was garriſoned by ſir Thomas Fairfax, who, in 1642, repulſed ſir Thomas Glenham, in two different attacks. A little below the town is St. Helen's Ford, where the Roman military-way croſſed the Wharfe. Within a mile of the town is Wetherby Grange, the ſeat of Richard Thompſon, eſq. In the park is an heronry, a thing rather uncommon in this part of the country. The herons build their neſts in the tops of the higheſt trees; but ſeldom take the trouble, when they can get them ready made by the rooks, whom they expel, and enlarge and line the neſts, driving away the original poſſeſſors, ſhould they happen to renew their fruitleſs claims.

About two miles to the weſt of Wetherby, is Stockeld park, the ſeat of William Middleton, eſq. His anceſtors deſcended from Hypolitus de Brame, lord of Middleton, who lived in the reign of Henry II. Not far from the houſe, and near the high road, is a rock of a very ſingular ſhape, 65 feet in circumference, and 30 feet high, ſtanding on the margin of a lake.—Hargrove's Hiſtory of Knareſborough, 1809. Beauties of England and Wales, vol. xvi. Yorkſhire. By J. Bigland, 1812.

WETHERSFIELD, a town of Connecticut, in the county of Hartford, containing 3961 inhabitants.

WETMORE's Island, a ſmall iſland on the coaſt of Maſſachuſetts, at the mouth of the river Penobſcot.

WETSTEIN, John James, in *Biography*, was born at Baſle in 1693, and made ſuch proficiency in his early ſtudies, that he was fit to be admitted into the univerſity at the age of eleven years. In his 20th year he was ordained miniſter, on which occaſion he maintained a diſputation on the various readings of the New Teſtament, in which he defended the authenticity and integrity of the text. To this courſe of ſtudy he was ſeduloufly devoted, and in order to explain the words and phraſes of the New Teſtament, he carefully read the Greek authors, both ſacred and profane; and he alſo conſulted the Rabbinical writings, for the purpoſe of acquainting himſelf with the opinions and cuſtoms of the Jews. Richly furniſhed with this kind of knowledge, he ſet out, in 1714, on a literary tour to Zurich, Berne, and Geneva. From the latter place he proceeded through Lyons to Paris, where he became acquainted with Montfaucon, Courayer, and other eminent men; and he alſo viſited England, where he was particularly noticed by the celebrated Bentley, and diligently ſearched for MSS. of the New Teſtament. During his ſtay in this country, he was made chaplain to a regiment of Swiſs troops, and having obtained leave of abſence, viſited Paris, in order to collate a particular MS., and, after three months, joined the regiment at Bois-le-duc. Having afterwards viſited Holland and Germany, he returned to Baſle in 1717, and became deacon to the church of St. Leonard, which office he held with diſtinguiſhed approbation for nine years. In purſuance of his main object, he correſponded with Bentley on the ſubject of various readings; but he was interrupted in his plan by a violent diſpute with a divine of Baſle, who had been his intimate friend, occaſioned by his publication of a ſpecimen of his various readings in 1718. In the progreſs of this diſpute, the clergy took a part, and preſented a petition to the council, requeſting that Wetſtein's edition of the New Teſtament might be prohibited; alleging, amongſt other objections, that it favoured of Socinianiſm. His Prolegomena, however, were printed in 1730, and a new accuſation was preferred to the council againſt the author. This kind of clamour proving ineffectual, his enemies engaged ſome of his pupils to appear as witneſſes againſt him; and they produced extracts of his lectures from the MS. copies of theſe pupils to ſupport their accuſation. The reſult of theſe diſhonourable proceedings was a ſuſpenſion of his functions in 1729, and this was ſoon followed by his total depoſition. This conduct of the clergy was aggravated by a variety of miſrepreſentations; the miniſters of Mulhauſen, Neufchatel, Vallangen, and Geneva, expreſſed their diſapprobation of theſe meaſures; and forty heads of families in the pariſh of St. Leonard preſented a petition for obtaining Wetſtein's re-eſtabliſhment. But as this interpoſition on his behalf was unſucceſsful, he left his native country, and removed to Amſterdam, where the Remonſtrants elected him profeſſor of philoſophy in the room of Le Clerc, requiring, at the ſame time, that he ſhould juſtify himſelf, either by a public apology, or before the council at Baſle. Adopting the latter method, he returned to Switzerland, and in the preſence of thirteen commiſſioners, choſen from the council and body of the profeſſors, he ſhewed that the extracts furniſhed by his pupils were not worthy of credit; that the witneſſes had ſworn nothing that could prove the accuſation alleged againſt him; and that the acts of the divines contradicted each other. The council, in March 1732, annulled the decree of condemnation, and reſtored him to the full exerciſe of his functions. The Remonſtrants at Amſterdam were ſatisfied, and in 1733 he took poſſeſſion of his office, the duties of which he faithfully diſcharged till his death. His character being re-eſtabliſhed at Baſle, he was elected in 1744 profeſſor of the Greek language; but the Remonſtrants, in order to retain him, nominated him profeſſor of eccleſiaſtical hiſtory, and made an addition to his ſalary. Amidſt the labours of the offices, which he ſuſtained with great honour to himſelf and benefit to his pupils, he proceeded in collecting and arranging his various readings of the New Teſtament; grudging no expence, and availing himſelf of every opportunity that occurred in collating various MSS. Encouraged by a great number of learned men in England, Holland, and Germany, he at length publiſhed his firſt volume in 1751, and the ſecond in the following year; and in order to preclude every objection, he printed the text from that commonly received, and the various readings at the bottom. To the whole he ſubjoined a commentary, comprehending all the remarks with which he had been furniſhed by the Hebrew, Greek, and Roman writers whom he had conſulted. His attachment to received principles is evinced by his mode of explaining ſeveral paſſages, and particularly thoſe which related to the divinity of Jeſus Chriſt. To his New Teſtament he added two epiſtles of St. Clement, now firſt publiſhed, with a Latin verſion, and a diſſertation on their authenticity. His literary reputation being now eſtabliſhed, he was made a foreign aſſociate of the Academy of Sciences at Berlin, in 1752; and in the following year elected a fellow of the Royal Society in London. Although Wetſtein's conſtitution was vigorous, his inceſſant labour accelerated the infirmities of age; and he was ſeized with a numbneſs and coldneſs in his right leg, which threatened a gangrene, and all attempts to check the progreſs of this malady were ineffectual; ſo that it terminated his valuable life in March 1754, in the 61ſt year of his age. He beheld the approaches of death with tranquillity and reſignation. Wetſtein was ſocial, and fond of innocent amuſements, though ſtudious. He was an excellent Greek ſcholar, poſſeſſed a retentive memory, and ſpoke ſeveral modern languages. He was affable even to ſtrangers, and kind and condeſcending to his pupils. His benevolence comprehended all of every nation and communion, and he was prompt in communicating aſſiſtance and advice to all who applied to him. His character has been amply vindicated from invidious and degrading charges by Krighout, in his "Memoria Wetſteniana Vindicata," 4to. Formey's Elog. Gen. Biog.

WETTELSHEIM, in *Geography*, a town of Germany, in the principality of Anſpach; 4 miles N.W. of Treuchtlingen.

WETTENHAUSEN, a princely abbey, founded in the tenth century; 20 miles W. of Augſburg.

WETTER, a town of Germany, in the county of Mark; 6 miles S.W. of Schwiert.—Alſo, a town of Germany, in the principality of Heſſe; 6 miles N.W. of Marburg. N. lat. 50° 54′. E. long. 8° 45′.—Alſo, a river of Germany, which riſes in the county of Solms, and runs into the Nidda, at Aſſenheim.

WETTER *Iſland*, an iſland in the Eaſt Indian ſea, about 90 miles in circumference, of an irregular form. S. lat. 7° 24′. E. long. 126° 40′.

WETTER *Lake*, a lake of Sweden, in Eaſt Gothland, ſixty-five miles long, and from ten to ſixteen wide. This lake has but one outlet by the river Motala, though above forty little ſtreams diſcharge themſelves into it. This lake lies much higher than either the Baltic or the North ſea, and is deep and clear, but very boiſterous in winter. It is ſuppoſed certainly to prognoſticate the approach of ſtormy weather. As this lake, like all inland pieces of water, ſurrounded with hills or mountains, is ſubject to ſudden ſtorms in the ſtilleſt weather, ſuperſtition and credulity cooperating, as in other caſes, have been buſy in explaining and admitting cauſes for this phenomenon; and accordingly it has been reported and credited, that theſe ſudden ſtorms are occaſioned by a ſubterraneous communication with the lake of Conſtance in Switzerland. It is ſaid, that by a regular ſeries of correſpondence and obſervation it was found, that when the waters of one lake aroſe, thoſe of the other fell in the ſame proportion; and frequently the waters of the Wetter were violently agitated without the leaſt wind, or any apparent cauſe, until information arrived that at the ſame time the lake of Conſtance had been diſturbed by a tempeſt. The whole is ſuppoſed to be a fable grounded on ſome antiquated tradition. See WADSTENA.

WETTERAU, or WETTERAVIA, a country of Germany, ſituated between the county of Heſſe and the river Maine, which takes its name from the river Wetter. It contains the counties of Siegen, Schaumburg, Dillenburg, Dietz, Hadamar, Weilburg, Idſtein, Hanau, Solms, Weſterburg, Iſenburg, Sayn, Witgenſtein, Hohenſtein, Cronberg, and Waldeck, the lordſhips of Weid, and the imperial towns of Wetzlar, Friedberg, and Gelnhauſen. The northern part is called Weſterwald.

WETTERINGEN, a town of Germany, in the biſhopric of Munſter; 7 miles S.W. of Rheine.

WETTING, a town of Weſtphalia, in the duchy of Magdeburg, on the Saal, the principal place of a bailiwick, which was formerly a county, in the year 1283 granted to the cathedral of Magdeburg. In the neighbourhood are ſome coal-mines; 34 miles S. of Magdeburg. N. lat. 51° 37′. E. long. 12° 3′.

WETTINGEN, a town of Switzerland, and principal place of a bailiwick, in the county of Baden, on the Limmat, with a celebrated wooden bridge of one arch over the river, executed by the ſame perſon who built the bridge over the Rhine, at Schaffhauſen; 1 mile S. of Baden.

WETZ, a river of Germany, which runs into the Lahn, near Wetzlar.—Alſo, a town of Germany, in the principality of Solms Braunfels; 5 miles S. of Wetzlar.

WETZLAR, an imperial town of Germany, in the circle of the Upper Rhine, ſituated on the Lahn. The Roman Catholics, the Lutherans, and the Calviniſts, have each a church; 45 miles E. of Coblentz. N. lat. 50° 34′. E. long. 8° 33′.

WEVELSBURG, a town and citadel of Weſtphalia, in the biſhopric of Paderborn; 8 miles S. of Paderborn.

WEVER, a river of England, in the county of Cheſter, which runs into the Dee, 7 miles N. of Cheſter.—Alſo, a river of England, in the county of Devon, which runs into the Culm, near Bradninch.

WEVERHAM, a townſhip of England, in Cheſhire; 3 miles W. of Northwich.

WEVERY, a river of Wales, which runs into the Wye, near Builth.

WEWER, or WEVER, a town of Weſtphalia, in the biſhopric of Paderborn; 22 miles S.S.W. of Paderborn.

WEWURTZE, a river of Lithuania, which runs into the Minnic, 3 miles S. of Proeculs.

WEXEL, a mountain of Stiria; 4 miles N.W. of Fridberg.

WEXFORD, a county of Ireland, in the ſouth-eaſt part of it, which has St. George's Channel on the E. and S., the counties of Waterford, Kilkenny, and Carlow, on the W., and that of Wicklow on the N. It extends from N. to S. 44 Iriſh miles, and from E. to W. 25; being 56 Engliſh miles in length, by 32 in breadth. It contains 342,900 acres, or 535 ſquare miles Iriſh, equal to 550,888 acres, or 695 ſquare miles in Engliſh meaſure. The number of pariſhes 142, having 41 churches, all of which, except two pariſhes with one church, are in the dioceſe of Farns. The population was eſtimated by Dr. Beaufort at about 115,000. Wexford forms almoſt a peninſula, being ſeparated from Waterford and Kilkenny by the haven of Waterford, and the deep and navigable river Barrow, and from the counties of Carlow and Wicklow by formidable ranges of mountains, which admit of few paſſes. Being ſituated next to the principality of Wales, and nearly oppoſite to the mouth of the Britiſh Channel, it preſented great advantages to the Engliſh invaders of Ireland in the reign of Henry II.; who, after their firſt victories over the natives, ſelected this county, from its natural ſtrength, for the reſidence of the firſt coloniſts. The inhabitants of the baronies of Bargie and Forth are ſuppoſed to retain traces of their deſcent from theſe ſettlers. (See BARGIE.) Wexford cannot be called hilly or mountainous, except on the frontiers of Carlow and Wicklow. Yet it contains a great deal of coarſe cold land, and ſtiff clay ſoil, which the want of lime-ſtone renders it difficult and expenſive to improve. The baronies of Bargie and Forth, being of a lighter ſoil, are well tilled, and produce large quantities of barley. The river Slaney croſſes the county from Newtown Barry to Wexford, receiving the Bann from the northward, and affords a perpetual variety of picturеſque and romantic views among its wooded and winding banks. This river is navigable to Enniſcorthy. The linen manufacture has made no progreſs in this county, but there is a manufacture of coarſe woollens. The chief towns are Wexford, New Roſs, and Enniſcorthy, of which an account is given

given under their names. Wexford has been notorious for the events which took place in it during the rebellion of 1798. In it the misguided populace was succesfsful for some time, and the massacres at Scullabogue, and at the bridge of Wexford, afford a melancholy proof of what may be expected from an ignorant and almost barbarous peasantry, when they have the ascendancy. Their leaders were unable to controul them, and if the king's troops had not been succesfsful, there would have been no bounds to their exterminating phrensy. Before the Union, Wexford had eighteen members, but these have been reduced to four, two for the county, and one each for the towns of Wexford and New Ross. Beaufort.

Wexford, a sea-port and post-town, and also the assize town of the county of the same name, in Ireland, at the mouth of the river Slaney. It was originally built by the Danes, who named it Wesford, and it was formerly considered a place of strength, being enclosed by very thick walls, some of which are still remaining. There are some handsome buildings; on the scite of the old castle the barracks are erected, commanding an extensive view of the harbour. The church, situated in the main street, is an elegant modern structure. The market and court-house are likewise new edifices; but the chief ornament of Wexford is its wooden bridge, thrown over an arm of the sea, 2100 feet long, where insurmountable difficulties baffled all efforts to form a stone bridge. This bridge is a favourite promenade, and is as delightfully calculated for a pleasant recreation, as it constitutes an useful communication. The harbour, though spacious, is shallow, and formed by two necks of land, between which there is an entrance about half a mile broad, which was formerly defended by two forts, erected at the extremity of each isthmus. The mouth of the harbour is choked with a bar, and therefore no vessel drawing more than twelve feet water can pass to the town. Provisions of all kinds are very plentiful and cheap here, particularly the finest wild fowl. The chief export is corn, principally barley and malt. Wexford was taken from the Danes by the English invaders, after a siege of four days, in 1170; it was besieged and stormed by Cromwell in 1649; and on being evacuated by the king's troops, it was taken possession of by the rebels in 1798. The shocking murder of the loyal inhabitants, when 97 unoffending victims suffered at the bridge, has been already alluded to. There are seven parishes, but they are all united, and have only one church in common. Wexford is 67 miles S. by W. from Dublin. Carlisle. Traveller's Guide.

WEXIO, a town of Sweden, in the province of Smaland, situated on the Helga lake: the see of a bishop, and residence of the provincial governor; 46 miles N.N.W. of Carlscrona. N. lat. 56° 52′. E. long. 14° 44′.

WEY, a river of England, which runs into the Thames at Weybridge. This river is made navigable to Guilford and Godalmin, and a canal has lately been made from it to Basingstoke, in Hampshire.—Also, a river of England, which runs into the sea at Weymouth.

Wey. See Weigh.

WEYBER, in *Geography*, a lake of Bavaria; 3 miles W.N.W. of Kempten.

WEYBRIDGE, a considerable village in the hundred of Elmbridge, and county of Surrey, England, is situated on the river Wey, whence it derives its name, not far from its conflux with the Thames, at the distance of 12 miles N.E. by N. from Guildford, and 20 miles S.W. by W. from London. It contains some respectable houses, among which is a large edifice, called Holstein-house, from having been the residence of a prince of Holstein, when on a visit to England; it has for some years been used as a printing-office. The church is a small, but neat structure, having a nave and south aisle, at the west end of which is the vault of the earl of Portmore's family, built up about four feet above the level of the pavement, inclosed with iron rails, but without any inscription. The population return of the year 1811 states the parish of Weybridge to contain 167 houses, and 918 inhabitants.

In this parish is Oatlands, the seat of his royal highness the duke of York. This domain came into the possession of Henry VIII. by an exchange with the family of Rede, for the manor of Tandridge, in the same county. It was settled by Charles I. on his queen Henrietta Maria for her life; and their youngest son, called Henry of Oatlands, was born here. At the Restoration the queen dowager was again put in possession of the estate; and after her death Charles II. granted it to the earl of St. Alban's. In the next century it descended to the earl of Lincoln, afterwards duke of Newcastle, who fixed his residence here, enlarged the park, and made considerable plantations. In the park is a large piece of water, formed by springs which rise in it. Between the house and garden is a grotto, divided into three apartments, in one of which is a bath, supplied by a small spring, dripping through the rock; at the end of it is a copy of the Venus de Medicis, as if going to bathe.

The duke of York purchased this estate of the duke of Newcastle, together with the manors and parks of Byfleet and Weybridge, which he held by leases from the crown. In 1800 two acts were passed for inclosing the common fields and wastes, under which the duke obtained by allotments and purchases about 1000 acres of the waste, so that the domain now comprises about 3000 acres. The mansion was burned down while the duke was in Flanders, in 1793. The present house was then erected, from designs by Mr. John Carter; and in 1804 an act was passed for granting to the duke so much of this estate as was held of the crown.

In a small park in this vicinity is Ham, an old mansion, formerly the residence of the countess of Dorchester, mistress of James II. It is now uninhabited, and in a ruinous condition. Near it are many large cedars; one, in particular, measures, at five feet from the ground, about thirteen feet in circumference, and runs up straight to a great height. —History and Antiquities of Surrey. By the Rev. John Manning, and William Bray, esq. 3 vols. folio. Beauties of England and Wales, vol. xiv. Surrey. By F. Shoberl.

Weybridge, a township of the state of Vermont, in the county of Addison, separated from Newhaven by the Otter Creek, containing 750 inhabitants.

WEYDA, a town of Saxony, in the circle of Neustadt, on the Elster; 11 miles E.N.E. of Neustadt. N. lat. 50° 42′. E. long. 12° 1′.—Also, a river of Saxony, which runs into the Elster, 2 miles N. of Weyda.

WEYDEN. See Weiden.

WEYDENAU, a town of Silesia, in the principality of Neisse; 8 miles S.W. of Neisse. N. lat. 50° 12′. E. long. 17° 2′.

WEYDENEN, a town of Prussian Lithuania; 3 miles W.S.W. of Pilkallen.

WEYDENHAYN, a town of Saxony, in the margravate of Meissen; 7 miles W. of Torgau.

WEYER, a town of Austria; 2 miles N.E. of Gmunden.—Also, a town of the duchy of Stiria; 6 miles S. of Pruck.

WEYEREN, a town of Austria; 6 miles W. of Gmunden.

WEYERS,

WEYERS, a town of Weftphalia, in the bifhopric of Fulda; 8 miles E.S.E. of Fulda.

WEYERSHEIM, a town of France, in the department of the Lower Rhine; 6 miles S. of Haguenau.

WEYHER, a town of Auftria; 6 miles W. of Bavarian Waidhoven.

WEYHILL, a village of England, in the county of Hants, celebrated for the great annual fair held here for the fale of fheep, hops, &c.; 3 miles W. of Andover.

WEYL, or WYL, a town of Switzerland, belonging to the abbey of St. Gal, and principal place of a bailiwick; 14 miles S.S.W. of Conftance.

WEYLANOO, a town of Hindooftan, in Guzerat, on the coaft; 20 miles S.E. of Puttan Sumnaut.

WEYMOUTH, or WAYMOUTH, a borough and market-town in the hundred of Uggefcombe, Dorchefter divifion of the county of Dorfet, England, is fituated on the fouthern coaft of England, at the extremity of a beautiful bay, which forms nearly a femicircle, making a fweep of about two miles. The town is 8 miles S. by W. diftant from Dorchefter, and 128 miles S.W. by W. from London. It received its name from the mouth of the little river Wey, near which it ftands, and communicates with Melcombe Regis, to which it is united by a bridge erected in 1770. That the fcite of Weymouth was known to the Romans is probable from feveral circumftances; and Mr. Baxter fuppofes it to have been the Clavinio, which is mentioned in the anonymous Ravennas. In the Saxon ages, however, it is exprefsly named in a Saxon charter ftill extant, by which king Ethelred gave a certain portion of land, called by the inhabitants Weymouth (or Wick), near the ifle of Portland, to his faithful minifter Atfere. In the reign of Edward III. the town had become of fome importance, the inhabitants being ordered, together with thofe of Melcombe and Lyme, to fend a certain quota of fhips for the king's expedition to Gafcony. In the 21ft year of that reign, Weymouth (for Melcombe is not mentioned, though perhaps included) furnifhed the king with 20 fhips, and 264 mariners, at the fiege of Calais, according to the roll of his fleet preferved in a manufcript in the Cottonian Library. In the year 1471, Margaret of Anjou, with her fon, prince Edward, landed here from France, in order to reftore her hufband to the throne. In 1507, king Philip of Caftile, with his queen, were driven on this coaft, and having run into the port, were detained by fir Thomas Trenchard, till an interview took place between the Englifh and Spanifh monarchs, from which the former derived fome advantages. In 1588, Weymouth contributed fix fhips to oppofe the Armada, one of which was of 120 tons burthen. During the civil war of Charles I., this town was alternately garrifoned and befieged by the king, and by the parliament's forces. In 1649 the corporation petitioned parliament for an indemnification for the loffes they had fuftained in the war, and a relief from the burthen of maintaining the garrifon; but their requeft does not appear to have been granted, as a letter was foon afterwards received concerning the "refractorinefs of the magiftrates." The manors of Portland and Wike, with the ports of *Waimuth* and Melcombe, and the liberties attached to them, were granted by charter of Henry I. to the monks of St. Swithun, Winton; and Henry II. confirmed the port of *Waimue* and the whole land of Melcombe to that eftablifhment, with additional privileges. Weymouth and Melcombe are (as has been obferved under MELCOMBE *Regis*) fo frequently joined in defcents and ancient grants, that fome difficulty occurs in feparating them with precifion. Weymouth is the more ancient borough; though neither fent members to parliament till the reign of Edward II., fince which time each of them returned two. Melcombe, being part of the demefne of the crown, and poffeffing fome peculiar privileges, is principally noticed in fucceeding charters. The rivalfhip which fubfifted for centuries between the two boroughs arofe, in the reign of Elizabeth, to fuch a height, that it was judged expedient to unite them; and an act was paffed in her 13th year (afterwards confirmed by James I.), by which they were incorporated, and directed hereafter to be called "The united Town and Borough of Weymouth and Melcombe Regis;" the government being vefted in a mayor, recorder, two bailiffs, an indefinite number of aldermen, and twenty-four capital burgeffes: and they now poffefs, as one borough, the peculiar right, with the metropolis, of fending four members to parliament. The reprefentatives are elected by the freeholders of Weymouth or Melcombe, whether inhabitants or otherwife. The number of voters is about two hundred. Thefe electors have alfo votes for the county members. Leland fays, "The tounlet of Waymouth lyith ftrait agayn Milton (Melcombe) on the other fide of the haven, and at this place the water of the haven is but a fmaul brede, and the trajectus is by a bote or a rope bent over the haven; fo that in the ferry-bote they ufe no oars. Waighmouth has certain liberties and priviledges, but there is no mair in it. Ther is a kay and wharf for fhippes. By this town on a hill is a chapel of eafe. The paroche church is a mil off." The chapel mentioned by Leland was remarkable for its elevated fituation; having, according to Coker's furvey of this county, an afcent of eighty ftone fteps. It was of confiderable antiquity, as appears by a patent of Henry VI., granting a licence to found a guild in the chapel of St. Nicholas, in the borough of Weymouth, by the name of the mafter and wardens of the fraternity or guild of St. George, in Weymouth. This chapel was demolifhed in the civil war: the fcite is ftill called Chapel Hays, and is now ufed as a bowling-green. Weymouth, fince the time of Elizabeth, had, from a variety of caufes, been gradually going to decay. The removal of the wool-ftaple to Poole, the lofs of the Newfoundland trade, the havoc made by the civil wars, damages by fire, want of public fpirit, and other circumftances, had concurred to produce this effect; and till it began to acquire celebrity as a watering place, it was little more than an inconfiderable fifhing-town. The late Ralph Allen, efq. of Bath, about the year 1763, firft contributed to bring Weymouth into repute. Having received great benefit from bathing there, he proclaimed its falubrity to the extenfive circle of his acquaintance; and his encomium being exceeded by the real beauties of the fituation, it foon began to be the refort of the firft company from all parts of the kingdom. The reputation thus acquired was extended by the late duke of Gloucefter, who, having derived confiderable advantage himfelf, provided a refidence for the accommodation of the royal family; and their majefties, accompanied by the three elder princeffes, in the year 1789, made their firft vifit to this place. His majefty experienced its beneficial effects, and became fo attached to the fpot, that he has repeatedly honoured it with his prefence. The advantages arifing from thefe vifits have proved of the greateft confequence to the town, which has rapidly augmented in fize and importance, from the vaft concourfe of people by which it is now frequented. The chief objects of curiofity to ftrangers, are the Efplanade and the Bay. The Efplanade, a fine level piece of fand, which, but a fhort time ago, was nothing but a receptacle for all the rubbifh of the town, is now converted into one of the moft charming promenades in England, and adorned by a range of handfome edifices.

This

This public walk is half a mile in length, and about thirty feet in breadth. The bay, where the company bathe, makes a ſemicircular ſweep of nearly two miles, and is protected from winds by the ſurrounding hills, which render the ſea perfectly ſecure. As ſoon as Weymouth became a place of faſhionable reſort, the expediency of public amuſements was perceived; and Mr. Sproule of Bath offered propoſals for erecting a ſet of aſſembly-rooms, with an hotel, and other neceſſary appendages. The propoſitions were acceded to; and about the year 1772, a building, 600 feet in length, and 250 in width, was erected on a vacant ſpot adjoining the town, at the expence of 6000*l.*, which was defrayed by ſubſcriptions in ſhares of 100*l.* each. The Royal Aſſembly Room is a lofty, light, and ſpacious building, in which upwards of an hundred couples may dance with eaſe and pleaſure. The theatre has been recently fitted up in a ſtyle of elegance that does equal credit to the manager and the architect. The boxes are capable of containing 300 ſpectators; and the mode in which they are decorated is little inferior to the London theatres. On the quay is a moſt convenient hot ſalt-water bath. The bridge has been rebuilt in the Chineſe ſtyle. The church is a low ſtructure, occupying the ſcite of an ancient chapel belonging to the church at Radipole, of which pariſh this was originally a part, but in the reign of James I. was made a ſeparate juriſdiction; within it is a fine altar-piece, repreſenting the Laſt Supper, for which ſir James Thornhill, who executed and preſented it to the town, is ſaid to have refuſed 700*l.* Eaſt of the church are ſome buildings that are connected with a Dominican priory, founded here about the commencement of the fifteenth century. Theſe are now parcelled out in tenements; and the chapel belonging to the priory is uſed as a malt-houſe. The Quakers and Independants have each a meeting-houſe here. The number of houſes in Weymouth, as returned under the population act of 1811, was 447; of inhabitants 1747. Markets are held on Tueſday and Friday; and here are three annual fairs.

Several ſmall forts have at various periods been erected to defend the town and harbour. On a high cliff, about a mile from the town, are the ruins of Sandisfoot caſtle, a fortreſs erected by Henry VIII. about the year 1539, when he expected the Papal ſee to excite an invaſion of this country. Leland denominates it, "a right goodly and warlyke caſtle, having one open barbicane." Its form was a parallelogram, the greateſt length running from north to ſouth. The walls, which were moſtly caſed with ſquared Portland ſtone, were lofty and very ſtrong: in ſome places, the thickneſs was not leſs than ſeven yards.—Hutchin's Hiſtory of Dorſetſhire, 3 vols. folio. Beauties of England and Wales, vol. iv. Dorſetſhire. By J. Britton, and E.W. Brayley, 1804.

Weymouth, a town of New Jerſey, in the county of Glouceſter, containing 1029 inhabitants.

Weymouth, or Wassagusset, a town of the ſtate of Maſſachuſetts, in the county of Norfolk, containing 1889 inhabitants. This is ſaid to be one of the oldeſt towns in the ſtate. It lies on the coaſt, and has ſome ſmall veſſels employed in fiſhing. The cheeſe made in its environs is much eſteemed; 5 miles S. of Boſton.

Weymouth *Bay*, a bay on the N.E. coaſt of New Holland, to the N.W. of Cape Weymouth.

WEYPERT, a town of Bohemia, in the circle of Saatz; 25 miles N.W. of Saatz. N. lat. 50° 25′. E. long. 13°.

WEYS, a river of Auſtria, which runs into the Danube, a little to the E. of Ips.

WEZE, a river of France, which runs into the Meuſe at Liege.

WHALE, in *Aſtronomy*, one of the conſtellations. See Cetus.

Whale, *Cete*, in the Linnæan ſyſtem of *Zoology*, the ſeventh order in the claſs of *mammalia*. For the characters and diſtribution of this order, ſee Cete.

For the diſcriminating characters of the genus of *balæna*, or whale, and a general account of its ſpecies, ſee Balæna.

The common whale, or *balæna myſticetus* of Linnæus, with its variations, &c. is deſcribed under the article Mysticetus. Ariſtotle is ſaid to have given it the name of *myſticetus*, μυςικῆτος, or *bearded* whale, from its having in its mouth hairs inſtead of teeth.

In old time the whale ſeems never to have been taken on our coaſts, but when it was accidentally flung on ſhore: it was then deemed a *royal fiſh*; and the king and queen divided the ſpoil; the king aſſerting his right to the head, and the queen to the tail. The reaſon of this whimſical diviſion, as aſſigned by our ancient records, was to furniſh the queen's wardrobe with whale-bone.

The anatomy of the bones of the whale has been ſo little underſtood, that there have been many very great errors in regard to ſuch of them as have been at times found foſſile, or buried in the earth among the teeth of elephants, and the remains of teſtaceous and other animals. The moſt frequent and moſt ridiculous of all the wrong opinions about theſe, is their having originally belonged to creatures of the human ſpecies; yet many, even among the more intelligent part of the world, have taken them for the remains of giants. The vertebræ of a whale have been miſtaken for thoſe of a giant, and a part of its fins for a hand, and ſo of the reſt. While the world, more ready to ſpread the marvel, than to enquire into the truth, have made computations of the height of the man to whom bones of that ſize muſt have belonged, and from their proportion in regard to thoſe of the common human ſize, have found the giant who poſſeſſed them muſt have been 90 or 100 feet high; much leſs pains in comparative anatomy would have taught them, that they never could have belonged to any human body at all. Mem. Acad. Par. 1727.

Whale, *Beaked*, *Bottle-head*, or *Nebbe-haul*, *Balæna Roſtrata*, the ſmall whale, with taper ſnout, and adipoſe back fin, or with very long and acute beak or ſnout. The head, upper part of the back, fins, and tail, are of a dark or blueiſh-brown; and the ſides and abdomen are of a beautiful white, with a ſlight tinge of pale roſe or fleſh colour; and marked for more than half the length of the animal by numerous longitudinal plaits or furrows: the eyes are ſmall, as is alſo the head, and the ſnout is more elongated than in any other ſpecies, tapering gradually to the extremity, which is ſlightly pointed; the back fin is ſmall, and ſituated at no great diſtance from the tail; the pectoral fins are ſmall and narrow, and the tail is divided into two longiſh and pointed lobes. This is of a more elegant form than thoſe of the larger ſpecies. Theſe fiſh ſometimes, but rarely, grow to the length of twenty-five feet; they make little noiſe in blowing, are very tame, come very near the ſhips, and will accompany them a great way.

Whale, *Fin-back*, *Balæna Phyſalus* of Linnæus, called alſo *fin-fiſh*. See Physalus.

Whale, *Pike-headed*, *Balæna Boops* of Linnæus, is a ſpecies which takes its name from the ſhape of its noſe, which is narrower and ſharper-pointed than that of other whales. The length of one taken on the coaſt of Scotland, obſerved by ſir Robert Sibbald, was forty-ſix feet, and its greateſt circumference twenty; but it ſometimes exceeds this length. From the ſkinny flap at the root of the tongue, as well as from

from the inteftines, the Greenlanders prepare windows. See Boops.

Whale, *Round-lipped*, or *Broad-nofed*, or *Under-jawed*, *Balæna Mufculus* of Linnæus, is characterifed by having the lower lip broader than the upper, and of a femicircular form. See Musculus.

Whale, *Bunched*, *Balæna Gibbofa* of Linnæus, with one or more gibbous excrefcences on the back, and without dorfal fins: the knotenfifch oder knobbelfifch of Anderfon and Crantz. This fpecies is a native of the Northern feas, and though not much known, is faid to be of the fame general form with the great whale, but of fmaller fize, and having its back furnifhed with one or more tubercles. The variety with a fingle tubercle is found about the coafts of New England; the other with fix tubercles along the back is fuppofed to fwarm about the coafts of Greenland. Their whale-bone is faid to be of a pale or whitifh colour.

Whale *Spermaceti*. See Cachalot, Physeter, and Spermaceti.

See on the fubjects of the preceding articles, Pontopiddan's Nat. Hift. of Norway, vol. ii. p. 118, &c. Crantz's Hift. of Greenland, vol. i. p. 106, &c. Pennant's Brit. Zool. vol. iii. p. 50, &c. Phil. Tranf. abr. vol. viii. p. 424, &c. Shaw's Zoology, vol. ii.

Whale-*Blubber*, in *Agriculture*, the fat oily refufe matter left in making the oil from that fifh. It is a material which has been ufed as a manure in fome cafes with fuccefs, efpecially when employed in mixture with clayey loam, fandy loam, or any other common earthy or mouldy fubftances. Thefe matters fhould be blended together in fuch a manner, it is faid by the writer of the "Elements of Agricultural Chemiftry," as to expofe a large furface to the action of the air, the oxygen of which produces foluble matter from them. It is obferved, too, that lord Somerville made ufe of this oily fubftance with great fuccefs on his farm, in the county of Surrey; in which cafe it was made into a large heap with foil, and retained its powers of fertilizing for feveral fucceffive years.

It is noticed, that carbon and hydrogen abounding fo much in this as well as other oily fubftances, fully account for their effects; and that their durability is eafily explained from the very gradual manner in which they change by the action of the air and water on them, as muft obvioufly be the cafe.

This fatty material, in this fort of union with earthy matters, may confequently be a very beneficial application in many cafes of tillage-land, efpecially where the fuperficial bed of mould or foil is rather of the thin kind. It may alfo be very ufeful as a top-dreffing to grafs-land, particularly where the fward is thin, tender, and not well fet with graffy herbage, as tending not only to promote the growth of the crops, but the clofenefs and firmnefs of the furface fwardy covering. See Manure, and Oil *Compoft*.

It fhould therefore be preferved and procured as much as poffible for thefe ufes and applications.

Whale-*Bone*, a commodity procured from the whifkers of the whale, ufed as a ftiffening in ftays, fans, bufks, fcreens, &c. See Whale *fupra*.

Frederick Martens has particularly defcribed the whalebone and the method of procuring it in his "Voyage to Spitzbergen." Within the mouth of the fifh is the whale-bone, hairy as a horfe's hair, and hanging down from both fides, all about his tongue. In fome whales the whale-bone is bent like a fcymitar, and in others like a half-moon. The fmalleft whale-bone is before in his mouth, and behind towards his throat; and the middlemoft is the largeft and the longeft, being fometimes about two or three men's length. On one fide, all in a row, there are 250 pieces of whale-bone, and as many on the other, containing in all 500; and there are ftill many more, for the cutters let the leaft of all remain, becaufe they cannot eafily come at it to cut it out, on account of the meeting of the two lips, where the fpace is very narrow. The whale-bone is in a flat row, one piece by the other, fomewhat bending within, and towards the lips every where like a half-moon. It is broad at the top, where it fticks faft to the upper lip, every where overgrown with hard white finews towards the root, fo that between two pieces of whale-bone you may put your hand. Thefe white finews are of an agreeable fmell, break very eafily, and may be boiled and eaten. Where the whale-bone is the broadeft, as underneath by the root, there groweth fmall whale-bone, the other being greater. The fmall whale-bone, as Mr. Martens fuppofes, does not grow bigger; from one end to the other it is equally thick, and full of long jacks, like horfe's hair. The whale-bone is underneath narrow and pointed, and all overgrown with hair, that it may not hurt that which is young; but without the whale-bone has a cavity, for it is turned like a gutter, in which the water runs, where it lies the one over the other, like the fhields or plates of craw-fifh, or the pantiles of an houfe, that lie one over the other; for otherwife it might eafily wound or hurt the under lip. To cut the whale-bone out is a particular operation, and many iron tools are ufed for this purpofe. Some whale-bone is of a brown, black, or yellow colour, with ftreaks of feveral colours. The whale-bones of fome whales are blue and light-blue, which latter are fuppofed to come from young whales.

Whale-*Fins*, a name improperly given to whale-bone.

Whale-*Fifhery*. See Fishery.

Whale *Oil*. See Oil.

Mr. Parkes (Effays, vol. i.) obferves, that the dealer in Greenland whale oil might alfo increafe the profits of his trade very much, by preparing his oil for fale when the weather is fuitable for the operation. This kind of oil is always purified by paffing it through large flannel bags, which retain the impurities, and fuffer the finer parts to percolate through them. When the oil has undergone this treatment, it is called *bagged* oil, and is then deemed fit for fale. At a low temperature, a confiderable quantity even of this latter kind would concrete, and might be feparated by fimilar means; whereas in a warm atmofphere this diffolves, and, being lefs inflammable, very much injures the oil for burning.

By proper attention to this circumftance, all the oil which is defigned for burning might be very much improved, and the portion thus feparated from it, would be worth more to the foap manufacturer for making yellow foap, than fimilar oil which had not undergone this procefs.

This intelligent chemift conceives, that an oil-merchant would do well always to bag different oils in different feafons; though many experiments might be neceffary before it could be afcertained what was the exact temperature at which the refpective kinds would moft copioufly depofit this feculence. After obferving that in feveral parts of Germany, and particularly in the neighbourhood of Gottenburgh, ammonia is prepared from the dregs which remain after the expreffion of train-oil, he fuggefts that whale-blubber might be employed for the diftillation of ammonia. Madder, he fays, might be devifed for correcting its offenfive fmell, and rendering it very productive of volatile alkali. See Ammonia.

Whale *Bank*, in *Geography*, a fifhing-bank on the coaft of Newfoundland, 60 miles long, and 21 wide; 90 miles S. of Cape Mary. N. lat. 45°. W. long. 53° 50′.

Whale *Cove*, a bay of the Atlantic, on the north coaft of the ifland of Manan, near the coaft of Maine.

WHALE *Fish Island*, an island on the coast of Guiana, at the mouth of the river Essequibo.

WHALE *Island*, a small island in the North sea. N. lat. 69° 14′. W. long. 134°.—Also, a small island near the north-west coast of Borneo. N. lat. 4° 10′. E. long. 112° 21′.

WHALE *Islands*, small islands in Portsmouth harbour. N. lat. 50° 48′. W. long. 1° 5′.

WHALE *Point*, the south-east cape of an island in the straits of Magellan; 6 miles S.S.W. of Passage Point.

WHALE *Rock*, an under-water rock at the entrance of the Bay of Islands, on which the Endeavour struck in 1769; 4 miles S.E. of Point Pocock.

WHALE *Sound*, a channel in the straits of Magellan, between an island and the coast of Terra del Fuego.

WHALFIRTH VOE, a bay on the west coast of the island of Yell. N. lat. 60° 58′. W. long. 1° 25′.

WHAME, in *Natural History*, the name given by the people of some parts of England to the burrel-fly, or wringle-tail, a species of bee-fly very troublesome to horses.

WHANG-HO, in *Geography*. See HOANG-HO.

WHAPLODE, a township of Lincolnshire; 2 miles S. of Holbeach.

WHAPPING'S CREEK. See WAPPING'S *Creek*.

WHARF, a perpendicular building of wood or stone, raised on the shore of a road or harbour, for the convenience of landing or discharging a vessel, by means of cranes, tackles, capsterns, &c. See *Artificial* PORTS.

The fee paid for the landing of goods on a wharf, or for shipping them off, is called *wharfage*. And the person who has the oversight or direction of the wharf, receives wharfage, &c. is called the *wharfinger*.

There are two legal denominations of wharfs, *viz.* legal quays and sufferance wharfs.

Legal quays are certain wharfs in all sea-ports, at which all goods are required, by the 1 Eliz. c. 11., to be landed and shipped (except at Hull); and they were set out for that purpose by commission out of the court of exchequer, in the reign of Charles II. and subsequent princes. Others have been legalized by act of parliament; as the London docks, by 39 & 40 Geo. III. c. 47.; West India docks, by 39 & 40 Geo. III. c. 69. and 42 Geo. III. c. 113; East India docks, by 43 Geo. III. c. 126. and 46 Geo. III. c. 113. (See DOCKS.) Hull, by 14 Geo. III. c. 56. and 42 Geo. III. c. 191.; Milford, by 30 Geo. III. c. 55.; Bristol, by 48 Geo. III. c. 11.

In some ports, certain wharfs are deemed to be legal quays by immemorial practice, though not set out by commission, or legalized by act of parliament; such as Chepstow, Gloucester, &c.

Sufferance wharfs are places where certain goods may be landed and shipped; such as hemp, flax, raff, and other bulky goods; likewise goods carried coastwise, in Great Britain, by special sufferance granted by the crown for that purpose.

The constituting limits to the ports and legal quays is part of the royal prerogative. Lord Hale's Treatise. *Vide* Hargrave's Tracts.

WHARF also, in a *canal*, denotes that wider part of it where boats lie while loading or unloading.

WHARFAGE, in *Commerce*, certain rates paid for landing and shipping goods from the quays.

WHARFE, or WHERFE, in *Geography*, a river of England, in the county of York, which runs into the Ouse, 7 miles below York.

WHARFINGER, the proprietor or farmer of the quays where goods are shipped and landed.

By the 26 Geo. III. c. 40. no goods entitled to drawback or bounty on exportation are to be shipped in Great Britain, but by wharfingers licensed by the commissioners of the customs; and in docked lighters. And they are to give bonds not to be concerned in illegally landing, relanding, or shipping goods. They are also liable to certain penalties at conniving or knowing of any fraudulent transaction, or landing goods at improper places and times, by 1 Eliz. c. 11., and 13 & 14 Cha. II. c. 11.

WHARTON, HENRY, in *Biography*, an English divine of the Established Church, was born in 1664, at Worstead, in Norfolk, where his father was vicar; and in his sixteenth year admitted a pensioner of Gonville and Caius college at Cambridge, where he assiduously pursued the study of various branches of literature, and particularly of mathematics, under Isaac Newton, Lucasian professor. After taking the degree of B.A. with great reputation, he assisted Dr. Cave in his "Historia Literaria," contributing almost the whole of the appendix of the three last centuries. In 1687 he took orders, and his degree of M.A. in the following year. He had various literary occupations, chiefly in writing or editing treatises against Popery; until he took priest's orders, when he was presented first to the vicarage of Minster in the isle of Thanet, and in 1689 to the rectory of Chartham. By the advice of Dr. Lloyd, bishop of St. Asaph, he undertook the work which gave some celebrity to his name, intitled "Anglia Sacra, sive Collectio Historiarum, partim antiquitus, partim recenter Scriptarum, de Archiepiscopis et Episcopis Angliæ à prima Fidei Christianæ susceptione ad Annum 1540," 2 vols. fol. London, 1691. An additional part was published after his death in 1695, under the title of "Historia de Episcopis et Decanis Londinensibus; necnon de Episcopis et Decanis Assavensibus (St. Asaph); à prima Sedis utriusque Fundatione ad Annum 1540," 8vo. The author's "Anglia Sacra" was the result of great industry and labour, and evinces the author's zeal for the church to which he belonged; but it is chargeable with incorrectness. In 1692 he published "A Defence of Pluralities;" in the following year he edited some ancient theological pieces; and, under the name of Anthony Harmer, published "A Specimen of some Errors and Defects in the History of the Reformation of the Church of England, by Gilbert Burnet, D.D.," a work which excited the indignation of the author, and caused him to mention Wharton with asperity in the introduction to the third volume of that work. The last publication of Wharton was "The History of the Troubles and Trial of Archbishop Laud;" to which were added Laud's diary, and some other pieces. He also edited the Life of Cardinal Pole, by Bacatelli, together with some animadversions on Strype's Memorials of Archbishop Cranmer. Although his constitution was strong, he closed his life, in consequence of intense application, somewhat prematurely, in March 1694-5, in the 31st year of his age, leaving several MSS., some of which were afterwards printed, as also two volumes of sermons. He was interred in Westminster-abbey. Biog. Brit.

WHARTON, PHILIP, *Duke of*, the son of the marquis of Wharton, who was a firm supporter of the Revolution and Hanover succession, was born in 1699; and after having exhibited talents which commanded notice, when he was 13 or 14 years of age, in the course of his education under domestic tutors, contracted a premature marriage with the daughter of major-general Holmes, and thus disappointed his father's views, and hastened his death in 1715. In the beginning of 1716, Philip set out on his travels, proposing to finish his education at Geneva; but the young marquis, having contracted a taste for gaiety and expence, was difgufted with the manners of that place, and leaving his governor there, proceeded to Lyons, and wrote to the Pretender at Avignon, accompanying his letter with the prefent of a fine horfe. The Pretender was highly gratified, and receiving the marquis at his court, decorated him with the title of the duke of Northumberland. At Paris he paid his refpects to the dowager-queen of James II., and received notice and good advice from the Englifh ambaffador, lord Stair. About the end of 1716 he returned to England, and going over to Ireland, where he poffeffed a peerage, he was admitted to take his feat in the houfe of lords of that kingdom. Here, deferting the principles and connection which he had lately formed, he defended the eftablifhed government with all the powers of his reafoning and eloquence; in confequence of which he was advanced to a dukedom, by the ftyle of duke of Wharton, in the county of Weftmoreland. Upon coming to age, he took his feat in the Englifh houfe of lords, where he diftinguifhed himfelf by an abandonment of his lately avowed principles, in the defence of bifhop Atterbury; and he alfo publifhed a virulent oppofition paper, intitled "The True Briton." But fuch was his boundlefs extravagance, that his eftate was vefted, by a decree of chancery, in the hands of truftees, who allowed him an annuity of 1200*l*. Having only this pittance, he determined to live abroad, and to enter into the fervice of the Pretender. Having vifited Vienna and Madrid, he formed an acquaintance at the latter place with a young lady of Irifh extraction, who was maid of honour to the queen of Spain, and married her; his duchefs having died in 1726, without leaving any iffue. From Rome, where he appeared under the title of the duke of Northumberland, and decorated with a blue ribband and garter, he returned to Spain, and obtained permiffion from the king to go as a volunteer to Gibraltar, which was then under fiege by the Spaniards. When this fiege broke up, he vifited the Spanifh court, and was nominated by the king "colonel-aggregate" of one of the Irifh regiments. Difcouraged in his wifhes to be actively employed in the fervice of the Pretender, he went to Paris, and with fingular effrontery paid a public vifit to the Englifh ambaffador, Horace Walpole; informing him, upon taking leave, that he was going to dine with the bifhop of Rochefter, though it had been made criminal to hold any communication with that exiled perfon. At this time a bill of indictment for high treafon was preferred againft him in England, for having appeared in arms againft his majefty's fortrefs at Gibraltar; but a wifh to reclaim him induced fir Robert Walpole to fend two friends to offer him his re-eftablifhment and the poffeffion of his eftate, if he would only fue for pardon. This he refufed to do, confenting only to accept a pardon if freely granted him. His allowance from home was difcontinued, and he was overwhelmed with debts abroad. From Rouen, where he had for fome time refided, he removed to Paris, living meanly, and providing for himfelf by various difhonourable expedients. Having obtained a fmall fum, when all his refources had failed, he took his duchefs with him, and went by water to Bilboa. From thence he proceeded to join his regiment, fubjecting his duchefs to extreme diftrefs, in which fhe was occafionally relieved by the bounty of the duke of Ormond, who was himfelf an exile. In 1730 his health declined, and he amufed himfelf in compofing a tragedy, on the ftory of Mary queen of Scots; but his end was approaching. In his way to a mineral fpring, in the mountains of Catalonia, where he had once obtained relief, he was obliged to ftop at a fmall village, when his condition was fo pitiably deftitute, that the fathers of a Bernardine convent took compaffion upon him, and brought him to their houfe, where by attention and cordials his life was prolonged for about a week. At length, without a friend or acquaintance to clofe his eyes, having performed the laft duties of penitent devotion, he expired on May 31, 1731, in the 32d year of his age, and was interred the next day after the manner of a poor monk. Pope has recorded his character, in the firft epiftle of his Moral Effays, in the following beautiful lines:

> "Thus with each gift of nature and of art,
> And wanting nothing but an honeft heart;
> Grown all to all, from no one vice exempt,
> And moft contemptible to fhun contempt;
> His paffion ftill, to covet general praife;
> His life, to forfeit it a thoufand ways;
> A conftant bounty which no friend has made;
> An angel tongue which no man can perfuade;
> A fool, with more of wit than half mankind;
> Too rafh for thought, for action too refin'd;
> A tyrant to the wife his heart approves;
> A rebel to the very king he loves;
> He dies, fad outcaft of each church and ftate,
> And, harder ftill! flagitious, yet not great."

Wharton was one of the warmeft patrons of Young, who dedicated to him his moft celebrated tragedy "The Revenge," and gave him the credit of having fuggefted the moft beautiful incident in that compofition. Biog. Brit. Pope's Works. Johnfon's Lives of the Poets.

WHARTON, THOMAS, a phyfician and anatomift, was born in Yorkfhire, in 1610, and educated at Pembroke-hall, Cambridge. Before the civil wars he refided in Trinity college, Oxford, as private tutor to a natural fon of lord Sunderland. Upon the commencement of the war, he removed to London, and engaged in the practice of phyfic. After the furrender of Oxford to the parliament in 1646, he returned to Trinity college, and was created M.D. by the recommendation of general Fairfax. Returning again to London, he became a member and cenfor of the college of phyficians, and acquired confiderable practice and reputation. In 1652 he read lectures before the college on the fubject of the glands; but labouring, as other anatomifts of that day did, under a fcarcity of human fubjects, he was under a neceffity of availing himfelf of animal diffection. In his work, intitled "Adenographia, five Glandularum totius Corporis Defcriptio," 1656, 8vo., his defcriptions are almoft wholly taken from brute animals, and therefore cannot ftand the teft of modern accuracy. Neverthelefs he revived and improved the knowledge of the falivary ducts on the fide of the tongue, to which he affixed his own name; and he furnifhes ufeful obfervations on the difeafes of the glands. He died in 1673. Haller. Gen. Biog.

WHARTON, in *Geography*, a townfhip of Pennfylvania, with 922 inhabitants; 30 miles S. of Pittfburgh.

WHATLY, a town of Maffachufetts, with 891 inhabitants; 10 miles N. of Northampton.

WHATOGA, a town of United America, in the Tennafee ftate; 40 miles S. of Knoxville.

WHEAT, in *Botany*. See TRITICUM.

WHEAT, in *Agriculture*, a well-known valuable grain, much cultivated and grown in many parts of this as well as moft other countries, as being the principal fort of corn from which bread is made. It is not now well known from what country wheat was firft introduced into this; but it has lately been fuggefted as probable, by fir Jofeph Banks, in confequence of having a fmall paper of feeds, on which were written *Hill wheat*, put into his hands, the feeds contained in which were found to be fcarcely larger than thofe of our wild graffes; though, when nicely examined, they perfectly

perfectly resembled grains of wheat, and which on being sown in a garden very unexpectedly proved to be wheat of the spring kind, and the usual size, the grains of which being nearly, if not wholly, as large as those of the ordinary wheat of the above sort, that the packet and seeds came either from the peninsula, or from the hilly country, far within land from Bengal, as that province itself is a flat alluvial tract of land, entirely level. That as this hill wheat is, however, no doubt, it is supposed, known to some persons who are now either in India, or who have lately returned from thence into this country, it is certainly a matter of some importance to know what information they can give on the subject of it, especially whether this wheat be a cultivated, or a wild plant; as we shall, it is said, if the latter be the case, ascertain two of the greatest desiderata of cultivators; as those of the country where wheat grows spontaneously, and the nature of the grain in its original state, when unassisted by the fostering hand of man.

It is by no means improbable, from the nature and habits of wheat, that it may have come originally from the hilly country of the east, and been rendered hardy by time and cultivation in this and most other parts of the world.

Wheat is a kind of grain of which there are two different species, in cultivation as crops, in the climate of this country; as the common *smooth* or *polled* wheat, and the cone *rough* or *bearded* wheat. Of the first of these sorts, which is by much the most cultivated in this kingdom, as being the most suited to the nature and quality of the largest extent of the soils or lands in it, and as affording the finest kind of flour, there are numerous varieties that are differently preferred in different situations; and the latter species, which is often termed *rivet* wheat, and which has also several varieties that differ little except in the colour of the chaff and the form of the ears, though it does not afford the finest sort of flour, as yielding the largest quantity of produce on stiff moist clayey lands, and as being less subject to injury and disease from wetness on such soils, as well as less liable to lodge from its firmness of stem, is frequently cultivated and grown on such sorts of land.

It has been observed by an able and intelligent cultivator in the county of Kent, Mr. Boys, that the number of sorts of this grain is annually increasing by importation from foreign countries. But that the *old* sorts are the *brown* and *yellow lammas*, the *white straw*, *Fulham*, and the *white* or *egg-shell*. That the *brown lammas* was the kind chiefly cultivated in that county till within these twenty or thirty years; but that it has now given way to a variety of new kinds, as well as some of the other old sorts: experiment has, however, shewn it to be the least productive of the several sorts. It is the common *brown-strawed wheat* that grows with a long jointed ear, the chaff of a dark brown colour, the straw long and apt to fall, the hull or bran thin, the flour very white, and the corn mellow in grinding, for which reason it is esteemed by the millers as the best of the *old* sorts for their use; and that the *yellow lammas* resembles the *brown*, in every respect, except that the colour of the grain is of a yellow hue, and the chaff of a somewhat lighter colour than the others. A red lammas with a red straw, red ear, and red kernel, is noticed by Young as being reckoned by many farmers the best of all the sorts hitherto known, as yielding the finest and whitest flour. The first of these writers states, that the *white-strawed wheat* takes its name from the colour of its ear, and in other counties has the title of the *Kentish white straw*. That it sends out a greater number of stems from the stool or plant than the other sorts, and in that way is often a very thick crop on the land. That the straw is generally somewhat shorter than that of many other sorts, and not quite so liable to fall in rainy seasons. That it is on these accounts much sown in the eastern parts of that county; but that from its dull colour, its having a thick bran, and often grinding very steely, it is not much approved by the millers of the district. It is remarked, that the *Fulham* sort produces a white straw, which grows short and coarse; but that it is very productive, particularly on poor land: the grain is however coarse, and the bran thick, which circumstances render it the least valuable to the millers of any of the sorts described above. And that the *white* or *egg-shell* wheat is known by its producing a white straw, a smooth white chaff, and very white grain: the bran of which is very thick, but the flour remarkably white. It works mellow in grinding, is very early ripe, and so free in the ear as to blow out in windy weather, which is a disadvantage.

It is noticed, that of the *new* sorts of wheat in that county, as the *hoary white*, the *nonpareil*, the *pilbeam*, the *square ear*, the *hoary brown*, and the *hoary white*, called by some the *velvet-eared*, the last is by far the most valuable, as being very productive, and the best for the miller's use. It has the straw white and short, the chaff covered with a thick fine down, somewhat of a brownish hue; the grain remarkably small, and of a dull white colour, the bran very thin, so that the grain in some cases is almost transparent when held up to the light. It grinds very mellow, and makes a beautiful fine white flour. But from the quantity of the down upon the chaff, and its small ears binding up very close in the sheaf, it is apt in a rainy season to vegetate too freely in the field; on which account it is not so proper to cultivate in a moist climate, and in small inclosures that are not open to the influence of the sun and winds. That the nonpareil is a sort said to have been brought into this country from America: it has a bright straw, with a brown ear; and the grain is very white, large, and plump. It is very productive on all soils, thrashes very free, and yields in that operation the greater part of its chaff; thereby producing a great quantity of horse-meat. It grinds very mellow, and is well esteemed by the millers in most districts. And that the *pilbeam* is a brown wheat growing very stiff, and is generally thick on the land. The grain is small and plump, somewhat of a yellow-brown. It is accounted very productive on rich lands, and is a valuable kind to mix with others, but will not of itself make good bread, from its not fermenting or working properly in that operation. In regard to the *square-eared wheat*, that it is a very productive sort, but is apt to drop out in the field, before it is ripe, and in gales of wind, on which account it is not so much cultivated. And that the *hoary brown* is but lately introduced, consequently little known at present. And the *hoary white* sort, which has a white straw, ear, and grain, is in much the same situation. That the *Clarke-wheat*, which has a red blossom, chaff, and straw, but white grain, is much cultivated in Sussex. That the *hedge wheat* is also white and very productive. And that the *velvet wheat* is distinct from the hoary white, but is white, not weighty, yet affording much flour, being very thin in the skin.

There are also different varieties of cone or bearded wheat, a sort which is named from the form of the ear, as has been seen above. That of the *rivet wheat*, there are two sorts, the white and the brown, neither of which are much cultivated in Kent. They both ripen late in the season, and are so coarse and steely, as to be unfit for making bread, unless mixed with a large proportion of a better sort of flour. They, however, produce very abundant crops on strong wet lands, as has been noticed. It is remarked, too, by Mr. Young, to be a productive sort on very poor, wet, cold

cold land, though a coarfe grain, felling at an inferior price in the markets. And the bearded or rivet kind of wheat is likewife thought, by fome cultivators, to be the moft adapted to fuch kinds of rich lands as have been newly broken up, and where there may be danger of the crop lodging from too great luxuriance, as it poffeffes the property of a greater firmnefs of ftraw or ftem than the common kinds, as fuggefted above.

The white and the red are the forts the moft efteemed in general among the polled kind; the former affording the whiteft flour, but the latter has the greater produce in moft cafes.

It is obferved, that of the feveral forts of wheat that are in cultivation in the county of Suffex, the velvet-eared is preferred in the weald part of it, as having by much the thinneft fkin: they there call it *ftuffed*. It weighs on the average from fifty-nine to fixty pounds the bufhel. It is faid by the beft judges that the *white ftuff* on good land anfwers beft, as being the moft faleable: but that on poor land, fubject to poppies, the ftrong-ftrawed fort that overpowers this weed fhould certainly be fown.

There is a fort of wheat that obtains much on the Down parts, which is what they call Clark wheat. It is not bearded; has a red bloffom, red chaff, and red ftraw; white grain, as already feen; the fample coarfe, being in price under the fineft forts. It is, however, a great yielder, and requires to be cut forward.

The *Chidham white* or hedge wheat is much in cultivation, being introduced by Mr. Woods of this diftrict. Upon trial it is found to be a very fine fort: it is white, of a very fine berry, and remarkably long in the ftraw. It is now much grown in many of the fouthern as well as northern counties.

In the county of Effex, according to the Corrected Report on the Agriculture of that diftrict, Mr. Kemp of Hedingham compared wheat from Italy, from Scotland, and from Dantzic; the laft by far the beft, and next the Scotch; but the Italian was full of fmut in fpite of every attention in brining and liming; and fowing it a fecond time with ftill more precaution, the refult was the fame.

About Burnham, fome cultivate a fort of wheat from Italy, which they approve of much; the ftraw is remarkably ftout and ftiff. They cultivate alfo a fort called the *Sopfodite*; red grain, red chaff, and purple ftraw; this is a very good fort. The Taunton Dean, too, is beautiful, but will not bear rough weather. For two years paft the Hamburgh white, with white grain, and white chaff, has been a fafhionable fort; the white American fort is alfo ufed.

The forts moft ufually fown about Kelvedon are the *burrel red chaff*, and red grain; and the *white rough;* white chaff, and white grain, the chaff rough: this fort ftands the weather well, and does not fhell eafily; but is rather difficult to thrafh. About Langenhoe they generally fow white wheat on heavy land, and rarely rivets, *rough chaff*, *York white*, alfo *American red*. Some other of the above forts are likewife in ufe.

It is remarked that a few years ago, as a perfon at Bradfield was walking through his wheat-fields when the corn was in full bloffom, he was ftruck with the variety of hues, or colours, which the bloffoms affumed: at firft he conceived it might be owing to the different ftages of forwardnefs in the bloffom; but on particular examination and more mature reflection concluded that they were certain figns of a fpecific difference in the quality of the wheat: impreffed with this idea, he felected the ears of different hues, and particularly marked eleven diftinct numbers; noting very minutely their characteriftic qualities and appearances in the field. Thefe he gathered and kept feparate when ripe, and planted them apart from each other in his garden; the fame characteriftic difference was obferved to continue upon the feveral numbers when growing in the garden as was obferved in the field the preceding fummer, and are as below.

Firft year in the garden culture.—No. 1. A ftiff ftraw, thick ear, the rows or chefts in which fet clofer than in any other.

2. Dark ftraw, full blade, and large open ear.

3. A large long ear, ripened late, and well fet.

4. Full foliage, and a long open ear.

5. Straight handfome ftraw, large well-fet ears, flag or leaf fmall.

6. Red rufty leaf before fpindling, red ftraw with little leaf at harveft and fmaller ears than any.

7. Very like No. 6. in ftraw, the ears fmall, but well fet.

8. Straw leafy at harveft, of a good colour, well eared and handfome.

9, 10. Straw full of flag or leaf at harveft, ears fet wide.

11. Very like No. 5.

Second year in the garden culture.—No. 1. Short upright ftiff ftraw, thick well-fet ears, and later by four or five days than any of the others.

2. Very dark ftraw, upon which there remained a full dark blade at harveft; long open ears.

3. Strong leafy ftraw, of a good colour, with a thick long ear, well fet, rather later than Nos. 5, 8, and 11.

4. Thick leafy brown ftraw, with a fmall ear.

5, 8, 11. Short handfome bright leafy ftraw, ears long, thick and well fet.

6. Long ftraw with a good deal of flag, ears ill fet and open.

7. Straw handfome, but fmall ears, and fubject to root-falling.

9, 10. Long weak ftraw, very leafy, and fubject to root-falling.

It is noticed on thefe, that the lemon-coloured bloffom was obferved to attend Nos. 5, 8, and 11; but the colour of Nos. 1 and 3. was not particularly remembered. Thefe are the numbers which had been preferved, Nos. 5, 8, and 11, coming to the fickle about a week earlier than Nos. 1 and 3, the produce of which, when compared with the rejected numbers, is an excefs of from fix to eight bufhels *per* acre, and weighing about three pounds more to the bufhel.

At Bradwell, it is obferved, a crop of *Windfor* wheat was had, white grain, white ftraw, and white chaff, which was a moft beautiful fample; the ftrength of the ftraw middling.

That of all the different forts of wheat Mr. Hardy has tried on his farm, the beft has been the white egg-fhell, and this is the fort moft cultivated in Foulnefs ifland.

That the *red American* is a fort which yields remarkably well with fome; it is much approved in Merfea ifle. Some have had the beft fuccefs with it. But Mr. Strutt, at Terling, fowed a barrel of remarkably beautiful wheat from New York, in part of a field, the reft of which was fown with Englifh wheat, and the American was fo blighted in the ear as to produce a poor and miferable grain both in quality and quantity. He fowed it again, and the refult was the fame, and repeated the experiment the third time, the refult again the fame, though the adjoining Englifh wheat in all the three years produced a fair crop free from all blight. The *habit* of this wheat, therefore, was not, it is faid, changed in three years fowing.

That the *rough chaff*, a white chaff and white grain, with

a velvet

a velvet ear; is found about Burnham to be an excellent ſort; for there they are ſubject to ſtrong eaſterly winds, and it does not ſhell eaſily. But ſome, however, do not like it on heavy land, as it has not ſtraw enough; and think that it ſhould ſtand till ripe, or it will not thraſh well.

And about Hallingburg Riſe, and indeed through all the diſtrict of the Roodings, they find the *rivet* ſort a very uſeful wheat, which is very general, and is found to yield on that heavy ſoil much better crops than any common ſort; but on lighter ſoils the Kentiſh red.

In Norfolk about Reddleſworth they have an opinion that *red wheat* will not anſwer on black ſand, white ſucceeding to much better advantage. But at Winborough red is only ſown by Mr. Salter, the white ſorts not anſwering ſo well on the heavy ſoils: it is termed the *old red*. Some prefer the *red chaff*, or red wheat to the white, as being leſs liable to grow at harveſt; white however is a better ſample, and produces a better price.

In Hertfordſhire the rivet or bearded ſort is the common ſort on the clays and ſtrong loams about Sawbridgworth, on which it yields more abundantly than the red and white wheats, four or five quarters *per* acre not being uncommon in favourable years. And a ſort termed *polled rivets* is alſo very productive, one hundred grains having been ſeen in an ear.

About St. Alban's, *Day's ſtout*, which has the ears growing with four ſets of kernels, is much ſown: alſo about Hitchen, where it was diſcovered by a poor labourer who gathered a few ears. It is ſaid to yield well. It is ſuppoſed to be the *pirks* of Ellis. The *red lammas* and *Luſwell*, brought from Cambridgeſhire, are likewiſe much ſown. On the Albury clays the rivets are grown, yielding largely, but ſubject to mildew, and ſelling badly with indifferent ſtraw. They have a *blue* and *white* ſort; the latter is preferred.

In moſt other counties, the ſame ſorts of wheat are likewiſe cultivated and grown with ſome other varieties.

In addition to theſe, there is, however, another ſpecies or ſort of this grain, which is now much cultivated in ſome caſes, as that which is known by the name of ſpring-wheat. This is a ſort of wheat that is capable of being put into the ground at the ſame time with other grain crops, in the early ſpring months. The cultivation of it has been long practiſed, in ſome degree, in both the northern and ſouthern parts of the iſland; but of late a much greater attention has been beſtowed upon it, and at preſent it is raiſed and grown to conſiderable extent in different diſtricts and places, as in the fens of Lincolnſhire and Cambridgeſhire, in many parts of Oxfordſhire, in ſome inſtances in Berkſhire, in Hertfordſhire, where it is found to anſwer well, and in moſt of the other ſouthern counties, as well as in many parts of the north of England, and even in the lower parts of Scotland.

The common autumn or winter ſort of this grain is in general moſt ſuited to the heavier deſcriptions of mellow ſoils, which do not retain too much moiſture. They ſhould however be of a fertile quality, and capable of affording a fine ſurface mould, for the reception of the grain. But good crops may be raiſed on the lighter ſorts; though the introduction of it on ſuch kinds of land, has been ſuggeſted as diſadvantageous from their being ſo much more adapted to the raiſing of other kinds of crops.

The cone, bearded, or rivet ſorts of ſuch wheat are the moſt proper for the heavier, more moiſt, and leſs broken down and reduced kinds of land that have been more lately put in cultivation, on which very weighty crops are not unfrequently produced.

All theſe ſorts of wheat are grown to the moſt advantage and with the greateſt ſucceſs, where the bottom in the land is ſomewhat inclined to be firm and cloſe.

In regard to the ſpring ſort of this grain, it would ſeem to be capable of being cultivated on the ſtrong and heavy, as well as on the lighter ſorts of land; but that it is the moſt calculated for the latter, where the vegetation and growth are rapid, particularly ſuch fenny lands as have a firm turf-earthy bottom. In theſe it riſes in a very quick manner, and they are not by any means well ſuited for the winter ſorts of wheat from their lightneſs, rendering them liable to be thrown out in that ſeaſon.

Preparation of the Land.—Wheat is a crop that is uſually grown after the land has been prepared by repeated ploughing and harrowing or ſummer fallowing; but which is often capable of being raiſed after different kinds of green crops, as well as thoſe of the root and other ſorts with equal or more advantage. In ſome caſes, flax and hemp alſo afford a good preparation for this grain; but ſome conſider beans as the moſt favourable preparation: and experiment has ſhewn tares, and clover, to be nearly equal to them in this intention. In the county of Norfolk, wheat almoſt conſtantly ſucceeds clover, except where pea or bean crops are interpoſed, the land being ſcarcely ever fallowed with this view, except in the inſtances of what are termed *baſtard ſummer tills*. It has indeed been well obſerved, that if there is one practice in huſbandry proved by modern improvement to be worſe than another, it is that of ſowing wheat on fallows; it is therefore only ſtated on this point, that in ſome counties the fallows are ploughed juſt before harveſt on to two-bout ridges ready to plough and ſow under the furrow in the ſpraining method, a ſeedſman to every plough which reverſes the ridges. In others they lay their lands into ten or twelve furrow-ſtitches or ridges, and ſow ſome under the furrow, ſome under the harrow. That the ridges vary exceedingly, according to their wetneſs; and that in Kent they have by means of the turn-wreſt plough, no lands at all, but a whole field, one even ſurface. It would be uſeleſs to expatiate on the circumſtances of fallow-wheat which ought no where to be found. If fallows be or are thought neceſſary, let them be ſown for barley or oats, or with any thing but wheat. However, in whatever manner or after whatever kind of crop this ſort of grain may be cultivated, the ſoil ſhould conſtantly undergo that ſort of preparation that may be ſufficient, according to the particular circumſtances of the land, to bring it into a ſtate of conſiderable fineneſs of mould, eſpecially in the more ſuperficial parts, and thereby prevent as much as poſſible the riſing of weeds; for it has been well noticed by a late writer, that whoever has attended to the progreſs of this ſort of crop, in ſuch lands as have been well broken down and reduced, and in ſuch as have been left in a lumpy crude ſtate at the time of ſowing, will have found the difference to be very conſiderable. But it may be noticed, that when this kind of crop is taken after clover, the land ſeldom undergoes more than one ploughing, which is moſtly given immediately before the ſeed is ſown. However, as the graſſy matter, in many caſes where this mode is adopted, is extremely apt to riſe and injure the crops in the more early ſtages of their growth, it may be better to follow the practice adopted in ſome diſtricts of uſing a ſkim-coultered plough, as by this contrivance the remains of the clover weeds, and graſſy material on the ſurface, may be cut or ſkimmed off, and turned into the bottom of the furrows, where they are immediately covered with the looſe mould from below to ſuch a depth, that little or no inconvenience can be ſuſtained by them, while the land is thus rendered more clean, and capable of being harrowed in a more perfect manner than where the common plough only is employed.

ployed. Befides, perhaps, a better bed of mould is turned up in this way for the feed to vegetate in, provided the furrow is not made of too great a depth and breadth, and remain fome time before it is fown; which fhould conftantly be attended to by the agriculturift in preparing this fort of ground for wheat-crops. But it is the cuftom of fome counties, as of Norfolk and Warwick, where the land is often continued for nearly two years in a ftate of clover, to break them up in the latter end of June; in the fecond, giving two, and fometimes three ploughings. Where the fituation is favourable, and the weather turns out fuitable for reducing the foil to a proper ftate of tilth, this may be an advantageous practice, as by fuch means great benefit may be obtained by cutting the grafs in the beginning of the feafon, in which it is to be ploughed up; but where circumftances of fo favourable a nature do not occur, fuch a method of preparation muft be lefs beneficial than that of giving only one ploughing. In the preparation of a clover ley for wheat, Mr. Ducket has noticed a fingular experiment and practice. He had a field in which wheat rarely efcaped being greatly root-fallen; not to lofe fowing it with that grain, and at the fame time to guard againft the experienced malady, he fcarified it repeatedly, till he had torn up the clover, and alfo produced tilth enough for drilling it in; then he collected the clover fragments, and carted them into the farm-yard to make dung, and drilled the field; the wheat having a firm bottom in an unftirred foil, efcaped the difeafe, and yielded an ample produce. The clover bulb, which would have fecured the dreaded loofenefs of foil, had it been turned down, made a large quantity of dung, and therefore was not loft to the farm, though the particular field was deprived of it. And it has been ftated on the authority of a cultivator of much experience, that in cafes where the clover-crops have been fuch as to leave the land in a foul condition in refpect to weeds, it would be highly improper to fow them with this fort of grain, as from its remaining for fuch a great length of time upon the ground they may be liable to have their feeds perfectly evolved, and brought into a ftate of vegetation. In fuch cafes, it has been fuggefted as more advantageous to have recourfe to fuch fort of crops as may require the operation of hoeing during the time they are upon the ground. The putting in of wheat after pea-crops, is a practice that may probably be purfued with the moft propriety and fuccefs in thofe diftricts that are, from the nature of their fituation, fufficiently early to admit of the land being fully cleaned and prepared by repeated ploughings and harrowings, after fuch crops have been removed, before the proper time of fowing fuch grain. But where they are fo late as only to allow of the land being prepared by one ploughing before the period of fowing, it is fuppofed by fome to be an extremely hazardous practice to attempt the culture of wheat after fuch crops; as unlefs the ground be in a high ftate of tilth, there is little chance of a good crop being produced. This is the opinion of the writer of the work on modern agriculture; but the Norfolk farmers are in the conftant habit of fetting or finking in wheat upon a pea-ftubble with a fingle ploughing, and confider it a very fafe and excellent hufbandry. The pea-crop ought, however, to have been kept clean; and after it is harvefted, the haulm harrowed off. They never plough a bean-ftubble there more than once. In fome counties, it is the conftant practice to cultivate beans and wheat alternately on the fame land for fome time. This is the cafe on the ftronger kinds of foil in the county of Kent, on which it is found to anfwer in a very advantageous manner; and where wheat is only occafionally fown after fuch crops, it is often found an ufeful practice; but in all fuch cafes the beans fhould be cultivated in drills at from twenty to thirty inches diftance, in order that they may admit of being hand and horfe hoed in the moft perfect manner. If this method has been followed, and the bufinefs of hoeing during the growth of the crops effectually performed, the land may be fufficiently prepared for the fucceeding wheat-crops by one ploughing, as the foil from being thus kept clean, and in high tilth, can fcarcely fail of affording a good produce. It has been remarked, that where the farmer has a bean-ftubble intended to be fown with wheat, he fhould give it the due tillage as early as poffible, which fhould be regulated by the foil, as on fome it may be better to truft the fkim fcufflers and fcarifiers than the plough. That where the land is very clean, the great fkim of the ifle of Thanet is capable of cutting through every thing, and loofening the furface fufficiently to enable the harrows to render it as fine as poffible, being picked and burned by women. Where not fo clean, the Kentifh broodfhare may be more effective. In other cafes, the fcuffler may be fufficient for the purpofe. It is noticed that in this cafe, when the farmer has got the furface to his mind, he is to confider whether or not he fhould plough it, which is advifeable if the foil be of a firm folid tenacious quality, and if he does not intend to drill the wheat: if he fhould plough fuch a foil he may not have any apprehenfion of root-fallen wheat, that is, failing roots, from a loofe bottom; but he will bring up a new furface that may drill with difficulty, whereas that which has received the influences of the crop, atmofphere, and of his late operations, will be in exactly the right temper for the drill to work in. If the foil is of a more loofe friable quality, and he fhould plough down the fine furface he has gained, he will give the wheat too loofe a bottom, and he will run the chance of a root-fallen crop. In all fuch cafes, or in any that have a tendency to this circumftance, he fhould determine not to plough at all, but drill directly; a method in which he faves tillage, and has the probability of a better produce.

This is rather a new practice on ftrong land, but fuch fuccefs has been feen in it as leaves no reafon for doubting the foundnefs of its principles. It was done by Mr. Ducket on a fandy foil for years, and with great effect. It fhould be remembered, that whatever other circumftances may influence the growth of this grain, it loves a firm bottom to root in, and rarely flourifhes to advantage where it is loofe and crumbly; nor will a depth of fuch mould do, if the under ftratum, in which it will attempt to fix its roots, be from its quality of a repellent nature. The beft bafis is the cultivable earth, firm from not having been lately difturbed. Thefe obfervations, as being quite practical, are certainly deferving of the farmer's attention. Where the diftrict is early, and the land is preferved in good order by proper modes of cropping, wheat may be grown after beans, whether cultivated in the drill or broad-caft fyftem, with fuccefs, as there may be fufficient time to give the neceffary preparation before the time of fowing, which cannot be done where they are late, and there is only time for one ploughing. But in other fituations it is found advantageous when this crop is to be grown after either peas, beans, or tares, to plough the land in as light or fhallow a manner as poffible, and then harrow and take out the roots and weeds, fo that they may be confumed on the ground in heaps; the field being after this formed into proper ridges for the reception of the feed by ploughing again a few inches deeper than the firft. And in fome cafes, it is even harrowed after the fecond ploughing, and ploughed a third time for the putting in of the grain.

Wheat, too, may fometimes be cultivated after turnip-crops to advantage on the heavier turnip-foils, particularly

 where

where they have been kept clean from weeds by repeated hoeings, and fed off upon the land at fuch early periods as to admit of the ground being prepared by once ploughing, in a light manner. In cafes where this kind of crop is intended to be cultivated after potatoes, which, from their having a great tendency to lighten the foil as well as to exhauft it, fhould never be done on the lighter forts of land in backward fituations, or under any circumftances where a fufficient proportion of manure has not been applied for the potatoe-crops, one light ploughing immediately before the feed may be in moft cafes an adequate preparation ; as where proper attention has been beftowed in the culture of fuch crops, the foil is generally left in a fufficiently fine condition for the purpofe. It has been remarked, that the caufe of wheat not fucceeding well after potatoe-crops, in many inftances, is, that, befides the land being rendered too light and porous by the growth and cultivation that are requifite for them, the wheat is more expofed to the injurious attacks of the grub, earth-worm, and other infects ; and in fome expofed fituations, from the feed-time being too long protracted, the practice becomes obvioufly improper. In growing the crop after thofe of hemp and flax, as weeds are apt to rife, it is always proper that the land fhould be ploughed over two or three times, in order that a fine ftate of tilth may be produced. The cuftom of giving but one earth after fuch forts of crops, can feldom or ever enfure full returns of this grain. It has been remarked in " Practical Agriculture," on the beft authority, that experience has fhewn, in the moft clear and fatisfactory manner, that this fort of crop fhould never, when it can be avoided, be grown after other kinds of grain-crops, as rye, barley, or oats ; and that the manure fhould not be applied to it, but for fuch crops as may precede it. That where the contrary is practifed, the crop is not only liable to be injured by the rampant growth of weeds, but from its being more apt to be difeafed.

On the whole, it may be obferved, that whatever the nature or ftate of the ground may be, or the kinds of crops that precede this fort of grain, it would appear that the preparation for it fhould always be fuch as has a tendency to reduce the parts of the foil to a pretty fine ftate, as under fuch circumftances the growth of the crops is not only more regular and perfect, but from the even and compact ftate in which the furface is left, it is more fit for affording fupport and protection to the roots of the wheat-plants, as allowing them to fpread and extend themfelves with greater readinefs in the fine mouldy earth thus provided, as well as by its falling down more clofely about them. It has, however, been contended by fome cultivators, that a rough cloddy ftate of the furface-part of the land is the moft proper fituation of it for the reception of this kind of crop, as the young wheat-plants are thereby better guarded and fecured againft the effects of the fevere cold that often takes place in the winter feafon. It is probable, however, that cold is feldom hurtful, in any great degree, to winter wheat-crops, except when accompanied with too much moifture, or where fudden frofts and thaws have the effect of rendering the furface parts of the foil fo light and open, as to be incapable of affording proper fupport to the roots of the young wheat-plants.

In Berkfhire they prepare the land for wheat chiefly in three different ways, as by fummer fallowing, and manuring with yard-dung, compoft, rags, foot, and chalk in fome cafes ; by folding on it with fheep in cafes where the ground is not of too deep and wet a nature ; and by putting it in on the back of clover-leys, after one or two crops of grafs by one or more ploughings.

It is thought by fome, however, that manuring for beans or other crops is a much better practice when followed by wheat, than the old cuftom of fallowing and manuring for this crop, which renders the land too light, and confequently fubject to blight.

The farmers in Oxfordfhire prepare for wheat by different numbers of ploughings, as the circumftances of the land may be ; but the layers are moftly ploughed in a fhallow manner, as wheat loves a firm bottom to root in, and which, in fandy land, cannot be too tight. Too loofe a bottom is apt to caufe a root-fallen crop.

An equally careful preparation of the foil is neceffary for the fpring fort of this grain, though fewer ploughings will often be fufficient.

Time of fowing.—In regard to the proper period of fowing this fort of crop, it may, the author of Modern Hufbandry obferves, be ufeful to remark, that the earlier the autumnal fowings can be put into the foil, the greater chance the young plants will have of being well eftablifhed before the frofts take place, which has been feen to be a circumftance on which the welfare of the crop in a great meafure depends. Befides, the ftate of the land and that of the feafon are much more proper for the procefs of vegetation, when the crop is put in at an early period, than when it is delayed till a late one ; the ftate of the weather in the latter cafe often admitting of only a very languid and imperfect growth till the fpring, by which the crop muft be expofed to much danger from various caufes. Indeed experience has abundantly fhewn that late fown wheats feldom fucceed fo well, or afford fuch plentiful crops as thofe that are put in early. But when fown too early there may notwithftanding be danger of the crop running too much to ftraw, and confequently of the grain proving light in the ear. From the beginning of September to the middle, or even the end of October, may probably be confidered as the moft favourable period for this bufinefs. This is indeed confirmed by the eftablifhed practice of the moft correct farmers in almoft every diftrict of the kingdom where this fort of grain is grown. If fown earlier, efpecially on the heavy kinds of foils, the land is for the moft part in too hard and lumpy a ftate to allow of the feed being properly covered by the harrow ; and in the lighter ones in too dry a condition for the grain to vegetate in a proper manner : and when delayed later, the ground in one cafe is apt to become too wet and clofe by the falling of the autumnal rains, and in the other too loofe and porous from the action of the froft upon it. It is remarked by the writer juft mentioned, that more than four-fifths of the whole of this fort of grain is fown between the middle of the firft and the end of the laft of the above months. Mr. Young thinks September the beft feafon for cold backward wet foils, and October for thofe of the more dry and warm kinds, after there has been a plentiful rain. There are, however, circumftances, it is farther obferved, on the authority of the Synopfis of Hufbandry, that may render the times of fowing different from the above ; as where the foils are of the rich fertile, loamy, chalky, or gravelly kinds, it may be better to defer it in many inftances to a confiderably later period ; as when fuch warm forts of land are cropped too early, they are apt, it is faid, to pufh the plants forward in fuch a rapid manner, that they become weak and fpindling in the early fpring months, and at the fame time the crops are more liable to be infefted with weeds, on account of the feafon being then more favourable to their growth. But that the practice of putting in crops of this fort fo late as the latter end of November and beginning of December, frequently depends on the crops that precede them not being capable, from the latenefs of of the fituation, or other caufes, of being taken off fo early as that the land may be made for the wheat-crop in the proper time. This is often the cafe after peas, beans, tares, turnips, and other fimilar crops. In thefe cafes, on the lighter forts of foils, and where drill culture is employed, it may often be an advifeable practice to fow in the fpring, as by fuch a delay the ground may be brought into a more perfect ftate of preparation than could be the cafe in fowing it fo late in the winter.

It is indeed remarked in the Corrected Report on Agriculture for Middlefex, that thofe perfons who fow wheat in autumn lofe the great advantage of a previous crop of turnips, both as to deftroying the weeds and manuring the land; and that they create the labour of either hoeing, harrowing, or otherwife tampering with the weeds and young wheat in the following fpring. That a wet feed-time fometimes renders it impoffible for the farmer of a clayey foil to fow his ufual quantity of wheat in autumn; this fhould not induce him to fow his grain when the land is too wet for the occafion, but rather let him wait till the firft favourable opportunity in the months of February or March, by which time froft will have rendered the land mellow, and then he fhould fow the refidue of his wheat; as the probability is great that wheat fown on a mellow foil, in a dry February, will be more productive than if it had been fown on the fame land, in an adhefive ftate, during a wet November.

That autumnal-fown wheat precludes cultivation for one entire year, which, apart from all other circumftances, gives great encouragement to the growth of weeds; but that in order to appreciate the great mifchief done by fowing wheat in that feafon, its connection with the ufual courfe of crops muft be taken into confideration. For inftance, firft, in the ancient, and ftill very common courfe of fallow, wheat, oats, there is feldom any ploughing from the fowing of the wheat until the fowing of the oats, which is one year and a half; fecondly, in the courfe of wheat, clover, fpring corn, or pulfe, there are two years together in which the plough cannot poffibly be put into the ground; thirdly, in the valuable courfe of turnips, barley, clover, and wheat, the plough is fhut out of the ground for two years and a half. That thefe three cafes include moft of the arable land in Britain, and they demonftrate the prodigious encouragement which fuch courfes give to the growth of weeds. On the contrary, wheat fown in the fpring occupies the ground only half a year; and that when that is placed in a fucceffion with winter tares and turnips every two years, the weeds have not time to grow in fuch a manner as to do any material injury. There is no period in fuch a courfe of more than fix months in fummer, or eight in the winter, free from the operation of the plough. This degree of tilth keeps the land free of weeds, and, in that manner, preferves it from being exhaufted by them; and, by giving the green and root crops to fheep and other cattle, on the land, it becomes doubly manured every other year, which cannot fail to force the growth of the wheat as though it were growing in a hot-bed.

It certainly is not in every poffible cafe advifeable to refrain from fowing wheat in the autumn, in order to fow it in the fpring. A dry feed-time is of fo much importance to the occupiers of adhefive and fenny foils, that they fhould not let any fuch time pafs without fowing their grain. In the cafe of a dry autumn, which is the fame thing as a fine feed-time, the farmers fhould fow all fuch land as is then ready, and thereby enfure the important points of a good feed-bed for their grain, and againft the danger of a wet fpring. On the other hand, the more rain that falls in autumn, the better chance there is of having a dry fpring; and confequently in every wet autumn the wheat-fowing fhould be poftponed until the fpring. The proof of the fuccefs of one inftance of this kind may enable farmers to judge what is capable of being effected, even in an unfavourable fituation, by patience in wet feafons, and exertion in fuch as are dry. A large wheat-farmer, near Haddington, in Scotland, owing to a wet autumn, delayed fowing his wheat until after the 19th day of February, between that time and the middle of March, feeding one hundred and forty-five acres with wheat, principally the Effex white and Egyptian red. The harveft in this cafe was about ten days later than ufual, and the crop yielded from twenty-four to forty Winchefter bufhels on the acre, which weighed nearly fixty-two pounds each. On examination, the wheat was found a firft-rate fample.

Such a fuccefsful cafe of raifing fine wheat from the feed fown in the fpring may afford reafon for putting it in at that feafon in many cafes. Such a practice has never been known to fail, by the writer, when performed early, and on land in good heart. The advantages of the practice are faid to be many, and very confiderable.

When the fowing is to be done later than the above periods in the fpring, the true fummer wheat is always to be ufed.

The exact periods at which this fort of grain may be put into the ground in different cafes with the greateft chance of fuccefs, under different circumftances of foil and climate, have not hitherto, however, fo far as we know, been fully afcertained and fhewn by any correct trials; but the above periods of autumn fowing are in very common ufe by the beft farmers.

In the counties of Effex, Suffex, Hertford, Oxford, and many others, moft of the beft farmers are in favour of early fowing; but more to the eaft it is done fomewhat later. In Berkfhire they fow their light lands early, and thofe that are rich at a later period.

The fpring fort of wheat may be fown from about the middle of March to the end of the following month, in moft parts towards the fouth; but moft probably the fooner it is put in after that period of the above month, as the ftate of the feafon will permit, the better it will be in the crop or produce.

Seed.—In refpect to the proportion of feed that is neceffary in different cafes, it muft depend upon and be regulated by a variety of different circumftances, but in general from two to three bufhels, according to the ftate of the foil, the nature of the climate, and the period in which it is put into the ground, may be the moft fuitable proportion for foils of a medium ftate of fertility, under the broad-caft method of hufbandry; but where the drill fyftem of culture is practifed, a confiderable lefs quantity may be fufficient for the purpofe. In the drilling and dibbling methods of fowing, however, which are unqueftionably the beft where they are performed with correctnefs, fix pecks of feed are fufficient; in the latter mode two rows being put in on a flag, care being taken to have the land rolled after having been ploughed a fortnight or more, and the feed dibbled in to a fufficient depth, without fcattering, covering it in by bufh harrowing.

Where the lands have a known difpofition to mildew, a larger proportion of feed fhould be given, whatever the time or feafon in which it is put in may be. Much lefs feed is alfo neceffary in early than late fowings. It is remarked that on the rich foils of Gloucefterfhire, the quantity generally fown is about feven pecks, while in Yorkfhire it is from eight to twelve. Where the lands are in a fuitable ftate of tillage for receiving crops of this grain, ten pecks have been advifed by a practical writer as the medium proportion; but

but much larger quantities are frequently fown in the northern parts of the kingdom. It is obvious, however, that where fuch large proportions of feed are made ufe of, the plants muft be liable to be drawn up too much, and the crops in confequence to become weak and imperfectly fed, as well as fmaller in the fize of the ears. There may be alfo difadvantages from making ufe of too fmall proportions of feed, from the ground not being properly covered with plants; but where care is taken in the after-culture of the crops, lefs danger is probably to be apprehended from this than the other extreme, as a great number of plants will be fupplied by the tillering or fhooting out of new ftems from the joints about the furface, in confequence of the mould being laid up againft them.

In Hertfordfhire, in the broad-caft method, from two to three bufhels are ufually fown. But in the county of Norfolk they fow broad-caft, from two to two and a half bufhels; and in the drilling and dibbling methods, from five to fix or feven pecks.

In Effex they fow broad-caft about two and a half bufhels; and in the drilling and dibbling modes, from feven to ten or more pecks.

In Suffex they fow a large quantity of feed, fome four bufhels on ley land, and three upon tilth; others three and a half: but when this crop fucceeds peas, only three, if it be early, but if late, more. The medium quantity is about three.

In Berkfhire commonly from two and a half to three in the broad-caft fowings of this crop.

And in Oxfordfhire from two to two and a half, and fometimes three.

In the fowing of the fpring fort of this grain, the quantity made ufe of is various. Some, for a full crop, fow fourteen pecks to the acre, but with grafs-feeds only nine. Eight pecks have produced an abundant crop in fome cafes, on the fame portion of land. Others advife two bufhels to the acre; and fay that the earlier it is fown the lefs feed will be required. Sometimes three bufhels are fown upon the acre. However, from two and a half to three bufhels on the acre may be confidered as the moft proper quantity. In the dibbling method, four pecks and a half have been found fufficient for an acre and a half.

The broad-caft practice of putting this fort of crop into the ground is the moft common on the heavier kinds of wheat-lands, as thofe of the clayey and loamy forts, the feed being harrowed well in by a rather light harrow. But in the lighter forts of wheat-lands, the drilling method is often practifed when they are clean, and fufficiently mellow and mouldy on the furface. Sometimes, too, the feed is put in partly by the plough, and partly by the harrow. In fome diftricts it is ploughed in on the fallows, and harrowed in on clover. The clover-leys are alfo occafionally ploughed in fome cafes, and have the feed fcuffled in, and folded upon by fheep. See SOWING, SEED, &c. Alfo UNDER-FURROW *Sowing*.

Some farmers prefer a ftale furrow for fowing wheat upon, while others are in favour of the contrary practice. A ftale furrow is probably, however, the beft in many cafes. See STALE-*Furrow*.

Preparing feed-wheat for fowing is practifed in many cafes and places in different modes and manners. See PICKLING, STEEPING, &c. Alfo WHEAT-*Seed, Liming of*.

The depth of putting the feed in fhould not probably be more than from one to two or three inches.

In fome parts of Oxfordfhire the laft is the ufual depth, and the farmers are generally friendly to depofiting the feed to a fhallow depth.

It is alfo the practice with many farmers in thefe different diftricts to change their feed-wheat frequently.

In the county of Suffex, an intelligent and fpirited farmer has found by long and attentive experience that a change of feed-wheat is of effential importance to the cultivator, as that feed which has been repeatedly fown over the fame ground at length degenerates, and the produce each fucceeding year becomes inferior in quality; on which account, wheat that is apt to run to ftraw is fown on ley-land, and the Hertfordfhire white fort on pea-ftubbles.

In other diftricts the practice is thought by the beft farmers to be always proper; and that the feed-wheat fhould be brought from a colder foil or fort of land than that on which it is to be fown. See *Change of* SEED, and SEED.

As foon as the feed has been put into the land, it fhould conftantly be laid as dry as poffible by the conftruction of proper drains and water-furrows, fo as in all feafons to keep the water from ftagnating upon it. See WATER-*Furrowing*.

It has been lately fuggefted as a beneficial practice to have the feed-wheat well trodden in at the time of fowing it by fheep, or ftill heavier ftock, on heavy as well as light foils; as by this means the young plants are prevented from dying away in the winter, from the land lying too light and hollow. But more facts are wanting to eftablifh the utility of this method of practice in different cafes. See TREADING *Wheat in*, and PLOUGH.

Although under the prefent practice and management in the cultivation of wheat, the autumn or winter fort muft always neceffarily occupy a large extent of the heavier kinds of wheat-lands in this country, and be raifed in the manner that has been directed above; yet in a number of cafes the true fpring fort may be cultivated, grown, and had recourfe to with great advantage, fuccefs, and benefit. But in all fuch culture, the real fummer fort muft always be employed, for though the winter kind may be put into the ground with advantage in many cafes fo late as after the middle of February, as has been feen above, it is better to have this real fort for later fpring fowing, as it poffeffes many properties highly neceffary for the purpofe. By fome it has been fuppofed that it would interfere with winter wheat, and that it may be difficult to find proper courfes for introducing it in. However, this fort of wheat fhould principally be cultivated and grown on foils or lands, and in climates which are not well fuited for winter wheat, or in cafes where that fort is particularly liable to mildew. But though it may not be fuited for univerfal application, it is moft likely to fucceed in the lighter, the fenny, and the fofter forts of foil, where the winter wheat is apt to be thrown out of the earth by frofty feafons. In fuch cafes the courfes might be turnips, or rape, according to the nature of the land, fpring wheat, clover, and oats, or fome fuch rotations, as in fuch, if after the clover or other grafs, the land be paftured for one year, the oat-crops will be certain, and abundantly productive.

The preparation in fome cafes might be the rendering the land fine and clean by one or more ploughing and proper harrowing, and in others by ploughing and burning, and fowing cole and other feeds and crops, for being fed off by fheep, or in fome other fuch ways.

In this manner large crops have been raifed in many different inftances, as thirty Winchefter bufhels, or more, on the acre, which were ripe and ready at the fame time with the other fpring-fown grain. It is a wheat which is faid to yield

yield as much flour in any given quantity as other wheats, and which does not appear to be fubject to any difeafe, nor to have any difadvantages attending the cultivation of it. It does not require more manure than barley or beans, nor does it exhauft the land more. It anfwers extremely well for laying down with clover, in which cafe the clover-feed fhould be fown and harrowed in with the laft harrowing for the wheat, and the ufual quantity of grafs-feeds fown. It is to be preferred to all other forts of corn for raifing crops of grafs-feeds; owing to the fmall quantity of leaf which it bears, and which is of fhort duration, as it fades and falls down almoft as foon as it has attained its full fize: more air is thus admitted to promote the growth of the clover, or other grafs; and the admiffion of more air may alfo contribute to prevent the mildew with which this fort of wheat is fo rarely affected.

There is a further advantage ftated to arife in the cultivation of this fort of wheat in fome cafes, which is, that on various foils, and in fome feafons, it often happens that the autumnal-fown crop of wheat may be feen to fail and to go off in patches, from the injury of the wire-worms, or other caufes. Confequently, that in the beginning of April, by raking fpring wheat into the vacant places, as alfo where the wheat-plants may appear weak and thin fet, the uniformity of the crop may be reftored, and the fpring wheat be ready for the fickle quite as early as the autumnal fown. And that, although fuch a mixed crop would render its produce highly improper for feed; for the miller's ufe it would afford no objection.

The remarks that are given below are the refult of much experience and practice in the cultivation of this fort of wheat. It is found that crops of this kind are ready to cut quite as early as the autumnal-fown wheat in fimilar foils and fituations. That it is highly probable that the fuccefs of this fort of wheat on clover ley may be found to depend more on the coming feafon than autumnal-fown wheat; as if the following feafon fhould prove dry, the crop would be more hazardous in the former than in the latter. In a dry fummer it would feem that this wheat would have a better chance upon land that has been longer upon tillage than upon clover ley. That turnip and rape fallows, where the foil is not too light, feem highly proper for fpring wheat. That pea and bean fallows may alfo in many inftances prove eligible for fpring wheat; and efpecially after having been ploughed early in the autumn, and benefited by the winter's rains and froft. That when the fpring wheat is harrowed in, at the laft light harrowing, clover-feeds, &c. may be fown, the ground will moftly be well fet, and the feeds profper equal to any in other cafes. That in the application of top-dreffings for this fort of wheat, it may feem, that in a long-continued dry feafon, the moft eligible way would be by applying them at the fame time when the wheat is fown. Only once lightly harrowing after may fuffice. But that, in a moift and continued rainy feafon, top-dreffing would probably prove to act more powerfully by being fown upon the furface of the foil; becaufe top-dreffings are moft particularly calculated to invigorate the coronal roots of the wheat-plants, and thereby to caufe them to tiller well. And that, when top-dreffings are fown on the furface of the foil, the beft time of applying them, it may feem, would be when the wheat is grown to the height of three or four inches; becaufe if laid on before the blades of the corn-crop afford a kind of fhelter, the finer particles thereof are liable either to be exhaled by the fun, or blown away by high winds, which frequently occur at that feafon. Moift and fhowery weather, at that critical period, will always be found of the higheft importance; therefore, the farmer would do well by having due attention to the ftate of the weather when employed on this bufinefs. And that, as a crop of this fort of wheat is fo much more valuable than any other kind of fpring-fown corn, there are good grounds for fuppofing that top-dreffings cannot any other way be more beneficially employed.

Trials with this fort of wheat in other unfavourable cafes of poor wet cold land likewife fhew that this fort of grain may be had recourfe to with confiderable fuccefs in different cafes. That five quarters *per* acre have been had on rich good land in perfect cultivation of excellent wheat of this kind, when put into the foil fo late as the 4th of May. It is evident, that this fort of wheat has a rapid growth, being equally forward at harveft with the autumn-fown crops. That on the whole it feems probable, from the fuccefs that has attended this kind of culture in the fen, in the fouthern and the more northern diftricts of the kingdom, that it may be advantageoufly introduced in many different fituations and circumftances of arable land.

We have already confidered the hiftory, nature, qualities, and many other properties and circumftances in relation to this fort of grain. See SPRING-*Wheat*.

Culture while growing.—In the culture of wheat after it has been put into the foil, there may be fome difference, according as it has been fown, according to the preparation of the land, or other circumftances. But in all cafes it fhould be kept perfectly clean and free from weeds, either by the horfe or hand hoe, as weeds not only injure the crop in its growth, but leffen the value of its fample when brought to the market. And befides, the ftirring of the mould on the furface amongft the plants may frequently be ufeful in other ways, in addition to that of preventing the growth of feed-weeds; for as in the heavy kinds of foils that are moft adapted to this grain, the more fuperficial parts are liable to become fo hard and baked as not to be eafily penetrated by the new-formed or coronal roots of the plants in the early fpring months, efpecially when they are very dry, and have been preceded by much wet; loofening of the earth, by any means whatever, muft of courfe be of great utility. This effect is generally fhewn to have taken place by the appearance and progrefs of the crop, which becomes of an unhealthy yellow colour, and advances but little in its growth. In fuch cafes it has been fuggefted that harrowing once or oftener in a place may be of much fervice in the early fpring months. Where the crops are thin, and of feeble growth, this operation may produce beneficial effects, by affording a fort of earthing up to the weak plants, and thereby promote a more vigorous growth, at the fame time that a number of new fhoots are fent off from the joints thus covered, and the crop in confequence rendered more full and abundant; and where the grain is too thick upon the ground, it may alfo be of utility by drawing out and deftroying many of the plants. It has likewife been fufpected by Dr. Darwin, that many of the root-fibres, by being torn in the operation, may prevent the over luxuriance of the ftem and leaves, and by that means promote the more early fructification of the grain.

It has been obferved by a late writer, that the practice of fcarifying the young drilled wheat-crops fhould conftantly be performed in an effectual manner, and not later than March: but that fome have not fuppofed it to be fo very beneficial, from not performing it at the proper time. Mr. Cook has, it is faid, contrived two implements for this ufe, a fixed harrow and fcarifier; the former executing its work merely by common tines or teeth, having three rows, which, by by varying its poſition diagonally, one, two, or three of them may be brought to act in the ſpace of nine inches, without injury to the rows of wheat-plants. If two, they may, it is ſaid, be drawn in a breadth of three inches; if three, in a ſpace of four inches, and theſe ſpaces widened at pleaſure, but ſtill ſo as to keep quite clear of the rows of wheat; and that by loading the harrow, the teeth are forced to a proper depth. Further, that the ſcarifier has teeth of various breadths; but for working at this ſeaſon, between nine and twelve-inch rows, the narroweſt are to be preferred. By the action of theſe tools the ſurface mould is, it is remarked, looſened, and the air admitted, being performed to the depth of two inches with ſafety, and without mould being raiſed ſo as to cover or bury the plants, the earth being only looſened, and not diſplaced. By theſe contrivances much work can be accompliſhed in a very ſhort time. This proceſs is alſo uſeful againſt the attacks of the worms. They horſe and hand hoe their wheat-crops repeatedly in Eſſex, and with great advantage, though very expenſive.

But the drilled and dibbled crops, where this method is not employed, particularly in the latter mode, where only one row is placed on a flag, muſt be hand-hoed in the intervals, which ſhould be done the firſt time in the beginning of the above month, and a ſecond time towards the end of it, or a little later. Some likewiſe do it to the broad-caſt wheats, but this has been ſuppoſed injurious by many. The buſineſs of thiſtling the wheat-crops ſhould alſo be carefully performed in May, or in the very early part of the following month, in all caſes where it may be neceſſary. The practice of rolling ſhould alſo be employed without either having recourſe to the harrow, or after it has been uſed, being highly beneficial where the ſurface is cloddy, and the operation is executed when the ground poſſeſſes a medium degree of moiſture, as well by forcing the roots of the wheat into the earth, as by cauſing the new ſtems to riſe. And in thin light ſoils, when this ſort of grain is cultivated upon them, much benefit may alſo be produced in this way, by the roots of the plants being prevented from being ſo eaſily looſened and thrown out of the ground. And the ſame practice is recommended as generally uſeful by ſome where clover or graſs-ſeeds are ſown with wheat-crops, as a means of rendering the vegetation more ſecure and perfect.

In Berkſhire, wheat-crops by the beſt farmers are hoed every where, and ſometimes hand-weeded, the former on ſtrong ſoils often twice.

By good cultivators in ſome parts of Oxfordſhire, too, all the wheat-crops are hand-hoed in February or March, and weeded afterwards.

And in Suſſex, the practice moſt commonly adopted is to hand-hoe wheat in the ſpring, ſometimes only once, but frequently twice, as the nature of the preceding crop may have been. By ſome, however, hand-hoeing wheat is diſapproved of, they never hoe white corn, having given it up, from a conviction that the crops were never benefited by the practice; but, on the contrary, that miſchief was always done by it. On which, it is obſerved, that ſhould the practice ſometimes be right, and ſometimes wrong; or right on ſome ſoils, and wrong on others, theſe contrary facts may probably depend on the ſpring roots, which are ſaid to ſtrike into the air, and enter the ground at ſome ſmall diſtance from the ſtem. If a hand-hoeing be given juſt before the appearance of thoſe roots, it may, on a bounden ſurface, prepare for their eaſy entrance; but if given afterwards, it is probable the effect would be miſchievous, would retard the progreſs of the plant, and force it to do its work over again, perhaps at a worſe ſeaſon. If this be the caſe, the benefit which reſults from hitting the time exactly, may by no means equal the probability of miſchief upon a ſcale of any extent; in which the right time can ſcarcely be taken for the whole of a crop. It has been heard declared, too, by excellent farmers, that if a perſon would pay for the hoeing of their wheat, they would not permit the operation, being convinced that it does more harm than good.

It has alſo been recommended, in ſuch caſes where the land is not in a ſufficient ſtate of fertility or preparation to bring the crops to perfection, to make uſe of top-dreſſings. Subſtances of both the ſolid and fluid kinds have been made uſe of for this purpoſe; the firſt conſiſt chiefly of the dung of different ſorts of birds, after being brought into a powdery ſtate, bone-duſt, ſoot, peat-aſhes, and various ſaline matters. The latter are principally the drainings of dung-hills, and other ſimilar liquid materials. The former ſhould be thinly ſown over the crops with as much evenneſs as poſſible, as early in the ſpring as horſes can be admitted upon the land without injury; and if it can be done when the weather is inclined to be moiſt, it is the better; a roller may then be paſſed over the crop with advantage. Where the latter ſubſtances are made uſe of, care ſhould always be taken that the plants be not injured by having too large a quantity applied to them. In this practice, the expence ſhould be a primary conſideration, and ſmall trials firſt made where dungs are not to be uſed. The proper ſeaſon for performing the buſineſs is the beginning of February. See Manure, and Top-*Dreſſing*.

It has been ſuggeſted, too, that the method of tranſplanting wheat may be had recourſe to in particular caſes, with beneficial conſequences, as where there are ſome parts of ſuch crops too thickly ſet upon the ground, while others are too thin, irregular, or patchy; as by thinning and ſetting out the plants of ſuch overabundant parts, among thoſe that are deficient, much ſervice may be done to each of them. The firſt will be rendered more capable of admitting the operation of the hoe, and thereby of ſupplying more abundant nouriſhment for the luxuriant vegetation of the plants, and the latter be ſupplied with the proper number of plants, which could not be accompliſhed in any other way. And it has been ſtated, that when raiſed in the garden, one acre would be capable of affording ſets for an hundred, when planted, after being properly divided at the diſtance of nine inches from each other; and that as the buſineſs of tranſplanting is to be performed in the ſpring, it is ſuppoſed that crops of this grain may be raiſed in this manner on lands that poſſeſs a greater degree of moiſture than is ſuited to the healthy growth of wheat in general. Beſides, clean crops may be produced in this way with much greater certainty, as where the ground is ploughed over juſt before the plants are ſet out, the grain may riſe much quicker from the plants than the weeds from their ſeeds, and the crop in this way overpower ſuch noxious plants. Advantages of other kinds have been ſtated by different writers, as the reſult of this mode of raiſing wheat-crops. It is a practice, which, as well as that of dibbling, has been had recourſe to with ſucceſs, both in Norfolk and Eſſex.

The cuſtom of feeding down wheat-crops, where too forward or luxuriant in the early ſpring months, by means of ſheep, is a practice that has been contended to be beneficial in many caſes. The good effects, in ſuch inſtances, according to Dr. Darwin, are ſuppoſed to ariſe from the removal of the upright central ſtems, by which means different new lateral ſtems or root ſcions are ſent off or brought

brought forward with more vigour, by the acquifition of a larger proportion of nutritious matter from the joints in confequence, that muft otherwife have been exhaufted in fupporting the central ftems. It is, however, a method which has been found by experience to be the moft ufeful on fuch ftrong and fertile lands as are apt to produce a larger proportion of ftraw than can be properly fupported. In which cafes, advantage has been faid to be derived by feeding off the blade at two or more fucceffive times; but in effecting the bufinefs, great care is neceffary to fee that the whole is completed before the crop begins to fpindle, otherwife more injury than good may be produced. And on the lighter and poor defcriptions of foils, the practice muft be employed with great caution, as on fuch lands the growth of the crops may be fo retarded, as to become weak and fpindly. Befides, on thofe lands where they are very light, and the crops thin, injury may frequently be done by many of the plants being pulled up, on account of the clofenefs of the bite of the fheep. They fhould, therefore, never be fuffered to remain upon the crops when the weather is wet, and the furface of the ground much loofened, or after fudden frofts and thaws; as in fuch cafes much harm may be done by the plants being pulled up and deftroyed.

The treading of the animals may, however, be of great fervice in all the light forts of wheat-land, and where the crops are thin; as by it the earth will not only be preffed more clofely about the roots of the plants, but the ftems in many inftances fo forced into the ground and covered up, that new fhoots will be fent off laterally, and the crops be thus rendered more full on the land. But where the foils are very ftiff and adhefive, the growth of the crops may be checked and retarded by the practice, and of courfe the fhoots thus caufed become weak, affording only fmall ears and light grain. Obfervations and experiments have convinced a writer in the Bath Papers, that wheat ought not to be fed down with fheep, unlefs it be very rank in January; and that fuch crops fhould only be fed as were fown early. And it has been fuggefted, that though this practice has much fimilarity to that employed in gardening, of ftopping the growth of the main ftems of fome forts of plants, as thofe of the cucumber and melon kinds, by rubbing off or cutting away the central buds, in order to expedite their fruiting; yet in wheat-crops, where the principal ftems are eaten down, except when they are early, and of very luxuriant growth, the ears of the new fhoots may not have time to perfect the feed, and of courfe become light and fhrivelled in the grain, and the new ftems from their weaknefs be more apt to fall down and be lodged. Thefe are circumftances that have been frequently obferved to occur by Mr. Tull, in the feeding down of wheat-crops by means of fheep. And that the fame philofophical obferver fuppofes, that in the culture of wheat-crops, the moft beneficial method is that of promoting, as much as poffible, the time of bloffoming, while that of ripening is protracted, as it is for the farinaceous refervoir of nutriment, depofited in the cotyledon of the new feed, in order to fupport the growth of the *corculum*, or frefh embryon, that the plant is cultivated; which farinaceous depofition is effected in the interval between the bloffoming and ripening of the corn, either before the impregnation of the pericarp or feed-veffel, or afterwards; and the weight and plumpnefs of the rain are thus augmented.

The practice of feeding down young wheats by fheep may, therefore, be often hurtful, by retarding the period of bloffoming, as well as by reftricting the growth of the ftems of the wheat-plants.

Sheep have likewife been employed on young wheat-crops in other views, as it has been remarked, that as the coronal parts of the roots of fuch crops are liable to be laid bare and expofed for fome inches in length about the furface of the earth, during fevere frofty winters, the turning in fheep upon them in fuch circumftances when the ground is moift, and keeping them in motion, may tend to prefs them into the loofe foil, and in that way produce new roots, as well as afford covering and protection to fuch as have been denudated. And, it is added, that fome farmers who contend that much advantage is derived from it, turn fheep upon the crops where danger is apprehended from worms, flugs, and other infects; in order that by keeping them conftantly in motion, fuch animals may either be wholly deftroyed, or fo fixed in the furface mould as to caufe their more gradual death. There is a very great variety of thefe animals, which are fuppofed injurious to wheat as well as other crops; and for the deftruction of which, lime, foot, and other faline matters, have been had recourfe to with fuppofed advantage. See Grub, Soot, &c.

Wheat-crops are fuppofed to be much injured from different forts of vegetable difeafes, as the *Blight*, *Blaft*, *Mildew*, *Smut*, &c. &c. See thefe different heads.

In the Effex Report it is mentioned, that a difeafe which had not before been noticed or heard of, was met with at Copdock in that diftrict, which is called the *purples*. The ears affected are perceived at once by their colour, a dirty brown mixed with green, as if part was ripe, with fome chefts quite green: they feel nearly, but not quite, like blighted or abortive ears, which are brown, while the ears in general of the crop are of a bright red or white; when rubbed in the hand, as if to get the grain, no wheat is found, but apparently the fmall grains of a flattened indented globular form, and of a darkifh purple, greenifh or dark hue. It has not the fmalleft refemblance in appearance or fcent to fmutty grains or bladders, and is certainly a diftinct diftemper. In many of thefe purpled ears are found fome grains of good wheat. In order to difcover if all the ears from the fame root were affected on trial, in many inftances they were found all fimilar from every root. It is very fingular that no account that is recollected fhould have been given of fuch a ftrange malady, and fo diftinct from all others. Smutty ears were found in the fame field, under all the common circumftances of that diftemper. In Kent, it is faid, this diftemper is called *cockle-eared*.

It has likewife been noticed, that particular ftates of the weather have confiderable influence on wheat-crops, at particular periods of their growth. As when the feafon is fufficiently dry, there is feldom much injury done to them during the winter months, however fevere they may be in other refpects, nor in thofe of the fummer, provided the weather is not too moift about the time of blooming, as where that is the cafe the crops are moftly deficient in their produce.

And feveral forts of weeds are injurious to wheat-crops, where they have been fown upon lands in an imperfect ftate of preparation, as *charlock* on the light calcareous foils; the *corn poppy*, on thofe of the chalky kind, as well as *cockle*, *white-darnel*, *puck-needle*, and *couch:* likewife *colt's-foot* on the rather heavy kinds of lands. See thefe different heads, and Weed and Weeding.

This fort of crop is fhewn to be ripe and ready for the reaper by its ftraw turning of a yellow colour, its ears beginning to bend in the neck and hang down, there being no greennefs in the middle of them, and the grain becoming hard and plump. It is remarked, in the Effex Report on Agricul-

Agriculture, that ſome do not like to cut wheat green, except it be the American white, which is brittle, and muſt be cut early, to prevent a loſs of ears. It rarely lays. In Rochford hundred they do not cut till the wheat is ripe; but ſome few reap while it is yet green. It is, however, obſerved by a good farmer, that moſt rough chaff wheats, if they do not ſtand till fully ripe, will not threſh well.

It is ſtated, too, in the Norfolk Report on Agriculture, that Mr. Parmenter, miller at Ayleſham, a conſiderable farmer alſo, and a very intelligent man, remarked that the farmers let their wheat ſtand too long before cutting. They are apt to have a notion, that when millers give this opinion, it is ſpeaking for their own intereſt; but he cuts his own wheat before it is ripe, and would do ſo on the largeſt ſcale, if he was not a miller. The quality is far ſuperior, and the corn juſt as good. And Mr. M. Hill prefers cutting green, and never yet commenced harveſt but he wiſhed he had begun three days ſooner.

In the firſt of theſe Reports on Agriculture, a practice termed *fagging* is noticed as being for the firſt time met with. When the wheat-crops are very heavy, with broad luxuriant leaves, men with ſickles move regularly through it, ſtrike off many of them, for lightening the top, as a preſervative againſt being beaten down by rain. It ſhould be done carefully, or damage may enſue. See REAPING, HARVESTING *of Grain*, STACKING, and THRESHING.

Produce.—In reſpect to the quantity of wheat produced upon an acre, it muſt vary conſiderably, according to the circumſtances of ſoil and preparation, as well as the ſtate of the ſeaſon; for it has been found that in ſome years the yield is under twenty, while in others it is upwards of thirty buſhels the acre, the ſoil and culture being in every reſpect the ſame. And the average return of this crop throughout the whole of the kingdom, is probably not more than from three to three and a half quarters. And Mr. Donaldſon has, indeed, ſtated it at not more than three quarters the acre. The greateſt crop of wheat, of which the author of the Report on Agriculture for Middleſex has any account, is, it is obſerved, fixty-eight buſhels *per* acre; the leaſt about twelve. The medium between theſe extremes is forty, which, it is conceived, would be the average of land highly conditioned. But the average produce of Britain does not, it is imagined, exceed one-half of this quantity, and yet, it is thought, that wheat is as certain a crop as any that is cultivated. It is obſerved, that the yield of ſeveral years varies the proportion which wheat bears to the ſtraw in a very great degree, but that the average is about twelve buſhels of wheat to each load of ſtraw, weighing eleven hundred weight two quarters and eight pounds. It has been aſſerted, and probably with truth, that the ſtraw of autumnal-ſown wheat is more harſh, and leſs agreeable to cattle, than the ſtraw of that which is ſown in the ſpring. The weight of wheat by the buſhel differs very much in different caſes; but in moſt ſtrong land diſtricts it is uſually about ſixty-two or three pounds to that quantity.

The yield of wheat is the greateſt at the time of reaping, and becomes ſucceſſively leſs and leſs the longer it is kept, ſo as ultimately, in many caſes, to be a diſadvantage to the farmer of not leſs than nearly one ſhilling in the buſhel.

It may be noticed, that it is neceſſary, with the view of aſcertaining the goodneſs of a ſample of wheat, to determine by the eye whether the berry be perfectly fed or full, plump and bright, and whether there be any adulteration proceeding from ſprouted grains, ſmut, or the ſeeds of weeds; and by the ſmell, whether there be any improper impregnation, and whether it has been too much heated in the mow or upon the kiln; and finally by the feel to decide if the grain be ſufficiently dry, as when much loaded with moiſture, it is improper for the uſes of the miller and baker. In caſes where a ſample handles coarſe, rough, and does not ſlip readily in the hand, it may be concluded not to be in a condition either for grinding or laying up for keeping.

Wheat is uſually ſold by the farmers to the dealers for being made into flour; and, in ſome caſes, as ſeed-wheat for other diſtricts, which is very advantageous, as the price in that way is moſtly higher. The dealers, who convert it into flour, diſpoſe of that to the different conſumers, and the refuſe part, as the pollard, to other perſons for the food of horſes, ſheep, hogs, and other animals.

WHEAT, *Brining of*. See BRINING.

WHEAT, *Bruſh*, that ſort of wheat-crop which is grown after oats, barley, or any other ſuch kinds of grain, on light ſoils of the ſandy and other ſimilar ſorts.

Bruſh-wheat crops are common in many of the more northern parts of this country, but the practice of putting wheat-crops in, in this way, is by no means to be much recommended, as they ſeldom anſwer any great purpoſe.

WHEAT, *Buck*. See BUCK-*Wheat*.

WHEAT, *Buck*, in *Botany*. See POLYGONUM *Fagopyrum*.

WHEAT, *Cow*, in *Botany* and *Agriculture*. See MELAMPYRUM, and COW-*Wheat*.

WHEAT, *Croſſing of*, the practice of putting into the ſoil in ſowing two different ſorts of this grain of good qualities, in order to raiſe a new variety of a ſtill better kind. The practice of croſſing in this manner has been found to anſwer perfectly, not only in this caſe, but in thoſe of peas, apple-trees, &c. by Mr. Knight. In his trials, in years when almoſt the whole wheat-crops of the country were blighted, the varieties procured by croſſing alone eſcaped, though raiſed on different ſorts of land, and in very different ſituations and circumſtances. See SEED, and VARIETIES.

WHEAT *Fallow*, that ſort of complete naked fallow on which wheat is ſown. See FALLOW, and FALLOWING.

WHEAT *Graſs*, a ſort of graſs met with in land of ſome kinds. In the trials made on graſſes at Woburn, the qualities of it ſtand as below.

	Oz.	Lbs.	Oz.
From a rich ſandy loam, the produce at the time of flowering was on the acre - - - - - -	196020 =	12251	4
Weight of the graſs when dry -	78408 =	4900	8
Weight loſt by the produce of the ſame extent of ground in drying		7350	12
The produce of the ſame ſpace of land in nutritive matter - -	7657 =	478	9
In the creeping rooted wheat-graſs, the produce from a light clayey loam, at the time of flowering, was on the acre - - - -	196020 =	12251	4
Weight of the graſs raiſed on the ſame ſpace when dry - - -	78408 =	4900	8
Weight loſt by the produce of the acre in drying - - -		7850	12
The ſame extent of land afforded in nutritive matter - - -	612510 =	38213	10

Sixty-four drachms of the roots afforded of nutritive matter 5.3 dr. The proportional value of the roots is therefore to that of the graſs, as 23 to 8.

WHEAT, *Grinding and converting of, into Flour, &c.*, the art and means of reducing it into this ſtate, in which there are much nicety and difficulty in ſome caſes, eſpecially with the thinner-ſkinned ſorts of this grain.

It

It is ſtated by the writer of the work on Agricultural Chemiſtry, that in this country the difficulty of grinding thin-ſkinned wheat is in ſome meaſure an objection ; but that this difficulty is eaſily overcome by moiſtening the corn. And on the authority of John Jeffery, eſq., the conſul-general at Liſbon, the following obſervations on the ſubject are given, as tranſmitted by ſir Joſeph Banks. In order to grind hard corn of this ſort with the mill-ſtones uſed in this country, the wheat muſt be well ſcreened, then ſprinkled with water at the miller's diſcretion, and laid in heaps, being frequently turned and thoroughly mixed together, which will ſoften the huſk ſo as to make it ſeparate from the flour in grinding, and, of courſe, give the flour a brighter colour ; otherwiſe the flinty quality of the wheat, and the thinneſs of the ſkin, will prevent its ſeparation, and will render the flour unfit for making into bread.

The writer has been informed by a miller of conſiderable experience, and who works his mills entirely with the ſtones from this country or Ireland, that he frequently prepares the hard Barbary corn of this kind by immerſing it in water in cloſe wicker baſkets, and then ſpreading it thinly on a floor to dry ; much depends on the judgment and ſkill of the miller in preparing the corn for the mill according to its relative quality. It is obſerved, however, that it is not from this previous proceſs of wetting the corn that the weight in the flour of hard corn is increaſed ; but from its natural quality it imbibes conſiderably more water in making it into bread. The mill-ſtones muſt not be cut too deep, but the furrows very fine, and picked in the uſual way.

The mills ſhould work with leſs velocity in grinding hard corn than with ſoft, and be ſet to work at firſt with ſoft corn, until the mill ceaſes to work well ; then put on the hard corn. Hard wheat always ſells at a higher price in the market than ſoft wheat, on an average of from ten to fifteen *per cent.* ; as it produces more flour in proportion, and leſs bran than the ſoft corn.

Flour made from hard wheat is more eſteemed than what is made from ſoft corn ; and both ſorts are applied to every purpoſe.

The flour of hard wheat is in general ſuperior to that made from ſoft ; and there is no difference in the proceſs of making them into bread : but the flour from hard wheat will imbibe and retain more water in making into bread, and will conſequently produce more weight of bread. It is the practice in Liſbon, and which it is thought would be adviſeable to adopt in this country, to make bread with flour of hard and ſoft wheat, which, by being mixed, will make the bread much better. As the moſt flinty wheats are capable of being readily and eaſily ground by theſe means, much advantage may ariſe from the mixing of the flour of the thin-ſkinned wheats with thoſe of the thicker-ſkinned kinds in the forming of bread, as well as in preventing the objections to the cultivation and growth of the former, on account of their ſteely quality, and grinding hard and with inconvenience. By theſe means many of the well-harveſted and well-kept wheats of this country will be found to be equal to thoſe of any other, for moſt purpoſes to which the flour is uſually put. See Spring-*Wheat*, and Wheat. Alſo Vegetables.

In the Middleſex Corrected Report on Agriculture, it is ſtated, that the beſt flour is moſtly uſed by the paſtry-cooks, and the makers of fine biſcuits, and the inferior ſorts in the making of bread. That theſe have often the worſe kinds of damaged foreign wheats, and other materials, mixed with them in grinding them into flour. And that, if the bread conſumed in the metropolis was prepared from the wheat of this country, unmixed with the leaner produce of other nations, the trial detailed below would ſhew with accuracy the quantity of bread that could be made from a Wincheſter buſhel of that grain.

One buſhel of the wheat of this country, which weighed ſixty-one pounds, was taken. It was then ground, and the meal weighed $60\frac{3}{4}$ lbs. ; which, on being dreſſed, produced $46\frac{3}{4}$ lbs. of flour, of the ſort called ſeconds, which alone is uſed for the making of bread throughout the greater part of this country ; and of pollard and bran $12\frac{3}{4}$ lbs., which quantity was bolted, and it produced in ſharps 3 lbs., which being ſifted produced in good ſecond flour $1\frac{1}{2}$ lb.

	lbs.	lbs.
The whole quantity of bread-flour obtained from the buſhel of wheat, weighed - - - -		48
Fine pollard - - - -	$4\frac{1}{4}$	
Coarſe pollard - - - -	4	
Bran - - - - -	$2\frac{3}{4}$	
		11
The whole together - -		59
To which add the loſs of weight in manufacturing the buſhel of wheat - - - - -		2
Produces the original weight -		61

The ſack of marketable flour is by law obliged to weigh 240 lbs., which is exactly the produce of five buſhels of ſuch wheat ; and the ſack of flour is conſtantly ſuppoſed to make eighty quartern loaves of bread ; and conſequently ſixteen of ſuch loaves are made from each buſhel of ſuch wheat. It is admitted, however, that two or three loaves more than the above quantity can be made from the ſack of flour, when it is the genuine produce of good wheat ; that is, in the proportion of about ſixteen and a half loaves from each buſhel of ſound grain, and, it may be preſumed, ſixteen from a buſhel of medium corn. The expence of making the ſack of flour into bread, and diſpoſing of it, is about 8*s*.

Wheat, *Indian*. See Maize.

Wheat, *Mildew in*. See Mildew.

Wheat, *Muſt of*, is, according to the ingenious Mr. Hatchett, a taint produced by damp upon the aylaceous part of the grain, or ſtarch ; and he conceives, that this taint is, in moſt caſes, ſuperficial. He propoſes the following as a ſucceſsful method of removing it.

The wheat muſt be put into a veſſel capable of holding at leaſt three times the quantity, and the veſſel filled with boiling water ; and the grain ſhould then be occaſionally ſtirred, and the hollow decayed grains, which float, may be removed. When the water has become cold, or in about half an hour, it is drawn off. Then rince the corn with cold water, and having completely drained it, ſpread it thinly on the floor of a kiln, and thus thoroughly dry it, ſtirring and turning it frequently during this part of the proceſs. Phil. Tranſ. for 1817, part i.

Wheat *Rickſtand*. See Staddle, and Stand.

Wheat, *Root-fallen* or *Welten*, that ſort of wheat-crop in which the roots are thrown out of the ground by its lightneſs or poroſity, as cauſed by froſts or other means. See Wheat, and Welt-*Root*.

Wheat, *Ruſt in*. See Rust.

Wheat-*Seed*, *Liming of*, the practice of drying moiſtened corn of this ſort by means of powdery lime. It is the cuſtom in ſome places to make it wet over-night, with ſalt or other water, and to duſt it over with the lime the next morning before it is ſown, mixing it well together in the operation. By the lime, however, thus remaining ſo ſhort a time on the grain before ſowing, it has no time to penetrate into

into the corn; whereas, by moistening the wheat, and leaving it until the succeeding morning well limed, the lime has a greater power, it is supposed, in destroying the smut-powder, than when it remains on it only for half an hour, and is then mostly rubbed off the corn. Half a bushel of the strongest lime is sufficient for a quarter of wheat, when sifted over and mixed well with it.

In this last mode of drying seed-wheat with lime, it is found to be very efficient in preventing the crops from being diseased in some districts. See STEEPING *Seed*.

As there is an uncertainty whether the effect in this practice is to be ascribed to the washing of the grain or the lime, some merely moisten the corn for the purpose of making the lime adhere to it; while others are extremely attentive to the liquor made use of and the washing of the seed, and simply make use of the lime for drying it for sowing. Lime is, however, considered as a great preventative of disease in the grain by many. It should always be used while fresh and newly slacked.

WHEAT, *Setting of*, the practice of putting it into the soil by the hand. In many parts of the vale of the county of Gloucester, they set wheat by the hand and line; but the difficulty of getting on with the work at the proper season, when on a large scale, in consequence of the want of hands, operates against the more general introduction of this practice. When wheat is set by the hand in this way, not more than three pecks of seed are made use of. On clover-leys wheat is often put in by the hand in small channels made across the beds, which have been formed by the plough to the width of half a ley, dropping the seed into them, and leaving a distance of about seven inches between the different channels. This mode is said to be good for late work; and the expence to be about seven shillings the acre, the seed being usually about six pecks. In some other districts the setting of wheat is said to be practised with much success and advantage; but it is probably too tedious and expensive a mode to be had recourse to on any large extent of wheat cultivation. See DIBBLING, and SETTING *of Wheat*.

WHEAT, *Spring*. See SPRING-*Wheat*, and WHEAT.

WHEAT, *Smyrna*, a peculiar kind of wheat that has an extremely large ear, with many lesser or collateral ears coming all round the bottom of the great one.

As this is the largest of all sorts of wheat, so it will dispense with the nourishment of a garden, without being overfed, and requires more nourishment than common husbandry in the large way can give it. In the common way its ears grow not much larger than those of our common wheat.

This sort of wheat seems, of all others, the most proper for the new method of horse-hoeing husbandry, as that method seems capable of giving as much nourishment as the farmer pleases, by often repeating the hoeing. Next to this, the white-cone wheat is best for this sort of husbandry; then the grey-cone wheat.

WHEAT-*Stubble, Cutting and Collecting of*, the useful practice of mowing and raking together the strong stubbles of wheat-crops, and stacking them up in or near the farm-yards as additional litter, and for other purposes. It should always be done as soon as possible after the wheat has been taken from the fields. See STUBBLE.

WHEAT, *Tillering of*, the throwing out of new shoots, stems, or stalks, from about the roots, so as to increase the thickness of the crops on the grounds. It takes place much more extensively in the autumnal and winter sown wheats than those of the spring sowings. See TILLER, and WHEAT.

WHEAT, *Transplantation of*, the practice of putting into the ground the young plants of wheat that have been raised in other places, or which stand too thick on the land. It is observed in the Middlesex Report on Agriculture, that it is well calculated for increasing the quantity of corn produced from a single grain, and that it may be resorted to for the sake of curiosity when the cultivator has procured a small quantity of some new and very valuable variety of seed; but that a farmer should never extend it to his field culture.

There would be much loss in labour and in other ways, it is supposed, by this practice, and nothing be gained by it. See TRANSPLANTING, and WHEAT.

WHEAT, *White-cone*, a term used by our husbandmen, to express a peculiar kind of wheat, which is very strong, and has a large ear.

It is the best kind for sowing in fields subject to the blight; for the stalks of it being, for the most part, solid or full of pith, like a rush, not hollow, like those of common wheat; the insects that cause the blight, seizing on the stalks of other wheat, do this no injury, even though they should attack it; the stalks of this kind being often found full of the black specks, which are always the marks of that insect having been there, and yet the ear full, and the grain good.

This wheat makes very good bread, if the miller does not grind it too small, or the baker make his dough too hard, it requiring to be somewhat larger than other wheat-flour, and somewhat softer in the dough. A bushel of white-cone wheat will make considerably more bread than a bushel of Lammas wheat; but it gives it a somewhat yellowish cast.

WHEAT-*Bird*, in *Ornithology*, a name given by the people of Virginia to a species of bird, which, after the time of the sowing of the wheat in that country, made its appearance annually at the season of its beginning to ripen, and was never seen there before. See MIGRATION *of Birds*.

WHEAT-*Ear*, the English name of the common œnanthe, or *motacilla œnanthe* of Linnæus, called also the *white-tail* and the *fallow-finch*. See MOTACILLA *Œnanthe*.

WHEATEN-BREAD. See THEORY *of Bread*, and WHEAT, *Grinding of*, &c.

WHEATFIELD, in *Geography*, a township of Pennsylvania, in the county of Indiana, with 1475 inhabitants.

WHEATLY, FRANCIS, in *Biography*, was born in London in 1747, and received his first instruction as an artist in Shipley's drawing-school. Whilst young he received several premiums from the Society for the Encouragement of Arts, &c. He does not appear to have had any particular instructor in painting, but by his own industry and ingenuity contrived to obtain some knowledge of it; and having formed an intimacy with Mr. Mortimer, whom he assisted in painting the ceiling at Brockett-hall, by that circumstance obtained considerable improvements. He had great employment in painting small whole-length portraits, to which he added landscape back-grounds with considerable taste. After practising some years in London, he went to Ireland, and was much employed in Dublin, where he painted a large picture of the Irish house of commons, with portraits of the most considerable political characters, by which he acquired great reputation. On his return to London he painted a picture of the soldiery attacking the rioters in 1780, which was well engraved by Heath.

About this time he appears to have changed his practice, and painted rural and domestic subjects in a manner which evidently exhibits them to have been the offspring of the natural bent of his mind. He was engaged in the Shakspeare Gallery, but failed to excite interest: neither his talent nor his style was suited to the character of the subjects given to him. In the slighter subjects of common life he was at home, and he touched them and composed them in a most agreeable manner, and with a very pleasing tone of colour;

colour: thefe he executed with rapidity, and, as he always fold them, he acquired fufficient money to indulge a natural propenfity to the pleafures of the table. Hence he became a martyr to the gout, and died of that difeafe in 1801, at the age of 54. He was elected an academician in 1791.

WHEE, Whey, *Whie*, or *Qui*, in *Rural Economy*, a term ufed to fignify a young heifer, or heifer-calf, in different places and parts of the country.

WHEEANG, or Whang, a provincial term made ufe of to fignify a thong or ftrap of leather for the harnefs or geer of farm-teams, or other domeftic purpofes.

WHEEL, Rota, in *Mechanics*, a fimple machine, confifting of a round piece of wood, metal, or other matter, which revolves on an axis.

For an account of the *wheel* and *axle*, as a mechanical power, fee Axis *in Peritrochio*, and Mechanical *Powers*.

The wheel is one of the principal mechanic powers. It has place in moft engines: in effect, it is of an affemblage of wheels that moft of our chief engines are compofed. Witnefs clocks, mills, &c.

Its form is various, according to the motion it is to have, and the ufe it is to anfwer. By this it is diftinguifhed into *fimple* and *dented*.

Wheels, *Simple*, are thofe whofe circumference and axis are uniform, and which are ufed fingly, and not combined. Such are the wheels of carriages, which are to have a double motion; the one circular about their axis; the other rectilinear, by which they advance along the road, &c. which two motions they appear to have; though, in effect, they have but one: it being impoffible the fame thing fhould move, or be agitated, two different ways at the fame time.

This one is a fpiral motion; as is eafily feen, by fixing a piece of chalk on the face of a wheel, fo as that it may draw a line on a wall, as the wheel moves. The line it here traces is a juft fpiral, and ftill the more curve, as the chalk is fixed nearer the axis.

The fact, however, has been difputed; and it has been alleged, that nothing is more eafy than for any one, who will take the trouble to make the experiment, to prove its falfehood. Place the chalk on the face of the wheel, as directed, and you will find that, fo far from its defcribing a juft fpiral, and that ftill the more curve as the chalk is fixed nearer the axis, the chalk, if placed on the periphery of the wheel, will defcribe a cycloid, and the nearer it is placed to the axis, the nearer will the line it defcribes approach to the ftraight line which is defcribed by the axis itfelf. Moreover, it is not true, nor pretended to be fo, that the fame thing moves two ways at once in the rectilinear and circular motion of wheels. The local motion, or motion of the whole wheel, is rectilinear only; that of the parts of the wheel circular. Nor can this latter motion with any propriety be called that of the wheel, unlefs the fame thing could alfo move quick and flow at the fame time, which the different parts of the wheel, in revolving round its axis, evidently do. Jacob's Obf. on the Structure and Draught of Wheel-Carriages, 1773, p. 28, &c.

For a very nice phenomenon, in the motion of thefe wheels, fee Rota *Ariftotelica*.

We fhall add, that, in wheels of this kind, the height fhould always be proportioned to the ftature of the animal that draws or moves them. The rule is, that the load and the axis of the wheels be of the fame height with the power that moves them; otherwife the axis being higher than the beaft, part of the load will lie upon him; or, if it be lower, he pulls to difadvantage, and muft exert a greater force. Though Stevinus, Dr. Wallis, &c. fhew, that, to draw a vehicle, &c. over wafte uneven places, it were beft to fix the traces to the wheels fomewhat lower than the horfe's breaft. See Wheels *of Coaches*, &c.

The power of thefe wheels refults from the differences of the radii of the axis, and circumference. The canon is this: "As the radius of the axis is to that of the circumference, fo is any power to the weight it can fuftain hereby."

This is alfo the rule in the axis in peritrochio; and, in effect, the wheel, and the axis in peritrochio, are the fame thing; only, in theory, it is ufually called by the latter name, and in practice by the former.

Wheels, *Dented*, are thofe either whofe circumference, or axis, is cut into teeth, by which they are capable of moving and acting on one another, and of being combined together.

The ufe of thefe is very confpicuous in clocks, jacks, &c.

The power of the dented wheel depends on the fame principle as that of the fimple one. It is only that to the fimple axis in peritrochio, which a compound lever is to a fimple lever.

Its doctrine is comprifed in the following canon; *viz.* "The ratio of the power to the weight," in order for that to be equivalent to this, "muft be compounded of the ratios of the diameter of the axis of the laft wheel to the diameter of the firft; and of the ratio of the number of revolutions of the laft wheel, to thofe of the firft, in the fame time." But this doctrine will deferve a more particular explanation.

1. Then, if the weight be multipled into the product of the radii of the axes, and that product be divided by the product of the radii of the wheels, the power required to fuftain the weight will be found. Suppofe, *e. gr.* the weight A (*Plate* XL. *fig.* 83. *Mechanics*,) = 6000 pounds, B C = 6 inches, C D = 34 inches, E F = 5 inches, E G = 35 inches, H I = 4 inches, H K = 27 inches: then will B C × E F × H I = 120; and C D × E G × H K = 32130. Hence the power required to fuftain the weight, will be 6000 × 120 ÷ 32130 = 22$\frac{1}{2}$ very nearly; a fmall addition to which will raife it.

2. If the power be multiplied into the product of the radii of the wheels, and the factum be divided by the product of the radii of the axes; the quotient will be the weight which the power is able to fuftain. Thus, if the power be 22$\frac{1}{2}$ pounds; the weight will be 6000 pounds.

3. A power and weight being given, to find the number of wheels, and in each wheel the ratio of the radius of the axis, to the radius of the wheel; fo as that the power, being applied perpendicularly to the periphery of the laft wheel, may fuftain the given weight.

Divide the weight by the power; refolve the quotient into the factors which produce it. Then will the number of factors be the number of wheels; and the radii of the axes will be to the radii of the wheels, as unity to the feveral wheels. Suppofe, *e. gr.* a weight of 3000 pounds, and a power of 60, the quotient of the former by the latter is 500, which refolves into thefe factors, 4. 5. 5. 5. Four wheels are, therefore, to be made; in one of which, the radius of the axis is to the radius of the wheel, as 1 to 4; in the reft, as 1 to 5.

4. If a power move a weight by means of two wheels, the revolutions of the flower wheel are to thofe of the fwifter, as the periphery of the fwifter axis is to the periphery of the wheel that catches on it.

Hence, 1. The revolutions are as the radius of the axis F E to the radius of the wheel D C. 2. Since the number

ber of teeth in the axis F D, is to the number of teeth in the circumference of the wheel M, as the circumference of that to the circumference of this; the revolutions of the flower wheel M, are to the revolutions of the fwifter N, as the number of teeth in the axis to the number of teeth in the wheel M, which it catches.

5. If the factum of the radii of the wheels G E, D C, be multiplied into the number of revolutions of the floweft wheel, M, and the product be divided by the factum of the radii of the axes which catch into them, G H, D E, &c. the quotient will be the number of revolutions of the fwifteft wheel O. *E. gr.* If G E = 8, D C = 12, G H = 4, D E = 3, and the revolution of the wheel M be 1; the number of revolutions of the wheel O will be 8.

6. If a power move a weight by means of divers wheels, the fpace paffed over by the weight, is to the fpace of the power, as the power to the weight. Hence, the greater the power, the quicker is the weight moved; and *vice verfâ*.

7. The fpaces paffed over by the weight and the power, are in a ratio compounded of the revolutions of the floweft wheel, to the revolution of the fwifteft; and of the periphery of the axis of that, to the periphery of this. Hence, fince the fpaces of the weight and the power are reciprocally as the fuftaining power is to the weight; the power that fuftains a weight will be to the weight, in a ratio compounded of the revolutions of the floweft wheel, to thofe of the fwifteft, and of the periphery of the axis of that, to the periphery of this.

8. The periphery of the axis of the floweft wheel, with the periphery of the fwifteft wheel, being given; as alfo the ratio of the revolutions of the one, to thofe of the other; to find the fpace which the power is to pafs over, while the weight goes any given length.

Multiply the periphery of the axis of the floweft wheel into the antecedent term of the ratio, and the periphery of the fwifteft wheel into the confequent term; and to thefe two products, and the given fpace of the weight, find a fourth proportional: this will be the fpace of the power. Suppofe, *e. gr.* the ratio of the revolutions of the floweft wheel, to thofe of the fwifteft, to be as 2 to 7, and the fpace of the weight 30 feet; and let the periphery of the axis of the floweft wheel be to that of the fwifteft, as 3 to 8: the fpace of the power will be found 280. For $2 \times 3 : 7 \times 8 :: 30 : 280$.

9. The ratio of the peripheries of the fwifteft wheel, and of the axis of the floweft; together with the ratio of their revolutions, and the weight, being given: to find the power able to fuftain it.

Multiply both the antecedents and the confequents, of the given ratios into each other, and to the product of the antecedents, the product of the confequents, and the given weight, find a fourth proportional: that will be the power required. Suppofe, *e. gr.* the ratio of the peripheries 8 : 3; that of the revolutions 7 : 2, and the weight 2000; the power will be found $214\frac{2}{7}$. For $7 \times 8 : 2 \times 3 :: 2000 : 214\frac{2}{7}$. After the fame manner may the weight be found; the power, and the ratio of the peripheries, &c. being given.

10. The revolutions the fwifteft wheel is to perform while the floweft makes one revolution, being given; together with the fpace the weight is to be raifed, and the periphery of the floweft wheel; to find the time that will be fpent in raifing it.

Say, As the periphery of the axis of the floweft wheel is to the given fpace of the weight; fo is the given number of revolutions of the fwifteft wheel to a fourth proportional: which will be the number of revolutions performed while the weight reaches the given height. Then, by experiment, determine the number of revolutions the fwifteft wheel performs in an hour; and, by this, divide the fourth proportional found before. The quotient will be the time fpent in raifing the weight. Wolf. Elem. Math. tom. ii. p. 214, &c.

Wheels *of a Clock*, &c. are the crown wheel, contrate wheel, great wheel, fecond wheel, third wheel, ftriking wheel, detent wheel, &c. See Clock and Watch.

Wheels *of Coaches*, *Waggons*, &c. With refpect to thefe, the following particulars are collected from the experiments and reafonings of Camus, Defaguliers, Beighton, Fergufon, Brewfter, &c.

1. The ufe of wheels, in the draught of carriages, is two-fold; *viz.* that of diminifhing, or of more eafily overcoming the refiftance arifing from the friction of the carriage, and that of more readily furmounting obftacles, which form angular prominences on the plane over which they are drawn, and which muft be either depreffed by the weight of the carriage, or render it neceffary for the carriage, with its load, to be lifted over them. They ferve in their firft ufe to transfer the friction from the under furface of the carriage, and the plane fupporting it, to the furfaces of the axle and nave of the wheel. The common method of accounting for this advantage is by faying, that the refiftance, arifing from friction in planes of equal afperity, increafes with the velocity of the motion; fo that this velocity muft be compared with that of the power neceffary to move the machine, and overcome the friction; and it is obvious, at the fame time, that the velocity of a circular motion diminifhes gradually from the circumference to the centre. See Friction.

But to this pofition it has been objected, that the illuftration is not applicable to the cafe: for, granting that, in the friction of fledges or flat furfaces, the refiftance increafes in proportion to the velocity of their motion, this is not a parallel cafe with that of a circular furface rolling over a flat plane. On the contrary, the velocity of motion, in the outer furface of a wheel, is greater than that of its nave, moving under the axle; while at fuch outer furface there is little or no friction at all; whereas at the nave, moving much flower, there is much more. Indeed, the friction, which the wheel would have againft its fupporting plane, if it did not turn round its axis, is by its turning round transferred almoft wholly to the axis and nave; whofe circular motion is notwithftanding fo much flower. It is, indeed, notorious, that the great friction of the wheels of carriages lies between the axle and nave; and how then can it be properly afferted, that fuch friction is diminifhed at the axle, as the velocity of the circular motion is there diminifhed? Accordingly it has been alleged by a late writer, that friction is not diminifhed by the ufe of wheels, but merely transferred from the outer furface of the wheel to its nave and axle; and that in the cafe of a wheel rolling along the ground, the fpokes act only as fingle levers, to overcome the friction of the periphery againft the plane of its fupport, the prominences, conftituting the roughnefs of the plane over which it moves, being the fulcra upon which they turn, and not the common centre of thefe fpokes, as others have maintained, who fay that the wheel acts, in overcoming friction, as an axis in peritrochio. However, in obviating the friction of the wheels in loaded carriages, their fpokes act as double levers, refting on a fulcrum at each end. See the author's method of illuftrating and evincing thefe principles, in Jacob's Obf. on Wheel-Carriages, p. 23, &c.

If carriages were to move along fmooth horizontal planes, wheels would be useful only in overcoming friction; but as they are drawn along roads covered with loose stones, indented with cavities, they are farther useful in serving to depress, or raise the carriage over the one, and in raising it out of the other.

2. The wheels of all carriages ought to be exactly round; and the fellies should be at right angles to the naves, according to the inclination of the spokes, *i. e.* the plane of the curvature of the wheel should cut the nave at right angles, though it need not pass through the place where the spokes are inserted into the nave.

3. The spokes, according to Mr. Ferguson and most other writers on mechanics, should be inclined to the naves, so that the wheels may be dishing or concave. If, indeed, the wheels were always to go upon smooth and level ground, it would be best to make the spokes perpendicular to the naves, or at right angles with the axles; because they would then bear the weight of the load perpendicularly, which is the strongest way for the wood. But because the ground is generally uneven, one wheel often falls into a cavity or rut, when the other does not, and then it bears much more of the weight than the other does; in which case dishing wheels are best, because the spokes become perpendicular in the rut, and therefore have the greatest strength when the obliquity of the road throws most of its weight upon them; whilst those on the high ground have less weight to bear, and therefore need not be at their full strength. Besides, by this form of the wheels, the base of the carriage is extended, and it is thus prevented from being easily overturned, and the fellies are hindered from rubbing against the load or the sides of the cart. Dr. Brewster, however, is of opinion, that the disadvantages of concave wheels overbalance their advantages. Mr. Anstice also, in his "Treatise on Wheel-Carriages," whilst he recommends concave wheels, candidly allows, that some disadvantages attend this construction of them; for the carriage thus takes up more room on the road, so that it is more unmanageable; and when it moves upon plane ground the spokes not only do not bear perpendicularly, by which means their strength is lessened, but the friction upon the nave and axle is made unequal, and so much the more as they are the more dished. Dr. Brewster farther shews, that they are more expensive, more injurious to the roads, more liable to be broken by accidents, and less durable in general, than those wheels in which the spokes are perpendicular to the naves. From these and other considerations, our author is decidedly of opinion, that if wheels are to be composed of naves, spokes, and fellies, the rim should be cylindrical, and the spokes perpendicular to the naves; whereas in concave wheels, the rims are uniformly made conical, which subjects them to a variety of disadvantages. Every cone that is put in motion upon a plane surface will revolve round its vertex, and if force is employed to confine it to a straight line, the smaller parts of the cone will be dragged along the ground, and the friction greatly increased. Now when a cart moves upon conical wheels, one part of the cone rolls while the other is dragged along, and though confined to a rectilineal direction by external force, their natural tendency to revolve round their vertex occasions a great and continued friction upon the linch-pin, the shoulder of the axle-tree, and the sides of deep ruts.

Dr. Brewster has made some farther observations on the construction of certain parts of the wheels. The iron plates, he says, of which the rims are composed, should never be less than three inches in breadth, as narrower rims sink deep into the ground, and therefore injure the roads and fatigue the horses. See the sequel of this article.

4. The axles of the wheels ought to be perfectly straight, and at right angles to the shafts, or to the pole. When the axles are straight, the rims of the wheels will be parallel to each other, and then they will move the easiest, because they will be at liberty to go on straight forwards. But in the usual way of practice, the axles are bent downwards at their ends; which brings the sides of the wheels next the ground nearer to one another than their higher sides are; and this not only makes the wheels to drag sideways as they go along, and gives the load a much greater power of crushing them than when they are parallel to each other, but also endangers the overturning of the carriage when any wheel falls into a hole or rut, or when the carriage goes on a road which has one side lower than the other, as along the side of a hill. Thus, in the hind view of a waggon or cart, let A E and B F (*Plate* XL. *fig.* 9. *Mechanics*) be the great wheels parallel to each other, on their straight axle K, and H C I the carriage loaded with heavy goods from C to G. Then as the carriage goes on in the oblique road A *a* B, the centre of gravity of the whole machine and load will be at C; and the line of direction C *d* D falling within the wheel B F, the carriage will not overset. But if the wheels be inclined to each other at the ground, as A E and B F are (*fig.* 10.), and the machine be loaded as before from C to G, the line of direction C *d* D falls without the wheel B F, and the whole machine tumbles over. When it is loaded with heavy goods which lie low, it may travel safely upon an oblique road, so long as the centre of gravity is at C (*fig.* 9.), and the line of direction C *d* D falls within the wheels; but if it be loaded high with lighter goods from C to L (*fig.* 11.), the centre of gravity is raised from C to K, which shews the line of direction K *k* without the lowest edge of the wheel B F, and then the load oversets the waggon. Mr. Beighton has offered several reasons to prove, that the axles of wheels ought not to be straight: for which we must refer to Desaguliers' Exp. Phil. vol. ii. Appendix, p. 540, &c. Moreover, if the axle were not at right angles to the pole or shaft, but this was on one side, then the coach or carriage would be drawn on one side, and almost all the weight would bear upon one horse. With some mechanics, it is a practice to bend the ends of the axle-trees forwards, and thus make the wheels wider behind than before. Mr. H. Beighton maintains, that wheels in this position are more favourable for turning; since, when the wheels are parallel, the outermost would press against the linch-pin, and the innermost would rub against the shoulder of the axle-tree. In rectilineal motions, however, these converging wheels occasion a great deal of friction, both on the axle and the ground, and must therefore be more disadvantageous than parallel ones. This fact is allowed by Mr. Beighton: but he seems to found his opinion upon this principle; that as the roads are seldom straight lines, the wheels should be more adapted to a curvilineal than to a rectilineal motion.

5. Large wheels are always more advantageous for rolling than small ones, in any case, or upon any ground whatever. If we consider wheels with regard to their friction upon the axles, it is evident, that small wheels must turn as much oftener round than the large ones, as their circumferences are less; and, therefore, a wheel which is twice as large as another will have twice the advantage in respect of the friction, the holes of the naves and axles, and the weights upon them, being equal. Again, if we consider the wheels as they sink into the earth, or fall into holes, the bearing of the great wheel being double that of the small one, it would sink but half so deep; and if the small wheel should meet with a hole of the same diameter with itself, it would wholly sink in, whilst only a segment less than half of the great wheel

wheel would fall in: the fame thing would alfo happen in marfhy ground, where the fmall wheel would fink wholly in the fame hole which the great one would fink into but in part. The large wheel would alfo have the advantage of a fmall one in rifing over eminences or rubs that occurred; fo that the former would go over rubs much higher than the latter; and indeed over any eminences, provided their height be not equal to its femidiameter. Defaguliers has reduced this matter to a mathematical calculation, in his Exp. Phil. vol. i. p. 171, &c.

A late writer has alfo proved, that a wheel of eight feet diameter has fomewhat more than twice the advantage in overcoming obftacles of a wheel of two feet; and he found, in practice, that if it requires a certain power to draw a carriage of a certain weight over a certain obftacle, with wheels of any determinate diameter, it will require wheels of four times that diameter, to draw the fame carriage over the fame obftacle with half that power. This writer alfo obferves, that, in the draught of carriages afcending inclined planes, the moving power acts not only againft the vis inertiæ, which is always equal to the abfolute gravity of the load, but alfo againft its relative gravity, which increafes with the inclination of the plane; and with refpect to carriages raifed on wheels, it is to be obferved, that the higher the axle is removed from the plane, the farther is the centre of gravity removed out of the perpendicular line of fupport; fo that the lower the wheel, the lefs is the relative gravity of the carriage. Hence he infers, that fuppofing the friction of two carriages of equal weight, but of different fized wheels, to be equal, the low-wheeled one would be drawn up hill, on a fmooth plane, much more eafily than the high-wheeled one; though on a fmooth, horizontal plane, the latter would be drawn more eafily than the former. On the contrary, in going down hill, the high-wheeled carriage will be urged forward, by its relative gravity, more than the low-wheeled one. Jacob, ubi fupra, p. 63, &c.

It appears, therefore, that the larger wheels are, the more advantageous they are in proportion, provided that they are not more than five or fix feet in diameter; for when they exceed thefe dimenfions, they become heavy; or if they are made light, their ftrength is proportionably diminifhed, and the fpokes, being long, are more liable to break: befides, horfes applied to fuch wheels, would be incapable of exerting their utmoft ftrength, by having the axles higher than their breafts, fo that they would draw downwards; as in fmall wheels the draught is made more difficult, by the horfes drawing upwards.

It is obferved by Dr. Brewfter, in the appendix to his edition of "Fergufon's Mechanics," that when the wheels of carriages either move upon a level furface, or overcome obftacles which impede their progrefs, they act as mechanical powers, and may be reduced to levers of the firft kind. In order to elucidate this remark, which is of great importance in the prefent difcuffion, let A be the centre, and B C N the circumference of a wheel 6 feet in diameter, and let the impelling power P, which is attached to the extremity of a rope A D P, paffing over the pulley D, act in the horizontal direction A D. Then, if the wheel is not affected by friction, it will be put in motion upon the level furface M B, when the power P is infinitely fmall. For fince the whole weight of the wheel refts on the ground at the point B, which is the fulcrum of the lever A B, the diftance of the weight from the centre of motion will be nothing, and therefore the mechanical energy of the fmalleft power P, acting at the point A, with a length of lever A B, will be infinitely great when compared with the refiftance of the weight to be raifed; and this will be the cafe, however fmall the lever A B, and however great be the weight of the wheel. But as the wheels of carriages are conftantly meeting with impediments, let C be an obftacle fix inches high, which the wheel is to furmount. Then the fpoke A C will reprefent the lever, C its fulcrum, A D the direction of the power; and if the wheel weighs 100 pounds, we may reprefent it by a weight W, fixed to the wheel's centre A, or to the extremity of the lever C A, and acting in the perpendicular direction A B, in oppofition to the power P. Now the mechanical energy of the weight W to pull the lever round its fulcrum in the direction A E, is reprefented by C E, while the mechanical energy of an equal weight P to pull it in the oppofite direction A F, is reprefented by C F; an equilibrium, therefore, will be produced, if the power P is to the weight W as C E to C F, or as the fine is to the cofine of an angle, whofe verfed fine is equal to the height of the obftacle to be furmounted; for E B, the height of the mound C, is the verfed fine of the angle B A C, and C E is the fine, and C F the cofine of the fame angle. In the prefent cafe, where E B is fix inches, and A B three feet, E B, the verfed fine, will be 1666, &c. when A B is 1000; and, confequently, the angle B A C will be 33° 33′, and C E will be to E F, as 52 to 83, or as 66 to 100. A weight P, therefore, of 66 pounds, acting in a horizontal direction, will balance a wheel fix feet diameter, and 100 pounds in weight, upon an obftacle fix inches high; and a fmall additional power will enable it to furmount that obftacle. But if the direction, A D, of the power, be inclined to the horizon, fo that the point D may rife towards H, the line F C, which reprefents the mechanical energy of P, will gradually increafe, till D A has reached the pofition H A, perpendicular to A C, where its mechanical energy, which is now a maximum, is reprefented by A C, the radius of the wheel; and fince E C is to C A as 53 to 1000, a little more than 53 pounds will be fufficient for enabling the wheel to overcome the obftacle.

Proceeding in this way, it will be found, fays our author, that the power of wheels to furmount eminences increafes with their diameter, and is directly proportional to it, when their weight remains the fame, and when the direction of the power is perpendicular to the lever which acts againft the obftacle. Hence we fee the great advantages which are to be derived from large wheels, and the difadvantages which attend fmall ones. There are fome circumftances, however, which confine us within certain limits in the ufe of large wheels. When the radius A B of the wheel is greater than D M, the height of the pulley, or of that part of the horfe to which the rope or pole D A is attached, the direction of the power, or the line of traction A D, will be oblique to the horizon as A *d*, and the mechanical energy of the power will be only A *e*, whereas it was reprefented by A E when the line of traction was in the horizontal line D A. Whenever the radius of the wheel, therefore, exceeds four feet and a half, the height of that part of the horfe to which the traces fhould be attached, the line of traction A D will incline to the horizon, and by declining from the perpendicular A H, its mechanical effort will be diminifhed; and fince the load refts upon an inclined plane, the trams or poles of the cart will rub againft the flanks of the horfe, even in level roads, and ftill more feverely in defcending ground. Notwithftanding this diminution of force, however, arifing from the unavoidable obliquity of the impelling power, wheels exceeding four and a half feet radius have ftill the advantage of fmaller ones; but their power to overcome refiftances does not increafe fo faft as before. Hitherto we have fuppofed the weight of the large and fmall wheels to be the fame, but

 it

it is evident that when we augment their diameter we add greatly to their weight; and by thus increafing the load, we fenfibly diminifh their power.

From thefe remarks, we fee the fuperiority of great wheels to fmall ones, and the particular circumftances which fuggeft the propriety of making the wheels of carriages lefs than four feet and a half radius. But even this fize is too great; and it may be fafely afferted that they fhould never exceed fix feet in diameter, nor ever be lefs than three feet and a half.

6. Carriages with four wheels, as waggons or coaches, are much more advantageous than carriages with two wheels, as carts and chaifes; for in applying horfes to a carriage with two wheels, it is plain that the tiller carries part of the weight, in whatfoever manner it be kept in equilibrio upon the axle. In going down a hill, the weight bears upon the horfe; and in going up a hill, the weight falls the other way, and lifts the horfe, by which means part of his force is loft. Befides, as the wheels fink into the holes in the road, fometimes on one fide, fometimes on the other, the fhafts ftrike againft the tiller's flanks, which is the deftruction of many horfes. Add to this, that when one of the wheels finks into a hole or rut, half the weight will fall that way, whereby the carriage will be in danger of being overturned.

7. It would be much more advantageous to make the four wheels of a coach or waggon large, and nearly of a height, than to make the fore-wheels of only half the diameter of the hind-wheels, as is ufual in many places. The fore-wheels of carriages have commonly been made of a lefs fize than the hind ones, both on account of turning fhort, and to avoid cutting the braces. Crane-necks have alfo been invented for turning yet fhorter, and the fore-wheels have been lowered, fo as to go quite under the bend of the crane-neck. See an account of an ingenious contrivance for this purpofe, under PERCH.

Some carriers and coachmen have, indeed, abfurdly alleged, that when the fore-wheels are much lower than the hind ones, they ferve to pufh them on. However, many difadvantages attend this conftruction. A confiderable force is loft that would be effectual, if they were large: the carriage would go much more eafily, if the fore-wheels were as high as the hind-ones; and the higher the better, becaufe their motion would be fo much the flower on their axles, and confequently the friction proportionably diminifhed. The jolting and uneafy motion occafioned by low wheels, has induced perfons to contrive fprings, in order to prevent it. But nothing can be more inconfiftent, even with this end, than the common method of fixing the braces to the bottom of the body of a carriage. In confequence of this practice, the centre of gravity of the fufpended body is fo high above the centre of its motion, that it is liable to be continually agitated by the jolting of the carriage, and its danger of overturning increafed: whereas if, inftead of practifing this method, the body were fufpended as near as poffible to its centre of gravity, the agitation of the carriage, as well as its danger of overturning, would be in a great meafure avoided.

The effect of the fufpenfion of a carriage on fprings is to equalize its motion, by caufing every change to be more gradually communicated to it, by means of the flexibility of the fprings, and by confuming a certain portion of every fudden impulfe in generating a degree of rotatory motion. This rotatory motion depends on the oblique pofition of the ftraps fufpending the carriage, which prevents its fwinging in a parallel direction; fuch a vibration as would take place if the ftraps were parallel, would be too extenfive, unlefs they were very fhort, and then the motion would be fomewhat rougher. The obliquity of the ftraps tends alfo in fome meafure to retain the carriage in a horizontal pofition: for if they were parallel, both being vertical, the lower one would have to fupport the greater portion of the weight, at leaft according to the common mode of fixing them to the bottom of the carriage; the fpring, therefore, being flexible, it would be ftill further depreffed. But when the ftraps are oblique, the upper one affumes always the more vertical pofition, and confequently bears more of the load; for when a body of any kind is fupported by two oblique forces, their horizontal thrufts muft be equal, otherwife the body would move laterally; and in order that the horizontal portions of the forces may be equal, the more inclined to the horizon muft be the greater: the upper fpring will, therefore, be a little depreffed, and the carriage will remain more nearly horizontal than if the fprings were parallel. The reafon for dividing the fprings into feparate plates has already been explained: the beam of the carriage, that unites the wheels, fupplies the ftrength neceffary for forming the communication between the axles: if the body of the carriage itfelf were to perform this office, the fprings would require to be fo ftrong that they could have little or no effect in equalizing the motion, and we fhould have a waggon inftead of a coach. The eafe with which a carriage moves, depends not only on the elafticity of the fprings, but alfo on the fmall degree of ftability of the equilibrium, of which we may judge in fome meafure, by tracing the path which the centre of gravity muft defcribe, when the carriage fwings.

There is an inconvenience which attends the ufual method of loading carriages; for when a carriage is loaded equally heavy on both axles, the fore-axle muft endure as much more friction, and confequently wear out as much fooner than the hind-axle, as the fore-wheels are lefs than the hind ones. However, the carriers commonly put the heavier part of the load upon the fore-axle of the waggons; which not only makes the friction greateft where it ought to be leaft, but alfo preffeth the fore-wheels deeper into the ground than the hind-wheels, although the fore-wheels, being lefs than the hind ones, are with fo much the greater difficulty drawn out of a hole, or over an obftacle, even fuppofing the weights on their axles were equal; for the difficulty, with equal weights, will be as the depth of the hole, or height of the obftacle, is to the femi-diameter of the wheel. Moreover, fince a fmall wheel will often fink to the bottom of a hole, in which a great wheel will go but a very little way, the fmall wheels ought to be loaded with lefs weight than the great ones; and then the heavier part of the load would be lefs jolted upward and dnwnward, and the horfes tired fo much the lefs, as their draught raifed their load to lefs heights. When the waggon-road, indeed, is much up-hill, there may be danger in loading the hind-part much heavier than the fore-part; for then the weight would over-hang the hind axle, efpecially if the load be high, and endanger tilting up the fore-wheels from the ground. In this cafe, the fafeft way would be to load it equally heavy on both axles; and then as much more of the weight would be thrown upon the hind axle than upon the fore one, as the ground rifes from a level below the carriage. But as this feldom happens, a fmall temporary weight might be laid upon the pole between the horfes, which would overbalance the danger.

From Mr. Ferguson's obfervations on the centre of gravity, it is evident, that if the axle-tree of a two-wheeled carriage paffes through the centre of gravity of the load, the carriage will be in equilibrio in every pofition in which it can be placed with refpect to the axle-tree; and in in going up and down hill, the whole load will be ſuſtained by the wheels, and will have no tendency either to preſs the horſe to the ground, or to raiſe him from it. But if the centre of gravity is far above the axle-tree, as it muſt neceſſarily be according to the preſent conſtruction of wheel-carriages, a great part of the load will be thrown on the back of the horſes from the wheels, when going down a ſteep road, and thus tend to accelerate the motion of the carriage, which the animal is ſtriving to prevent: while in aſcending ſteep roads a part of the load will be thrown behind the wheels, and tend to raiſe the horſe from the ground, when there is the greateſt neceſſity for ſome weight on his back, to enable him to fix his feet on the earth, and overcome the great reſiſtance which is occaſioned by the ſteepneſs of the road. On the contrary, if the centre of gravity is below the axle, the horſe will be preſſed to the ground in going up-hill, and lifted from it when going down. In all theſe caſes, therefore, where the centre of gravity is either in the axle-tree, or directly above or below it, the horſe will bear no part of the load in level ground. In ſome ſituations, the animal will be lifted from the ground when there is the greateſt neceſſity for his being preſſed to it, and he will ſometimes bear a great proportion of the load when he ſhould rather be relieved from it.

The only way of remedying theſe evils, ſays Dr. Brewſter, is to aſſign ſuch a poſition to the centre of gravity, that the horſe may bear ſome portion of the load when he muſt exert great force againſt it, that is, in level ground, and when he is aſcending ſteep roads; for no animal can pull with its greateſt effort, unleſs it is preſſed to the ground. Now, this may in ſome meaſure be effected in the following manner:—Let B C N (*Plate* XL. *fig.* 12.) be the wheel of a cart, A D one of the ſhafts, D that part of it where the cart is ſuſpended on the back of the horſe, and A the axle-tree; then if the centre of gravity of the load is placed at *m*, a point equidiſtant from the two wheels, but below the line D A, and before the axle-tree, the horſe will bear a certain weight on level ground, a greater weight when he is going up-hill, and has more occaſion for it, and a leſs weight when he is going down-hill, and does not require to be preſſed to the ground. All this will be evident from the figure, when we recollect that if the ſhaft D A is horizontal, the centre of gravity will preſs more upon the point of ſuſpenſion D the nearer it comes to it; or the preſſure upon D, or the horſe's back, will be proportional to the diſtance of the centre of gravity from A. If *m* therefore be the centre of gravity, *b* A will repreſent its preſſure upon D, when the ſhaft D A is horizontal. When the cart is aſcending a ſteep road, A H will be the poſition of the ſhaft, the centre of gravity will be raiſed to *a*, and *a* A will be the preſſure upon D. But if the cart is going down hill, A C will be the poſition of the ſhaft, the centre of gravity will be depreſſed to *n*, and *c* A will repreſent the preſſure upon the horſe's back. The weight ſuſtained by the horſe, therefore, is properly regulated by placing the centre of gravity at *m*. We have ſtill, however, to determine the proper length of *b a* and *b m*, the diſtance of the centre of gravity from the axle, and from the horizontal line D A; but as theſe depend upon the nature and inclination of the roads, upon the length of the ſhaft D A, which varies with the ſize of the horſe, on the magnitude of the load, and on other variable circumſtances, it would be impoſſible to fix their value. If the load, along with the cart, weighs four hundred pounds, if the diſtance D A be eight feet, and if the horſe ſhould bear fifty pounds of the weight, then *b* A ought to be one foot, which being one-eighth of D A, will make the preſſure upon D exactly fifty pounds. If the road ſlopes four inches in one foot, *b m* muſt be four inches, or the angle *b* A *m* ſhould be equal to the inclination of the road, for then the point *m* will riſe to *a* when aſcending ſuch a road, and will preſs with its greateſt force on the back of the horſe.

When carts are not conſtructed in this manner, we may, in ſome degree, obtain the ſame end by judiciouſly diſpoſing the load. Let us ſuppoſe that the centre of gravity is at O when the cart is loaded with homogeneous materials, ſuch as ſand, lime, &c. then if the load is to conſiſt of heterogeneous ſubſtances, or bodies of different weight, we ſhould place the heavieſt at the bottom, and neareſt the front, which will not only lower the point O, but will bring it forward, and nearer the proper poſition *m*. Part of the load, too, might be ſuſpended below the fore-part of the carriage in dry weather, and the centre of gravity would approach ſtill nearer the point *m*. When the point *m* is thus depreſſed, the weight on the horſe is not only judiciouſly regulated, but the cart will be prevented from overturning, and in rugged roads the weight ſuſtained by each wheel will be in a great degree equalized.

In loading four-wheeled carriages, great care ſhould be taken not to throw much of the load upon the fore-wheels, as they would otherwiſe be forced deep into the ground, and require great force to pull them forward. In ſome modern carriages, this is very little attended to. The coachman's ſeat is ſometimes enlarged ſo as to hold two perſons, and all the baggage is generally placed in the front, directly above the wheels. By this means the greateſt part of the load is upon the ſmall wheels, and the draught becomes doubly ſevere for the poor animals, who muſt thus unneceſſarily ſuffer for the ignorance and folly of man.

There is another great diſadvantage attending ſmall fore-wheels; *viz.* that as their axle is below the level of the horſe's breaſts, the horſes not only have the loaded carriage to draw along, but alſo part of its weight to bear, which tires them ſooner, and makes them grow much ſtiffer in their hams, than they would be if they drew on a level with the fore-axle; and for this reaſon, coach-horſes ſoon become unfit for riding. So that on all accounts it is plain, that the fore-wheels of all carriages ought to be ſo high as to have their axles even with the breaſts of the horſes; which would not only give them a fair draught, but likewiſe cauſe the machine to be drawn by a leſs degree of power.

Mr. Beighton diſputes the propriety of fixing the line of traction on a level with the breaſt of a horſe, and ſays it is contrary to reaſon and experience. Horſes, he ſays, have little or no power to draw, but what they have from their weight; otherwiſe they could take no hold of the ground, and then they muſt ſlip, and draw nothing. Common experience alſo teaches, that if a horſe is to convey a certain weight, he ought, that he may draw the better, to have a proportional weight on his back or ſhoulders. Beſides, when a horſe draws hard, he bends forward, and brings his breaſt near the ground; and then, if the wheels are high, he is pulling the carriage againſt the ground. A horſe tackled in a waggon will draw two or three ton, becauſe the point or line of traction is below his breaſt, by reaſon of the wheels being low. And it is very common to ſee, when one horſe is drawing a heavy load, his fore-feet will riſe from the ground; and he will nearly ſtand on end; in which caſe it is uſual to add a weight on his back, to keep his fore-part down, by a perſon mounting on him, which will enable him to draw that load, without which he before could not move. The great ſtreſs, or main buſineſs of drawing, ſays this ingenious writer, is to overcome obſtacles; for on level plains the drawing is but little, and then the horſe's back need be preſſed but with a ſmall weight. Moſt or all of theſe obſtacles may be confidered as inclined planes. In order to draw the wheel A B (*Plate* XL. *Mechanics*, *fig.* 13.) over the obftacle D, M. de Camus, agreeably to the principles above laid down, would have the horfe draw in the line H C; whereas Mr. Beighton fays, fince the obftacle is D, and the tangent of the earth, or line of the floor, is at B, and the line to be moved in is B D, an inclined plane; the eafieft pofition of drawing, to get the wheel over D, is to draw in the pofition of that inclined plane B T, or its parallel C *b*. As all the radii of a wheel are equal, the pulling at the centre is the fame as a balance in equilibrio; *viz.* there is the fame force at A as at B. But in the cafe of drawing in the horizontal line H C, when the obftacle is at D, the whole force which the horfe has for drawing is by the fhort end of the brachium $= e$ D, againft the force or weight of the long end of the brachium f D $= c$ C, which muft be very difadvantageous; therefore, he fays, the line of traction fhould be *b* C. Defag. Exp. Phil. vol. ii. App. p. 542, &c.

Whilft M. Camus maintained that the line of traction fhould be an horizontal line, or always parallel to the ground on which the carriage is moving, becaufe the horfe can exert his greateft ftrength in this direction, and becaufe the line of draught, being perpendicular to the vertical fpoke of the wheel, acts with the largeft poffible lever, M. Couplet, confidering that the roads are never perfectly level, and that the wheels are conftantly furmounting fmall eminences, even in the beft roads, recommends the line of traction to be oblique to the horizon. It is, however, to M. Deparcieux (Sur le Tirage des Chevaux, Mem. Acad. Roy., 1760.), that we are principally indebted for juft ideas on this fubject. He has fhewn in the moft fatisfactory manner that animals draw by their weight, and not by the force of their mufcles. In four-footed animals, the hinder feet are the fulcrum of the lever by which their weight acts againft the load; and when the animal pulls hard, it depreffes its cheft, and thus increafes the lever of its weight, and diminifhes the lever by which the load refifts its effects. Thus in *Plate* XL. *Mechanics*, *fig.* 12, let P be the load, D A the line of traction, and let us fuppofe F C to be the hinder leg of the horfe, A F part of its body, A its cheft or centre of gravity, and C E the level road. Then A F C will reprefent the crooked lever by which the horfe acts, which is equivalent to the ftraight one A C. But when the horfe's weight acts downwards at A, round C as a centre, fo as to drag forward the rope A D, and raife the load P, C E will reprefent the power of the lever in this pofition, or the lever of the horfe's weight, and C F the lever by which it is refifted by the load, or the lever of refiftance. Now, if the horfe lowers its centre of gravity A, which it always does when it pulls hard, it is evident that C E, the lever of its weight, will be increafed, while C F, the lever of its refiftance, will be diminifhed, for the line of traction A D will approach nearer to C E. Hence we may fee the great benefit which may be derived from large horfes, for the lever A C neceffarily increafes with their fize, and their power is always proportioned to the length of this lever, their weight remaining the fame. Large horfes, therefore, and other animals, will draw more than fmall ones, even though they have lefs mufcular force, and are unable to carry fuch a heavy burden. The force of the mufcles tends only to make the horfe carry continually forward his centre of gravity; or, in other words, the weight of the animal produces the draught, and the play and force of its mufcles ferve to continue it.

From thefe remarks, then, according to Dr. Brewfter's ftatement, we may deduce the proper pofition of the line of traction. When the line of traction is horizontal, as A D, the lever of refiftance is C F; but if this line is oblique to the horizon, as A *d*, the lever of refiftance is diminifhed to C *f*, while the lever of the horfe's weight remains the fame. Hence it appears, that inclined traces are much more advantageous than horizontal ones, as they uniformly diminifh the refiftance to be overcome. Deparcieux, however, has inveftigated experimentally the moft favourable angle of inclination, and found, that when the angle D A F, made by the trace A *d*, and a horizontal line, is fourteen or fifteen degrees, the horfes pulled with the greateft facility and force. This value of the angle of draught will require the height of the fpring-tree bar, to which the traces are attached in four-wheeled carriages, to be one-half of the height of that part of the horfe's breaft to that with which the fore end of the traces is connected.

This height is about four feet fix inches, and therefore the height of the fpring-tree bar fhould be only two feet three inches, whereas it is generally three feet.

8. The utility of broad wheels, in amending and preferving the roads, has been fo long and generally acknowledged, as to have occafioned fevera lacts of the legiflature to enforce their ufe. See TURNPIKE.

Several excellent and well-devifed experiments have not long ago been inftituted by Boulard and Margueron, which have fatisfactorily evinced the diftinguifhing advantage of broad wheels. See a Memoir prefented to the Academy of Lyons, in the Journal de Phyfique, tom. xix. p. 424.

Neverthelefs, the proprietors and drivers of carriages feem to be convinced by experience, that a narrow-wheeled carriage is more eafily and fpeedily drawn by the fame number of horfes than a broad-wheeled one of the fame burthen. And though government allowed them to draw with more horfes, and carry greater loads than ufual, they were perfuaded with difficulty to comply with the requifition of legiflature; and methods have been ufed to evade it. Their principal objection has been, that as a broad wheel muft touch the ground in many more points than a narrow wheel, the friction muft of courfe be fo much the greater; not confidering, that if the whole weight of the waggon, and load in it, bears upon many points, each fuftains a proportionable lefs degree of weight and friction than when it bears only upon a few points; fo that what is wanting in one is made up in the other, and, therefore, will be juft equal under equal degrees of weight, as appears by the following plain and eafy experiment propofed by Mr. Ferguson.

Let one end of a piece of packthread be faftened to a brick, and the other end to a common fcale for holding weights; then having laid the brick edgeways on a table, and letting the fcale hang under the edge of the table, put as much weight into the fcale as will juft draw the brick along the table. Then taking the brick to its former place, lay it flat on the table, and leave it to be acted upon by the fame weight in the fcale as before, which will draw it along with the fame eafe as when it lay upon its edge. In the former cafe, the brick may be confidered as a narrow wheel on the ground; and in the latter as a broad wheel. And fince the brick is drawn along with equal eafe, whether its broad fide or narrow edge touches the table, it fhews that a broad wheel might be drawn along the ground with the fame eafe as a narrow one, fuppofing them equally heavy, even though they fhould drag, and not roll as they go along. Befides, as narrow wheels are always finking into the ground, efpecially when the heavieft part of the load lies upon them, they muft be confidered as conftantly going up hill, even on level ground; and their edges muft fuftain much friction by rubbing

rubbing againſt the ſides of the ruts made by them. But both theſe inconveniences are avoided by broad wheels; which, inſtead of cutting and ploughing up the roads, roll them ſmooth, and harden them: though, after all, it muſt be confeſſed, that they will not do in ſtiff, clayey croſs roads; becauſe they would ſoon gather up as much clay as would be almoſt equal to the weight of an ordinary load; and alſo in paſſing along roads abounding with looſe ſtones and other obſtacles, which a narrow wheel may avoid paſſing over, and a broad one muſt ſurmount, the broad-wheel carriage will certainly be drawn leſs eaſily and leſs ſpeedily than a narrow-wheeled one, though not on account of any additional friction ariſing from the preſſure of the weight on a greater quantity of ſurface. Broad wheels are likewiſe more liable to an inequality of preſſure between the axle and box than narrow ones, and conſequently to a greater wear and tear.

Jacob's Obſ. on the Structure and Draught of Wheel-Carriages, 1773, p. 81, &c. See on the ſubject of the preceding article, Deſag. Ex. Phil. vol. i. p. 201, &c. Ferguſon's Lect. p. 56, &c. 4to., and Appendix by Brewſter. Martin's Phil. Brit. vol. i. p. 229, &c.

We ſhall here ſubjoin ſome additional remarks on wheels and axles for carriages. The eſſential qualities of wheels are ſtrength and durability, and it is deſirable that they ſhould be as light as is conſiſtent with ſtrength: for quick travelling carriages lightneſs is very neceſſary.

Wheels to four-wheel carriages ſhould be made as near of a height as the conſtruction and appearance will admit; and if not required for heavy work, the lighter they are made the better. The fixtures from whence the draught is taken ſhould be placed rather above the centre of the largeſt wheel, for advantage of draught.

The members of a wheel are of three deſcriptions; *viz.* the nave, or ſtock, which is the central piece; the ſpokes, or radii; and the fellies, or circumference. The nave or ſtock is made of elm, in which all the ſpokes are fixed, and in which the axletree-box, or wheel-box, is confined, to receive the axle-arms on which the wheel revolves. The ſpokes are ſtraight timbers made of oak, firmly tennoned in the nave, in the direction of radials, to ſupport the fellies, or wheel-rim. The fellies are made of aſh, or beech, and form the rim of the wheel; the whole circumference is uſually divided into ſhort lengths, in the proportion of one length to every two ſpokes. When the fellies are fixed on the ſpokes, the iron band, or tire, which maintains the wear, is nailed on in lengths, and keeps the fellies together. The diameters of wheels regulate the number of ſpokes and fellies they are to contain: for the larger the circumference of the wheel is, the greater is the number of ſpokes required in proportion; for they ſhould not in any wheel be more than fifteen inches diſtant on the fellies, or circumference.

The uſual height or diameter of wheels for coaches and travelling carriages extends to five feet eight inches, and are divided into four proportions. Thoſe which contain from eight to fourteen ſpokes, and only half that number of fellies, are called eights, tens, twelves, or fourteens, which are the number of ſpokes in ſuch wheels, or of fellies in a pair of wheels. The height which regulates the number is, for an eight-ſpoke wheel, not to exceed three feet two inches; for a ten, four feet ſix inches; for a twelve, five feet four inches; for a fourteen, five feet eight inches.

Theſe are the extreme heights for the different numbers of ſpokes to each wheel, which ſhould be rather more than leſs, in particular for the fore-wheel of a four-wheel carriage, which receives more ſtreſs than the hind one; and the coachmaker's rule is, when the hind-wheels are of that height to require fourteen ſpokes, the fore one, if under the neceſſary height before ſtated, ſhould have twelve; never allowing the fore-wheels to have but two ſpokes leſs than what is needful for the hind ones.

There are three deſcriptions of wheels; *viz.* the ſtraked, the hooped, and the patent rim: the differences of theſe are only in the rims.

The ſtraked wheel is made with the fellies in ſeparate lengths or pieces, which are joined together at the ends by dowels; that is, a round pin which enters part into one piece and part into the other, being cloſely fitted into holes made in each. The iron with which it is plated is called the ſtrake, and is put on in pieces of the ſame length as the pieces of the fellies, and faſtened by nails; the joints of the iron are made to fall over the middle of the pieces of wood ſo as to unite them firmly together. The hooped wheel is ſurrounded by a hoop of iron in one entire piece. The patent wheel is made with a hoop of wood in one entire piece, by boiling or ſoftening the wood until it can be bent into a circle; this is ſurrounded by a hoop of iron in an entire piece, and faſtened by nuts and rivets.

According to the uſual method of conſtructing ſtraked wheels, their peripheries are compoſed of a number of pieces or fellies joined together; but theſe are weak, and ſubject to ſeveral inconveniences. As the joints are the weakeſt parts of the wheel, they are moſt liable to yield inward; for which reaſon the wheelwrights leave them higher than the other parts of the rim, in conſequence of which the wheel is not exactly round withinſide the circle of the rim. Beſides, the fellies being ſegments of a circle, ſawed or hewn out of ſtraight wood, they are on this account rendered ſo brittle, from the croſs direction of the grain near the joints, that they are with difficulty kept together, even though almoſt twice the quantity of timber be employed that would otherwiſe be neceſſary. The ſtrength of ſuch a wheel depends on the thickneſs of the iron tire or rim that ſurrounds it, and hence the carriage is loaded with an uſeleſs weight, both of wood and iron. To obviate theſe inconveniences, Mr. Viny invented the proceſs for bending timber into a circular form, practiſed for ſome time by Meſſrs. Jacob and Viny, and is now continued by others. In wheels made of timber thus bent, the rim conſiſts either of a ſingle piece of wood, or two fellies only, and is caſed with a ſingle hoop of iron. By this mode of conſtruction, the grain of the wood is kept parallel throughout, ſo that the periphery of the wheel is every where equally ſtrong; its thickneſs is conſiderably leſſened, inſomuch that though little more than half the uſual quantity of timber is employed, the wheel is of itſelf ſtrong enough to ſuſtain the common burthen laid on ſuch wheels, without the aſſiſtance of iron tires, which are only applied to them as a ſafe-guard, to preſerve the wood from the injuries to which it would otherwiſe be neceſſarily expoſed from the roads; and hence a leſs quantity of iron is ſufficient, and even that will be fairly worn out before it becomes uſeleſs. Beſides, the wheel is rendered much lighter, and at the ſame time much ſtronger and more durable, than wheels conſtructed of detached pieces of wood and iron, in the uſual manner. Theſe patent wheels are very ſuperior to the common ſort, in their neat light appearance, and in the length of time they wear, as two ſets of the former will wear as long as three of the latter: their preſervation depends very much on the hoops that the wheels are rimmed with. Some perſons ſtill prefer the common ſort of wheels, on account of their being more eaſily repaired than the hoop-wheel; but though the repairing of the latter is more difficult, they are much leſs ſubject to need it.

As the rims of wheels wear ſooneſt at their edges, they ſhould

ſhould be made thinner in the middle, and faſtened to the fellies with nails of ſuch a kind, that their heads may not riſe above the ſurface of the rim. The fellies on which the rims are fixed ſhould, in carriages, be three inches and a quarter deep, and in waggons four inches. The naves ſhould be thickeſt at the place where the ſpokes are inſerted, and the holes in which the ſpokes are placed ſhould not be bored quite through, as the greaſe upon the axle-tree would inſinuate itſelf between the ſpoke and the nave, and prevent that cloſe adheſion which is neceſſary to the ſtrength of the wheel.

The track in which the wheels of every carriage are to run is generally the ſame, except when intended for particular roads, where waggons and other heavy carriages are principally uſed, and leave very deep ruts, in which light carriages muſt likewiſe run, or be liable to accident, and are alſo ſure to be heavy in draught. All four-wheel carriages ſhould have the hind and fore wheels regulated to roll in the ſame track. The ordinary width of the wheels is four feet eight or ten inches; that of waggons or carts generally meaſure five feet two inches; chaiſe-wheels, as being principally intended for the country, are adapted to this width. It is immaterial to what width wheels are ſet if uſed for running upon ſtones; but on marſhy roads, if their exactneſs is not attended to, the draught is conſiderably increaſed. We have ſeen a carriage of which the iron axle-tree is made in two pieces, overlapping each other in the middle where they are joined, and ſecured by proper bands to the wood-work of the carriage, ſo as to admit of ſliding in the direction of the axle-tree. Theſe parts are cut with teeth like racks, and a pinion is applied between them; ſo that by turning this pinion round, the two parts of the axle-tree are made to ſlide one upon the other; and the wheels which are fitted upon the two extreme ends of the axle-tree can at pleaſure be fixed at greater or leſs diſtance, as the roads require.

The different heights of hind and fore wheels make alſo a difference in the length of their axle-trees, agreeable to the proportion they bear to one another; the fore-wheel has the longeſt axle-tree by one or two inches between the ſhoulders.

The nave of the wheel is pierced through the centre, with a large hole to introduce the box, or iron tube, for the axle-arm, as this tends to weaken the wood. It has been frequently propoſed to make metal naves, or centre-pieces for wheels, which ſhould contain the box for the axis, and the mortiſes for the ſpokes of the wheel all caſt of one piece of metal. Meſſrs. Dodſon and Skidmore had a patent for this in 1799. The objection to it is, that, if the wood of the ſpokes ſhrinks, they become looſe in the mortiſes, whereas a wooden nave ſhrinks at the ſame time with the ſpoke. This defect has been ſince remedied by making the metal wheel-ſtock in two parts; one with receſſes, or ſockets, to contain the ſpokes, and the other a flat plate to faſten againſt the former with ſcrew-bolts, and preſs the ſpokes into their cavities. Mr. Plucknet had a patent for a metal wheel-ſtock of this kind in 1805, which anſwered extremely well for carts, waggons, and artillery. The ſpokes were made to fill up all the ſpace in the nave or ſtock, ſo that each ſpoke touched its neighbour. The metal ſtock was only a flat circular plate, or flanch, projecting from the box which received the axle, and another flat plate fitted upon it, and bound againſt the former by ſcrew-bolts, one paſſing through each arm; theſe rendered the wheel very ſtrong.

Mr. Wilks took a patent in 1813 for a metal ſtock, in which there are complete cells for each ſpoke, and the cells are dove-tailed; that is, they are made larger at the central part than at the outſide, to prevent them from drawing out, and they are firmly preſſed into the dove-tails by the ſcrew-bolts which confine the moveable plate.

Wheels for railway-waggons are made of caſt-iron, and uſually all in one piece; but this is objectionable, becauſe the unequal contraction of the arms and rim of the wheel in cooling, after the wheel is caſt, puts the different parts on a ſtrain, and they frequently break without any adequate force. It is better to caſt the rim in one piece and the arms in another, and put them together with ſcrew-bolts, or rivets. Mr. Hawks had a patent for this in 1807. In this way, the rims may be replaced when worn out.

The Axle-trees for Wheels of Carriages.—The ſtrong iron bar which extends acroſs beneath the wood-work of the carriage, is called the axle-tree; the round parts at each end, on which the wheels run, are called the axle-arms; and the part or ſtem between them, which is fixed beneath the wood-work of the carriage, is alſo called the axle-tree. In the form of the latter parts there are but two ſorts, the one made flat, and called a bedded axle-tree, it being ſunk all its length in the under ſide of the timbers of the carriage; the other is made of an octagon form, and flat only at the ends where they are bedded.

The axle-arms on which the wheels turn ſhould be made perfectly round, and ſomewhat ſtronger at the ſhoulder than at the extreme end, which is ſcrewed to receive a nut, through which and the axle-tree the linch-pin paſſes, to keep all tight. The nuts are made with a collar at the face; and a temporary collar, or waſher, is driven on the back of the arms, which form two ſhoulders for the wheel to wear againſt, and helps to preſerve the greaſe from running out, and to prevent dirt from getting in.

As the axle-trees are the principal or only ſupport of the carriage, every attention and care ſhould be fixed in the ſelection of good iron; and to ſee that they be well wrought, and of ſufficient ſtrength, rather going to the extreme of ſtrength, than riſking the life of the paſſenger by the overſetting of the carriage, which moſtly happens when an axle-tree breaks.

By the bend of the axle-trees, the wheels are regulated to any width at bottom, to ſuit the track of the roads in which they are to run, and are confined in the carriage by means of clips, hoops, and bolts. The ſhape of the axle-tree between the ſhoulders varies according to the ſituation they are placed in, or the form of the timber of the carriage with which they are united; thoſe are the moſt firm that are flat, bedded in the timber. Axle-tree boxes for wheels are of various kinds; thoſe which are frequently called long-pipe, or wheel-boxes, are long tubes fitted accurately to the arms of the axle-trees, and ſecurely fixed in the wheel-ſtocks, or naves; they are uſually made of wrought ſheet-iron of a ſubſtance proportioned to the weight of the carriage; their uſe is to contain a ſupply of greaſe, and to prevent the effects of friction, whereby the wheels are much aſſiſted in their motion. Theſe are now uſed inſtead of the old caſt-iron boxes, which for quick travelling-carriages are totally out of uſe, being found injurious to the axle-trees, by cutting them at thoſe parts they wear againſt, ſo as to occaſion a frequent lining of the arms; but with the wrought metal boxes this is ſeldom neceſſary.

There are many ſorts of axle-trees and boxes invented various ways, with a view of attaining the following advantages; *viz.* To contain a longer ſupply of greaſe or oil, to be more durable, to ſecure the wheels, and to leſſen the draught. Thoſe are all certainly great advantages, and though the expence is great, the utility of either of them muſt be more than adequate to it, and merits more general notice.

Some of thefe inventors even pretend that all thefe advantages are combined in one axle-tree; but the generality extend to the advantage only of retaining a fupply of oil, and remaining perfect to a confiderable length of time. The common fort of axle-tree and box, which is moft generally ufed, is fimple and cheap in comparifon with the others.

Common Axle-tree.—The arms of the axle-tree are made round, but rather of a conical form, ftrongeft at the back or fhoulders, tapering to the linch end, which is fcrewed for a nut, and alfo has a fmall hole for a linch-pin, which prevents the nut from coming off: at the body-end is a wafher or collar for the back of the wheel-ftock to wear againft. The box is made of fheet-iron, proportioned in fubftance to the weight or fize of the axle-tree, having the edges of the plate, of which it is formed, welded in a ridge which projects on the outfide; this fecures the box in the nave of the wheel, and prevents it turning round therein.

The nut which fcrews on the end of the axle-arm has a broad face to lie flat againft the wheel, and is tapped or fcrewed to receive the fcrew-end of the axle-tree. Each of thofe nuts muft turn on the fcrew the fame way the wheel goes, and muft have a notch for the linch-pin to pafs through, for the purpofe of fecuring the nut from turning off.

The box is what, of the axle-tree, wears moft, and is frequently obliged to be refitted to the arms; otherwife they give to the wheel while in ufe an unfteady motion, and foon exhauft their ftock of greafe.

Thofe that are well fitted will contain their fupply for about one week with regular ufe, or a journey of one hundred miles. They wear at the rate of one fet of boxes to every two fets of wheels, and require in that time to be twice or thrice taken out of the wheels and refitted to the axle-tree arms.

Axle-trees with Friction-Wheels.—Thefe were invented by Mr. Garnet, at leaft the beft kind, which are made in a very ingenious manner. The wheel-box is made much larger than the axle-tree, in fuch manner that the fpace all round between them may receive a number of rollers which fill it up. (See a defcription in the article MILL-*Work.*) Mr. Garnet had a patent in 1784, and for fome years manufactured great numbers; but being very expenfive, they fell into difufe, although very complete. This invention has been lately revived by Mr. Panter.

The Patent Anti-Attrition Axle-tree and Box.—The propofed advantages of this axle-tree are, eafe of draft by diminution of friction; the retention of oil to fupply a month's ufe; the eafe with which it is replenifhed without taking off the wheels; the great fecurity for the wheels, which it prevents from coming off, and the carriage from overturning, if even the arm of the axle-tree fhould break; and their durability, and even improvement by wear. Thofe axle-trees, if made with the fecuring-collar, for the wheels need no nut or linch-pin, as is generally ufed, but the wheel may be taken off and put on as eafily as thofe on the common principle.

Thefe axle-arms are reduced at the bottom from a perfect round, and grooved, to receive two fmall rollers, on which the weight of the carriage is borne, and which greatly facilitates the motion, in the fame manner as blocks of ftone or timber, which require to be removed by the affiftance of rollers. Thefe rollers form the outer circumference of the axle-trees at bottom, which are reduced to give a bearing only on them. A circular box or ciftern is provided to contain a fupply of oil; it is clofely fitted to the back of the inner end of the wheel-ftock, and fixed by three bolts. The oil is here contained within three circular receffes, and oozes through fmall channels on the arm of the axle-tree, which it feeds for a confiderable time. This oil-box is made of caft-metal, and has a cap projecting behind over the axle-tree, which prevents the dirt from getting into the box. This axle-tree is alfo provided with what is called the wheel-fecurity, or ftrap-wafher. It is an iron collar, fitted on the external part of the wheel-ftock, and confined between the refervoir and ftock, lying as it were in a groove, fo that the collar cannot come off. This collar has two lugs or ftraps extending backwards fome diftance along that part of the axle-tree which is bedded in the wood-work, where it is fixed by a nut-fcrew. By means of this ftrap-wafher, the wheel is fecured to the bedded part of the axle-tree; and fhould the axle-arm within the wheel break, the wheel will continue to act.

The cap of this axle-tree is alfo fixed on the outfide part of the wheel-ftocks; by the fame three bolts which faften the oil-box, and by means of a fcrew-plug in the cap, the axle-tree and refervoir are replenifhed with oil. The box is of the fame form as the common box, only made of a very hard durable metal, of a confiderable thicknefs, and is made in proportion to the weight of the carriage.

Collinge's Patent Cylinder Axle-tree and Box.—Thefe axle-trees have been a confiderable time in ufe, and their advantages have been proved in the length of time they wear, in the filent and fteady motion they preferve to the wheels, in the advantage of retaining the oil to profecute a journey of two thoufand miles without being once replenifhed; and laftly, they are very durable, and but little fubject to be out of order.

The axle-tree arm is made as perfectly cylindrical as poffible, and of a peculiar hard fubftance; the middle of the cylinder is reduced, to contain the oil neceffary to feed the axle-trees; fo that the two bearings are at the two ends of the axle, which has an internal fhoulder, againft which the inner end of the wheel-box takes its bearings. Behind this fhoulder is a deep groove for a wafher to preferve the oil, and prevent noife in its ufe; alfo a rim, or hollow box, on the collar of the axle-tree, which overlaps part of the inner end of the wheel-ftock to keep out dirt, and anfwer the ufe of a cuttoo. The extreme end of the arm is double-fcrewed, to receive two nuts for fecuring the wheel: the one fcrew turns the way of the wheel; the other the reverfe, and is meant as an additional fecurity.

The box is made of a very hard metal, nicely polifhed, and fitted to the arms, having a circular recefs all round at the end neareft the carriage, for containing there a fupply of oil. The box is longer than the part which bears on the axle; and the projecting part beyond the bearing at each end is bored out larger than the arm. The back projection fits clofe to the rim of the collar, which it covers: the fore one projects outwards beyond the furface of the wheel-ftock, and is fcrewed on the infide to receive the fcrew of the cap.

There are many other patents for axle-trees to wheels; but as few of them have come into ufe, we fhall only notice Meffrs. Flight and Brook's patent axles. The axle is fixed faft to the nave of the wheel, by paffing through it. This axle turns round within the wheel-box; whereas in others the wheel-box turns round upon the axle.

The axle is cylindrical, and is received into a cylindrical box or tube in the end of the iron axle-tree, which is firmly bolted to the underfide of the timber of the carriage. To hold the axle in its place, and prevent it from drawing out of the box, the end of the axle is reduced to a knob or button, which adheres to the end of the axle by a fmall neck.

neck. This button is fitted and received into a focket, in which it can freely turn round, but cannot draw out endways. It is made in a piece of metal, which is cylindrical on the outfide, and of the fame fize as the axle. It is made in two halves, which feparate longitudinally to introduce or take out the button at the end of the axle; but when the two halves are put together, the focket-piece forms as it were a continuation of the axle. When the axle is put into the box with this focket-piece at the end of it, the two halves of the focket will be confined together, fo that they cannot feparate; and to prevent them from drawing out of the box, a fcrew-bolt is put through the box, and paffes through both halves of the focket: this holds the focket and the axle in their places.

Mr. Ackermann has recently obtained a patent (1818) for a valuable improvement in the application of the fore-wheels to four-wheeled carriages. In our article COACH-*Making*, vol. viii. we have defcribed thofe methods which were then known of applying the fore-wheels, fo as to make a four-wheel carriage turn with fafety, and in a fmall fpace. See alfo PERCH.

Mr. Ackermann's improvement effects this in the moft perfect manner. Each of the fore axle-trees is connected with the carriage by means of a vertical axle, formed in the fame piece with the horizontal axle, and upon which the wheel turns, the two axles being fituated at right angles to each other. Thefe vertical axles are fitted into fockets, formed at the two extremities of a crofs beam of the frame of the carriage, which is called the fore-fpring tranfom. Upon thefe axles, as centres of motion, the axle-arms and wheels can be turned about horizontally, in order to place them obliquely to the direction of the hinder-wheels when the carriage is required to turn; but each axle turns upon a feparate centre of motion, and thefe centres are very near to their refpective wheels, being at the extremities of the crofs-beam or tranfom; hence the fore-wheels do not change their place upon the ground when they are placed obliquely.

In a common carriage, the axles of the two fore-wheels are both fixed to one piece of timber, called the axle-bed, which is placed beneath the fore-tranfom, and united to it by a vertical pin called the perch-bolt, paffing through the middle of the axle-bed. On this pin, as a centre, the axle-bed is turned round. When the wheels are to be placed obliquely, it is evident, that, in fo turning upon a fingle centre, one wheel muft advance forwards, and the other muft retreat backwards, fo as to diminifh the bearing of the carriage-wheels on the ground in a lateral direction, and at the fame time the horfes are pulling in that direction which tends to overturn the carriage. Another inconvenience is, that one of the wheels will touch the perch of the carriage, if placed very oblique.

In the new improvement, two feparate centres of motion being ufed, and thefe being removed from each other as far as poffible, many defirable properties are attained.

To give the oblique direction to the wheels, each vertical axle has a lever proceeding backwards from it; and thefe two levers are united together by a connecting-bar, which obliges both axles to move at the fame time with a fympathetic action. The pole of the carriage is united to the piece, called the futchel, in the ufual manner; and the futchel is united to the fpring-tranfom by a perch-bolt, in the ufual pofition; alfo the hinder end of the futchel is jointed to the middle of the connecting-bar, between the two levers of the vertical axles. The connecting-bar likewife anfwers the purpofe of a fway-bar.

When the horfes move to one fide, the pole and futchel turn upon the perch-bolt, as a lever upon a centre of motion; and the extreme end of the futchel acts upon both vertical axles at once by means of the connecting-bar, fo as to place both of the fore-wheels in an oblique direction. This is the invention of M. Lankenfperger of Munich.

WHEEL, *Ariftotle's*. See ROTA *Ariftotelica*.

WHEEL, *Blowing*, a machine contrived by Dr. Defaguliers for drawing out the foul air of any place, or for forcing in frefh, or doing both fucceffively, without opening doors or windows. See Phil. Tranf. N° 437.

The intention of this machine is the fame as that of Dr. Hales's ventilator, but not fo effectual, nor fo convenient. See Defagul. Courfe of Exper. Philof. vol. ii. p. 563. 568.

This wheel is alfo called a *centrifugal wheel*, becaufe it drives the air with a centrifugal force.

WHEELS, *Bufhes or Boxes of*, the infide metal linings of the naves. See WHEEL.

WHEEL, *Cutting Roller*, in *Agriculture*, a tool of the cutting and reducing fort, ufed for the purpofe of working over crops in fome cafes. In Oxfordfhire a cutting roller of this fort has been invented, which is compofed of twelve wheels, two inches and a half in thicknefs; and between each of them is a fpace of two inches and a half. They are three feet in diameter. It is a load in working fo as to be fufficient exertion for a ftrong team to draw it: it is paffed over wheat after it has been fown, or after it is come up; and if dry, crofs and crofs. It has alfo been ufed in the fpring upon wheat; it leaves the furface rough in a fort of diamond forms, which is found very beneficial in fome of the wheat-lands of that diftrict. It is alfo capable of being ufed in breaking down the furface of ftiff tillage-land in many other cafes and circumftances.

WHEEL, *Draining*, a wheel conftructed for the purpofe of cutting or making drains. Wheels differently formed are ufed for this fort of work. In Effex they employ workmen who make ufe of a caft-iron wheel which weighs about four hundred weight, and which is four feet in diameter; the cutting edge or extreme circumference of the wheel being half an inch in thicknefs, which increafes in this way as it approaches towards the nave or centre; and will, at fifteen inches deep, fcour out or cut a drain half an inch wide at the bottom, and four inches wide at the top. The wheel is fo placed in a frame, that it may be loaded at pleafure, and be made to pafs to a greater or lefs depth, as the nature of the land may be.

The writer of the Middlefex Report on Agriculture advifes the ufe of a common fix-inch cart-wheel, on the felly of which, all round, a fort of ridge-formed addition of wood is to be fixed, and a rim of iron of a triangular fhape faftened to the wood. A wheel of this kind put on the axle of a cart, in the ufual way, will, of courfe, reft on the edge of the rim of iron; and which, on driving the horfe forward, will make a fmall indent or depreffion in the ground merely by the revolution of it; but in order to make it prefs down to the depth of fix or eight inches, that fide of the cart fhould be loaded with ftones, iron ballaft, or any other heavy material that may happen to be at hand, until the whole of the parts, if neceffary, fink into the foil. It would however be as well, or better, it is faid, if the rim parts added to the wheel were in one piece of caft-iron; as the increafed weight of it would enable it to cut or fink without the aid of ballaft, or with lefs than ufual. The cart fhould then be drawn along in fuch a manner, that the cutting or depreffing wheel may revolve where the drains are intended to be made. In land that is in ridges and furrows, it will fometimes be neceffary to draw the wheel along every furrow.

furrow. When the ground is without ridge and furrow, the wheel ſhould be drawn over it in parallel lines, five or ten yards diſtant from each other. The wheel on the other end of the axle is a common ſix-inch wheel, ſupporting only the empty ſide of the cart, conſequently will not cut or depreſs the ground.

The advantage of this contrivance is, that it makes an indent or depreſſion in the ſurface ſoil of ſoft wet clayey graſs-lands, ſufficient to carry off the water during the ſame winter, by preſſing down the ſward and herbage without deſtroying it. In the following ſpring, theſe drains will be nearly grown up, and clothed with graſs; conſequently, there will be nothing taken from the paſturage or the ſcythe. It is neceſſary to obſerve, that the wheel muſt be drawn over the ground every year on the approach of winter. With it, and two old horſes, a ſtout boy or man may, it is ſaid, drain from ten to twenty acres in eight hours.

It may be found very uſeful in the graſs and hay land diſtricts about the metropolis and other places. See SURFACE *Draining*.

WHEEL, *Meaſuring*. See PERAMBULATOR.

WHEEL, *Orffyreus's*. See ORFFYREUS.

WHEEL, *Perſian*. See PERSIAN.

WHEEL-*Ploughs*, in *Agriculture*, all ſuch ploughs as are conſtructed with wheels. See PLOUGH.

WHEEL, *Potter's*, is a round board attached to a lathe, and capable of being moved by it, either rapidly or more ſlowly, as occaſion may require. This round board moves in a horizontal poſition; and when in uſe, the clay which is to be faſhioned is fixed on the centre of it; and it is put in motion either by a perſon who conſtantly attends it when at work, or by means of a treadle which is moved by the foot of the workman himſelf.

As the clay revolves upon this machine, the workman either models it by his fingers, or forms it, by means of an inſtrument which he holds in his hand, into any kind of circular ſhape that he may deſire; and when the object is to make a number of veſſels exactly ſimilar to each other, the ſize is generally determined by a gauge fixed without the circumference of the revolving wheel, but projecting over it in ſuch a manner that, whenever the yielding clay is ſpread out until it touch this gauge, the artiſt knows that the article which he is making has attained the exact figure which he intends.

The potter's wheel has lately been much improved by adapting a ſtrap to it, which paſſes over a large taper cylinder of wood, and by means of which the artiſt is enabled to increaſe or diminiſh the rapidity of the motion at pleaſure. This contrivance is known to mechanics by the name of the *cone pulley*. Parkes's Eſſays, vol. iii. See POTTERY.

WHEELS, *Tires of*, the iron hoops or bars which are put round the outſides of the felly-parts of them.

WHEEL, *Water*. See WATER.

WHEEL is alſo a name of a kind of puniſhment, which great criminals are put to in divers countries.

In France, their aſſaſſins, parricides, and robbers on the highway, were condemned to the wheel; *i.e.* had their bones firſt broken with an iron bar on a ſcaffold, and then to be expoſed and left to expire on the circumference of a wheel. In Germany, they broke their bones firſt on the wheel itſelf.

This cruel puniſhment was unknown to the ancients; as is obſerved by Cujas. It is not certain who was the inventor. Its firſt introduction was in Germany. It was, indeed, but rarely practiſed any where elſe, till the time of Francis I. of France; who, by an edict of the year 1534, appointed it to be inflicted on robbers on the highway. Richelet dates the edict in the year 1538, and quotes Brodæus, Miſcell. lib. ii. cap. 10.

WHEEL, in the *Military Art*, is the word of command, when a battalion or ſquadron is to alter its front, either one way, or the other.

To wheel to the right, the man in the right angle is to turn very ſlowly, and every one to wheel from the left to the right, regarding him as their centre; and *vice verſâ*, when they are to *wheel to the left*.

When a diviſion of men are on the march, if the word be, *wheel to the right*, or *to the left*; then the right or left-hand man keeps his ground, turning only on his heel, and the reſt of the rank move about quick, till they make an even line with the ſaid right or left-hand man.

Squadrons of horſe wheel after much the ſame manner.

In wheeling, the circle is conceived to be divided into four parts; whence wheeling to the right or left reſpects only a quarter of a circle; and wheeling to the right or left about, refers to half of the circle. In performing this motion, each man moves more quickly or ſlowly, according to his diſtance from the right to the left. See BATTALION.

WHEEL, or *Catherine-Wheel*, in *Architecture*, frequently occurs in the upper part of the north and ſouth tranſepts of our ancient cathedrals, being divided by mullions, like the ſpokes of a wheel: it reſembles the engine of torture ſaid to have been prepared by the tyrant Maximin to tear the fleſh of St. Catherine of Alexandria. The French, who have generally placed a large wheel of this ſort by way of a weſtern window to their cathedrals, call it *Roſe du Portail*.

WHEEL-*Animals*, *Brachionus*, in *Zoology*, a genus of animalcules, which have an apparatus of arms for taking their prey. (See BRACHIONUS.) This apparatus has been ſuppoſed, by microſcopical writers, to be a kind of wheels. This is one of the ſmaller animalcules; and is deſcribed by Dr. Hill to be, when at reſt, of a plain ſmooth body, conic figure, obtuſe at the poſterior extremity, and open at the anterior, of a duſky olive colour, and ſemi-tranſparent. When in motion it protrudes from the open extremity a part of its naked body, to the whole of which this outer conic body ſeems to be but a caſe or ſheath; from the end of this exerted part of the body, it thruſts out two protuberances, which give it the appearance of a double head; and in each of theſe is diſcovered an apparatus in continual motion, appearing to be a rotatory one, though really a vibratory one very quickly repeated. Each of theſe protruded bodies has ſix arms inſerted into it, which it continually ſhuts and opens over one another. Each of the arms is furniſhed with a double ſeries of fibres at its edge, which, being expanded, cauſe it to ſpread to conſiderable breadth. There are ſeveral ſpecies of this genus.

The wheel animal, deſcribed by Mr. Baker, has two ſeeming wheels, with a great many teeth or notches coming from its head, and turning round as it were on an axis. On the leaſt touch, this animalcule draws its wheel into its body into the ſheath; but when every thing is quiet, throws them out and works them again.

In order to find theſe animalcules, chooſe ſuch roots of duck-weed as are long, and proceed from ſtrong old plants, for the young roots ſeldom afford any; they ſhould not be covered with that rough matter which is frequently found about them, nor any way tending to decay, as they will often be.

In the water found remaining in the leaden pipes, or gutters on the tops of houſes, there are alſo found great numbers

numbers of thefe wheel-animals. Thefe are of a different fpecies from the former; and when the water dries away, they contract their bodies into a globular or oval figure, and are then of a reddifh colour, and remain mixed with the dirt, growing together in a lump as hard as clay. This, whenever it is put in water, in half an hour's time difcovers the animals' living again, and as brifk as ever; and they have been found to be living in this manner, after the matter had been kept dry twenty months.

It fhould feem from this, that as the water dries up, their pores become fhut in the manner of thofe of fuch animals as remain torpid for the winter; and that when they find water come on again from rain, they then unfold themfelves, and live and feed as long as it lafts. Baker's Microfcope.

Wheel-*Barometer*. See Barometer.

Wheel-*Boats* denote a fort of boats with wheels, to be ufed alternately on the water and upon inclined planes or rail-ways.

Wheel-*Fire*, among *Chemifts*, a fire ufed for calcining metallic fubftances; properly called *ignis rotæ*.

It is a fire which only encompaffes the crucible, coppel, or melting-pot, around the fides, without touching it in any part.

Wheel-*Shaped*, in *Botany*, a term exclufively appropriated to the *corolla*. See Rotata.

WHEELER, among *Brickmakers*. See Brick.

Wheeler, in *Geography*, a river of Wales, which runs into the Clyde, 3 miles N. of Denbigh.

WHEELING, a poft-town of Virginia, at the union of Wheeling Creek with the Ohio; 54 miles S.W. of Pittfburgh.—Alfo, a townfhip of Ohio, in the county of Belmont, with 656 inhabitants.

Wheeling *Creek*, a river of Virginia, which runs into the Ohio, N. lat. 39° 56'. W. long. 80° 45'.

Wheeling *Planks* are ftout planks which the navigators or workmen upon a canal make ufe of to wheel upon.

WHEELOCK, in *Geography*, a townfhip of Vermont, in the county of Caledonia, containing 963 inhabitants; 60 miles N. of Windfor.—Alfo, a river of Chefhire, which runs into the Dane.

WHEELWRIGHT Gut, a creek on the north-weft coaft of the ifland of St. Chriftopher, with a bar before its entrance.

WHEEZING and Blowing, in *Animals*, a fort of affection in the breathing, efpecially in horfes, in which they draw their breath with difficulty and noife.

The generality of people make this and purfinefs, in horfes, the fame diftemper; but the more judicious always diftinguifh it, as wholly different from that. Purfinefs proceeds always from a ftuffing or oppreffion of the lungs; but this wheezing is only owing to the narrownefs of the paffage between the bones and griftles of the nofe.

The horfes that are moft of all afflicted with this diftemper do not want wind; for notwithftanding that they wheeze exceffively when they are exercifed, yet all the time their flanks are not moved, but kept in the fame condition that they were when the creature ftood ftill. The dealers call this fort of horfes blowers, and though there is no real harm in the thing, it is a difagreeable quality, and few people will choofe them that have much fervice for them.

There are fome horfes which have a natural defect in their breathing, which makes it at all times attended with fome difficulty, but not with the wheezing before mentioned; thefe are called thick-winded horfes.

People who are careful in the buying of horfes, will purchafe neither of thefe kinds; but there is this caution to be obferved in regard to this defect, that it often feems to be in horfes where it really is not. When a horfe has been kept a long time in the ftable without exercife, he will at the firft riding be out of breath, and fetch it in a difficult and painful manner, though he be neither a blower nor thick-winded; but all this will go off with a little exercife.

There are fome temporary wheezers and blowers among horfes: thefe at times rattle, and make a great noife through their nofes in taking breath; but the complaint goes off and returns. This is only occafioned by a great quantity of phlegm, for their flanks do not redouble with it at the worft of times, nor have they any cough with it; fo that there is no danger of their being purfy.

It is probable, that in thefe cafes there is, for the moft part, fome fort of fpafm or conftriction in the chefts of the animals, as they are much relieved in moft inftances by the ufe of warm mafhes, and by having their fodder made moift.

How far remedies that remove fpafm might be ufeful has not yet been fully tried, either in thefe or other forts of animals.

WHELDY-AHAD Lake, in *Geography*, a lake of North America. N. lat. 61° 40'. W. long. 103° 30'.

WHELERA, in *Botany*, was fo named by Schreber, in memory of the celebrated Englifh traveller and botanift, fir George Wheler, Bart. F.R.S. who died in 1724, aged 74. His "Journey into Greece," however faulty in the plates, is a book of the firft authority.—Schreb. Gen. 725.—Clafs and order, *Polygamia Monœcia*, Schreb.; rather *Pentandria Monogynia*. Nat. Ord. *Sapotæ*, Juff.

Gen. Ch. *Cal.* Perianth inferior, of one leaf, in five deep, roundifh, erect, permanent fegments, fhorter than the corolla. *Cor.* of one petal, bell-fhaped, fpreading, in five deep, ovate, acute fegments. Nectary fomewhat pitcher-fhaped, in the bottom of the flower. *Stam.* Filaments five, awl-fhaped, rather longer than the corolla; anthers roundifh. There are five other filaments, alternate with the former, and fimilar to them, but fhorter, and deftitute of anthers. *Pift.* Germen fuperior, conical, villous; ftyle thread-fhaped, twice the length of the corolla; ftigma fimple. *Peric.* Drupa roundifh. *Seed.* Nut large, ovate, of one, two, or three cells.

Some flowers, on the fame plant, want the piftil, others the ftamens.

This is Schreber's generic defcription, from which we learn, without difficulty, the natural order of the plant. But it is one of thofe genera, like his Villaria, (fee that article,) which cannot be determined without an examination of the author's herbarium. Such alfo are his Meyera, already defcribed; his Wolfia, and Xystris, which will occur hereafter. We truft fome botanift, who may have the opportunity of clearing up thefe, the only important obfcurities in Schreber's claffical work, will favour the world with an explanation of them. Spartina is in the fame predicament, except that profeffor Schrader appears to be acquainted with it. See that article.

WHELKS, *Buccina*, in *Natural Hiftory*. See Shells, and Trumpet-*Shell*.

WHELPS. See Hound.

Whelps, in a *Ship*. See Capstan.

WHENNUIA, in *Geography*, a fmall ifland among thofe called the Society iflands, near Otaha.

WHERLICOTES, a fort of open chariots, of the ancient Britons' invention, ufed by perfons of quality before the invention of coaches.

WHERN,

WHERN, in *Natural Hiſtory*, a name given by ſome of our miners to a kind of ſtone found in ſtrata, but of the hardneſs and fineneſs of flint. It is called alſo *chert* and *nicomia*.

WHERRY. See VESSEL, BOAT, &c.

WHERRY, in *Rural Economy*, a provincial term applied to a liquor made from the pulp of crabs after the verjuice is expreſſed. It has not unfrequently the name of crab-wherry. See VERJUICE.

WHERWELL, in *Geography*, a village of England, in the county of Hants. Here was formerly a convent of nuns, founded by Elfrida, widow of king Edgar, to expiate the murder of her firſt huſband, Ethelwolf, and her ſon-in-law, prince Edward; 4 miles S. of Andover.

WHET-SLATE, or WHETSTONE-SLATE, and HONE, French *novaculite*, and *ſchiſte coticule*, in *Mineralogy*, a variety of ſlate uſed for ſharpening iron and ſteel inſtruments. (See SLATE.) The light green coloured variety from the Levant is conſidered as the moſt valuable. It is brought in maſſes to Marſeilles, and is there cut into pieces of various ſizes, and afterwards ground with ſand or ſand-ſtone, and then poliſhed with pumice and tripoli. Theſe whet-ſtones or hones ſhould be kept in damp places, for when much expoſed to the ſun, they become too hard and dry for many purpoſes. The powder of whet-ſlate is uſed for cutting and poliſhing metals, and is by artiſts conſidered as a variety of emery. It is neceſſary to the perfection of hones, that they ſhould contain no intermixed ſubſtances, ſuch as quartz, &c. (Jameſon's Mineralogy, ſecond edition, vol. i.) Whet-ſlate, approaching in appearance to foreign hones, occurs in the upper part of Long Sleddale, in Weſtmoreland; and at Howth, in Dublin bay.

WHET-STONE, in *Rural Economy*, the ſoft ſtone uſually made uſe of in ſharpening edge-tools of different kinds.

WHEWER, in *Ornithology*, a name uſed in ſome parts of England for the common wigeon. See DUCK.

WHEY, the ſerum, or watery part of milk.

In many diſorders of the human body, where the ſtomach will not bear milk, or when it is not proper, for other reaſons, whey may be given with great ſucceſs.

We have a diſſertation of Fred. Hoffmann on this ſubject, De Saluberrima ſeri Lactis Virtute. Oper. tom. vi. p. 9. This author recommends a particular kind of ſerum or whey, made by evaporating milk to a dryneſs, and mixing the reſiduum with water. See MILK.

There are various methods of making whey, vulgarly known. That with oranges is very agreeable, and much recommended by Dr. Cheyne, in his Nat. Method of curing Diſeaſes.

WHEY, in *Rural Economy*, a term applied to the ſerous part of milk, from which the curd has been ſeparated. There are two ſorts or colours of whey, the green and white; the latter is by much the richer, and that which chiefly affords the butter of this kind. See DAIRYING.

WHEY, *Alum*, *Serum Aluminoſum*, a whey made with alum; in the proportion of two drachms of alum to one pint of cow's milk boiled.

This whey is beneficial in an immoderate flow of the menſes, and in a diabetes, or exceſſive diſcharge of urine. The doſe is two, three, or four ounces, as the ſtomach will bear it, three times a day.

WHEY-*Butter*, that which is made from the cream of whey. It is commonly made in abundance in the dairy diſtricts after cheeſe-making begins. See DAIRYING.

WHEY-*Cream*, that which is collected from off the whey and made into butter of this ſort. A dairy cow uſually affords eight or ten ounces of it weekly in ſome dairies. See DAIRYING.

WHEY, *Muſtard*, is made by boiling of bruiſed muſtard-ſeed, an ounce and a half, in milk and water, of each a pint, till the curd is perfectly ſeparated, and ſtraining the whey through a cloth. This, ſays Dr. Buchan, is the moſt elegant, and by no means the leaſt efficacious method of exhibiting muſtard: it warms and invigorates the habit, and promotes the different ſecretions. Hence, in the low ſtate of nervous fevers, it will often ſupply the place of wine: it is alſo of uſe in the chronic rheumatiſm, palſy, dropſy, &c. The doſe is a tea-cupful four or five times a day, which may be ſweetened with a little ſugar.

WHEY, *Scalding of*, the heating of it and pouring it over the curd in making cheeſe.

WHEY, *Scorbutic*, is made by boiling half a pint of the ſcorbutic juices, in a quart of cow's milk. The ſcorbutic plants are, bitter oranges, brook-lime, garden ſcurvy-graſs, and water-creſſes.

WHEY *Springy Cheeſe*, the eyey ſpongy cheeſe of this ſort, cauſed by being improperly made.

WHEY-*Tub*, the veſſel in which the whey ſtands for yielding the cream, &c.

WHICHCOTE, BENJAMIN, in *Biography*, an eminent divine of the Engliſh church, was born in March 1609-10, of an ancient family at Whichcote-hall, in Shropſhire; and having finiſhed his education at Emanuel college, Cambridge, in 1626, he paſſed through the common degrees, and became fellow of his college in 1633, and a diſtinguiſhed tutor. In 1636 he took orders, and eſtabliſhed a lecture at Trinity church, in Cambridge, and continued it for nearly twenty years. It was his great object to ſubſtitute a ſpirit of ſober and rational piety in the univerſity, inſtead of the enthuſiaſm and fanaticiſm which then prevailed; nor were his efforts for this purpoſe unavailing. Being married, and having ſettled on a living in Somerſetſhire, his connection with the univerſity was for ſome time interrupted; but in 1644 he returned to it, as the ſucceſſor of Dr. Samuel Collins, the ejected provoſt of King's college, allowing to him part of the emoluments that belonged to this office. In 1649 he took the degree of D.D., and was preſented to the rectory of Milton, in Cambridgeſhire. He is repreſented by biſhop Burnet as a friend to liberty of conſcience, and in order to promote rational and ſublime ideas of religion, he adviſed the ſtudents to peruſe the ancient philoſophers, eſpecially Plato, Cicero, and Plotinus. At the Reſtoration he was deprived of his provoſtſhip, and removing to London, he was choſen miniſter of St. Anne's, Blackfriars, in 1662. Afterwards, when his church was burnt down, he retired to Milton, but he was recalled to London to the vicarage of St. Lawrence, Jewry, by preſentation from the crown; and he ſerved this church with great reputation till his death in 1683.

After his death, a volume of his "Select Sermons," 8vo. 1698, was publiſhed, with a preface by lord Shafteſbury, author of the "Characteriſtics," by whom they were valued, becauſe the author recognized that ſenſe of the beauty of virtue which is the foundation of his moral ſyſtem. Two more volumes were afterwards publiſhed by Dr. Jeffery, archdeacon of Norwich, who, in 1703, preſented to the public "Moral and Religious Aphoriſms collected from Dr. Whichcote's MS. Papers." A fourth volume was publiſhed by Dr. S. Clarke in 1707, and reprinted in 1753 by Dr. Salter, with large additions, and eight letters between the author and ſome of his friends on important ſubjects.

These feveral publications affigned to Dr. Whichcote a high rank among the rational divines of this country, and particularly at the period in which he lived. Biog. Brit.

WHICKS, in *Agriculture*, a term fometimes applied to young plants of the white-thorn kind, as well as to couch-grafs. See QUICKS and COUCH.

WHIDAH, in *Geography*, a kingdom of Africa, on the Slave Coaft; extending about ten miles along the coaft, and about feven miles into the land. Europeans who have been in Whidah fpeak of the country with rapture, and extol it as one of the moft beautiful in the world. The trees are ftraight, tall, and difpofed in the moft regular order, which prefent to the eye fine long groves and avenues, clear of all brufh-wood and weeds. The verdure of the meadows, the richnefs of the fields, clothed with three different kinds of corn, beans, roots, and fruits, and the multitude of houfes, form a moft delightful profpect. A perpetual fpring and autumn fucceed each other; for no fooner has the hufbandman cut his corn, than he again ploughs and fows the ground; yet it is not worn out; the next crop puts forth with the fame vigour as the former, as if nature here were inexhauftible. Certain it is, that the kingdom of Whidah is fo populous, that one fingle village contains as many inhabitants as feveral entire kingdoms on the coaft of Guinea; and yet they ftand fo clofe, that one is amazed how the moft fertile land on earth can fupply the number of people contained in fo fmall a compafs. One may compare the whole kingdom to a great city, divided by gardens, lawns, and groves, inftead of ftreets, the villages in Whidah not being a mufket-fhot diftant from each other. Some are the king's, fome the viceroy's villages, and others are built and peopled by particular private families. The former are the largeft and beft built; but the latter the beft cultivated, if there be any difference in a country fo uniformly rich and beautiful. Notwithftanding the fmall extent of this kingdom, it is divided into twenty-fix provinces, which take their names from the capital towns. Thofe fmall ftates are diftributed among the chief lords of the kingdom, and become hereditary in their families. The king of Whidah, who is only their chief, prefides particularly in the province of Sabi, or Xabier, which is the principal province of the kingdom, as the city of the fame name is the capital of the whole. Bujis, which the French by corruption call bauges, pafs frequently for money at their fairs in the country: this is a fmall white fhell, of the fize and fhape of an olive. In the kingdom of Whidah and Ardra, thefe bujis ferve equally for drefs and money, for ornament and ufe. They pierce each fhell with an iron made for that purpofe; forty of them they ftring upon a cord, which they call *fcuze*, and the Portuguefe *toquos*: five of thefe ftrings compofe what the Portuguefe call a *gallinha*, and the Negroes a *fore*. By thefe the exchange of gold-duft is rated, and the price of flaves determined. The Europeans, the nobility of Whidah, and all the rich negroes, are carried, when they go abroad, in hammocs, or palanquins, on the fhoulders of flaves. The natives of Whidah are in general tall, well made, ftraight, and robuft. Their complexion is black, but not fo gloffy as that of the people on the Gold Coaft, and ftill lefs than thofe of Senegal and the river Gambia. They excel all other negroes in induftry and vigilance. Idlenefs is the favourite vice of the Africans in general; here, on the contrary, both fexes are fo laborious and diligent, that they never defift till they have finifhed their undertaking; carrying the fame fpirit of perfeverance into every action of their life. Befides agriculture, from which none but the king and a few perfons of the firft diftinction are exempted, they employ themfelves in feveral kinds of manufactures: they fpin cotton-yarn, weave fine cotton cloths, make calabaffes, wooden veffels, plates, and difhes; likewife affagayes, and fmiths'-work in greater perfection than any other people on the coaft. Whilft the men are thus employed, the women brew pito, and drefs provifions, which, with their hufbands' merchandize, they carry for fale to market. As to religion, Bofman is of opinion, that the piety of this country is founded upon no other principles than thofe of intereft and fuperftition. In the latter, they exceed all other nations; for allowing, fays he, the ancient heathens to value themfelves upon thirty thoufand deities, I dare venture to affirm that the natives of Whidah may lay juft claim to four times that number. However, he believes that they have a faint idea of the one true God, to whom they attribute omnipotence and ubiquity. One of their principal fetiches, or deities, is the fnake, which they invoke in extreme wet, dry, or barren feafons, on all occafions relating to their government, civil policy, and cattle; in a word, on all the great difficulties and occurrences of life. This fnake has a large round head, beautiful piercing eyes, a fhort pointed tongue, refembling a dart: its pace flow and folemn, except when it feizes on its prey, then quick and rapid; its tail fharp and fhort, its fkin of an elegant fmoothnefs, adorned with beautiful colours, upon a light-grey ground. It is amazingly tame and familiar, permitting itfelf to be approached, and even handled: they have a mortal antipathy to all venomous ferpents: they attack them wherever they find them, as if they had pleafure in delivering mankind from their poifon. The Europeans find no difficulty in familiarizing themfelves to thefe inoffenfive animals, with which they play without any dread or apprehenfion of danger. There is no fear of miftaking them for the poifonous ferpents, the colour and fize fufficiently diftinguifhing them. The negroes entertain a notion that the firft progenitor of this race of fnakes is ftill living, and growing to an enormous bulk. When the Englifh firft fettled in Whidah, the captain having unfhipped his goods on fhore, the failors found at night one of thofe fnakes in their magazine, which they ignorantly killed, and threw upon the bank, without dreaming of any bad confequences. The negroes, who foon difcovered the facrilege, and had it confirmed by the acknowledgment of the Englifh mariners, were not long in avenging the horrid impiety, by a method no lefs horrible. All the inhabitants of the province affembled; they attacked the Englifh, maffacred them all to a man, and confumed their bodies and goods in the fire they had fet to the warehoufe. Animals of all kinds are punifhed with death for injuring a fnake. In 1697, a hog having had the prefumption to deftroy one of thefe deities, an order was iffued for a general flaughter of fwine throughout the kingdom, and the deftruction of the whole race was hardly prevented by the interpofition of the king.

WHIDAH, a town of Africa, in the country of Whidah. N. lat. 6° 25′. E. long. 1° 24′.

WHIDBY'S ISLAND, an ifland in the Gulf of Georgia, near the weft coaft of America; about 36 miles long, and from 2 to 6 broad: fo named from Mr. Whidby, an officer under captain Vancouver. N. lat. 48° 10′. E. long. 237° 40′.

WHIDDY, an ifland in Bantry bay, in the county of Cork, Ireland, about 2 miles from the town of Bantry. It is a pleafant ifland of a triangular form, and the foil is excellent.

WHIFF, in *Ichthyology*, the name of a fort of flounder.

WHIFFLER *of a Company*, in London, a young freeman,

man, who goes before, and waits on the company, on occafions of public folemnities.

WHIG, in *Rural Economy*, a term provincially applied to acidulated whey, which is fometimes mixed with butter-milk and fweet herbs, to give it a flavour, when it becomes a good cooling fummer beverage.

WHIGS, a party or faction in England, oppofite to the Tories.

The origin of the names of thefe two mighty factions is very obfcure. If fome little trivial circumftance or adventure, which efcapes the knowledge of mankind, gives name to a party, which afterwards becomes famous, pofterity labours in vain to find the original of fuch a name: it fearches the fources, forms conjectures, invents reafons, and fometimes, indeed, meets the truth, but always without knowing it affuredly.

Thus, in France, the Calvinifts are called Huguenots; yet nobody was ever able certainly to affign the caufe of that appellation.

Whig is a Scottifh, and, fome fay too, an Irifh word, literally fignifying *whey*. *Tory* is another Irifh word, fignifying a *robber* or *highwayman*.

Under the reign of king Charles II., while his brother, then duke of York, was obliged to retire into Scotland, there were two parties formed in that country. That of the duke was ftrongeft, perfecuted the other, and frequently reduced them to fly into the mountains and woods; where thofe unhappy fugitives had often no other fubfiftence for a long time but cows' milk. Hence they called thefe their adverfaries *tories*, q. d. *robbers*; and the tories, upbraiding them with their unhappinefs, from the milk on which they lived, called them *whigs*. From Scotland, the two names came over with the duke into England.

Others give a different origin and etymology of the two words, for which fee TORIES.

Bifhop Burnet gives another etymology of the term *whigs*. The fouth-weft counties of Scotland, he fays, are fupplied with corn from Leith; and from a word *whiggam*, ufed by the carriers in driving their horfes, all that drove were called *whiggamoors*, and by contraction *whigs*.

He adds, that in the year 1648, after the news of the defeat of duke Hamilton, who was charged with being a confederate with the malignants, or royal party, in England, the minifters animated their people to rife, and march to Edinburgh: who came up, marching each at the head of his parifh, with an unheard-of fury, praying and preaching all the way as they came. The marquis of Argyle and his party came and headed them. This was called the *whiggamoor's* inroad; and ever after, all that oppofed the court were contemptuoufly called *whigs*: and from Scotland the term was brought into England. Burnet's Hift. of his Own Times, vol. i. p. 43.

For the diftinguifhing principles and characters of the whigs, fee TORIES.

WHIMBRAL. See SCOLOPAX *Guarauna*, and PHÆOPUS.

WHIMSEY, WATER, a machine confifting of a refervoir, or bucket of water, employed for raifing another bucket, filled with coals or other materials, by means of a rope or chain, coiled round a cylinder or drum, or two drums of different fizes. When the bucket of water in this machine has reached the bottom of the pit or well, a valve is opened by ftriking againft a pin, and lets out the water. In a machine of this kind, ufed in the duke of Bridgewater's coal-works, the water defcends thirty yards, and raifes a fmaller quantity of coals from a depth of fixty. In fuch cafes, fuppofing the action to be fingle, and the ftream of water to be unemployed during the defcent of the refervoir, a confiderable preponderance may be advantageoufly employed in giving velocity to the weights, provided that the machinery be not liable to injury from their impulfe.

WHIN, in *Botany*. See GORSE.

WHIN, in *Agriculture*, a term fometimes applied to furze; which, when cut in the fap and bruifed in a proper way by flails, or in other modes, makes an excellent green food in winter for horfes, which eat and thrive on it well. It is alfo ufeful in fome meafure to fheep-ftock, as well as to bees. Its encroaches on land may be eafily and readily prevented by proper means being taken for the purpofe. See FURZE.

WHIN, in *Gardening*. See ULEX.

WHIN-*Afhes*, in *Agriculture* and *Planting*, the afhes produced in burning whins; which have lately been found of great benefit in planting young trees, as well as on land for other purpofes, promoting their growth in a very high degree. If the land to be planted be fuitable, they are advifed to be carefully fpread and ploughed in, if of quantity fufficient, over the whole field, otherwife only on the wet or colder fpots or parts of it. But if the ground be fuch that it will not admit of ploughing, the afhes fhould be mixed up with part of the beft furface mould, to keep them from blowing abroad; and in the procefs of pitting, a little of this compoft fhould be intimately mixed with the mould of each pit; previoufly diftributing it in fmall heaps at convenient diftances for facilitating the operation: and this extra trouble will be amply repaid by the progrefs the plants will make in confequence.

WHIN-*Axe*, in *Agriculture*, an inftrument employed for extirpating whins from land in many cafes. It is an implement that has one end like a common axe, with four inches of face; and the other like an adze, alfo with four inches of face; whereby the perfon ufing it, continuing in the fame pofition by fimply turning it in the hand, can make cuts at right angles with one another, as circumftances may require. The head of the tool may be about eight inches in length, weighing from three to four pounds; and the handle, of afh, about four feet long.

WHIN, *Petty*, a name given to a fpecies of *ononis*, or reftharrow.

WHIN, *Petty*, in *Gardening*. See GENISTA.

WHINCHAT, in *Ornithology*, the Englifh name of the *motacilla rubetra* of Linnæus.

It is of the common fize of the water-wagtail. Its head, neck, and back, are of a reddifh-brown, with regular rows of black fpots. Over each eye is a narrow white ftroke, and beneath that a broad bed of black, extending from the bill to the hind part of the head; the breaft is of a reddifh-yellow; the belly paler; the quill-feathers are brown, edged with a yellowifh-brown; the upper part of the wing is marked with two white fpots; the lower part of the tail is white, the two middle feathers excepted, which are wholly black; the upper part of the other is of the fame colour.

The colours are very uncertain in this bird, and it often much refembles the ftone-chatter; but may always, by an accurate obferver, be diftinguifhed from that bird by the white fpots in its wings, by the whitenefs of the under part of its tail, and the white lines on its head

The colours of the female are much lefs agreeable than thofe of the male; in lieu of the white and black marks on the cheeks is one broad pale brown one; and the white on the wings is in much lefs quantity than that of the male.

In the north of England, the whinchat is a bird of paf-

fage;

fage ; in the fouth he continues the whole year. Ray and Pennant.

WHINE, a hunting term, ufed in refpect of the cry of an otter.

WHINEBACH, in *Geography*, a town of Africa, on the Gold Coaft. N. lat. 5° 30′. W. long. 1° 30′.

WHIN-STONE, in *Geology*, the provincial name given, in many parts of England and Scotland, to bafaltic rocks ; it is alfo applied by miners to defignate every kind of dark-coloured and hard unftratified rock, which refifts the point of the pick. Many geologifts in this country clafs all bafaltic or trap rocks under the term whin-ftone. See TRAP.

The fubftance which fills very large mineral veins is generally dark bafalt, or green-ftone ; hence thefe veins are moft frequently called whin-dykes. Thefe veins being harder than moft of the rocks which they interfect, remain when the furface on each fide of them is wafhed away, forming enormous walls extending into the fea, or rifing above the level of the country in various parts of their courfe, and may often be traced for many leagues. They occur in the counties of Northumberland and Durham, and on the coafts of Scotland ; and when broken down, they form reefs of rock or iflands. The Farn iflands, off the coaft of Northumberland, are parts of a bafaltic dyke. When whin-dykes crofs rivers, they form ledges of rock conftituting fords ; or, if very abrupt, they hold up the water on one fide and form cafcades. The Cleveland bafalt, or whin-dyke, defcribed in Mr. Bakewell's Introduction to Geology, (fee VEINS, *Mineral*,) has been traced from the coaft of Yorkfhire feventy miles into the weftern part of Durham.

Under the article *Mineral* VEINS, we have obferved, that when whin-dykes interfect coal ftrata, they produce a change in the fubftance of the coal, and alfo of the other ftrata, fimilar to what might have been expected from a ftream of melted lava ; and we have recently obferved a fimilar effect produced on primitive rocks of gneifs, in the vicinity of Aberdeen, by contact with a powerful whin-dyke. The whin-ftone is alfo changed near its contact with the gneifs into a reddifh horn-ftone. In other parts, it is a dark granular bafalt or green-ftone. The gneifs has loft its characteriftic ftructure, and becomes porphyritic when near the whin-dyke. Between whin-dykes and the rocks which they interfect, there is fometimes a feam of foft argillaceous earth interpofed, which is wafhed out when they are near the fea-coaft, leaving the whin-ftone like a wall placed between two perpendicular precipices. Sometimes the internal part of a whin-dyke will be compofed of foft iron-clay ; in other inftances, the dyke will be compofed of folid blocks or prifms of bafalt feparated by fimilar clay. In fome whin-dykes, the fubftance which fills them appears a compact and folid mafs of whin-ftone, which, however, will divide into four, five, or fix-fided prifms, arranged horizontally.

Thefe are perfectly fimilar to the perpendicular bafaltic columns in ftructure, differing only in their pofition. There is a dyke traverfing the bafaltic ftrata of the Giant's Caufeway, on the coaft of Antrim, in which this peculiarity of ftructure is remarkably difplayed. It interfects beds of columnar bafalt, in which the columns are arranged with great regularity, and are perpendicular to the horizon ; but the whole dyke is compofed of fmall prifms of bafalt placed horizontally, or at right angles with the former. Some of thefe prifms do not exceed an inch in diameter, others are much larger : they are for the moft part extremely regular, and are articulated or jointed.

It has been fuppofed with much probability, that the different arrangement of the columnar ftructure in the beds and in the dyke, is to be attributed to the different circumftances under which they were folidified. If the beds have once flowed as lava under the furface of the ocean, the bafalt would begin to cool and cryftallize from the upper and lower furface. That this has probably been the cafe may be inferred from thefe beds refting on ftrata that contain marine organic remains, and which muft, therefore, have been formed under the bed of the ocean.

The perpendicular dykes interfecting rocks already formed would begin to cool from the fides with which they were in contact, and the procefs would proceed laterally.

In fome inftances, we find whin-dykes principally compofed of globular maffes of ftone feparated by a large quantity of foft clay, and the globular maffes are incrufted with ochreous clay : probably the whole of the clay in fuch dykes has been formed from the decompofition of the bafaltic maffes by the action of water percolating them.

Whin-ftone dykes prefent fo many analogies with volcanic rocks in their compofition, and the effects which they produce on the ftrata that they pafs through, that we are led to refer their origin to the action of fubterranean fire cracking the upper rocks and ftrata, and forcing the melted matter into the rent. Under the article VOLCANO, we have ftated many inftances of vaft rents made in the earth, and filled by eruptions of lava ; thefe rents fo filled with lava may be confidered as whin-dykes of recent formation. This is further confirmed by the obfervations of M. Cordier, (fee VOLCANIC *Products*,) who has fhewn that the fubftance which fills both are effentially the fame, being principally compofed of felfpar and augite, with iron-fand and olivine. Whin-ftone not only occupies the cavities of perpendicular dykes ; but it appears to have been, in many inftances, found laterally between the regular ftrata, producing fingular contortions and diflocations, and almoft always effecting a change in the fubftance of the rock with which it comes in contact. Sometimes it produces a change in the form of the bed or ftratum which it has paffed through, breaking it into diftinct maffes, or bending it in different directions, or enveloping large parts of it in the bafalt or whin-ftone. Of this a remarkable inftance is defcribed in the third volume of the Tranfactions of the Geological Society, occurring on the north coaft of Ireland, in the county of Antrim. (See *Plate* IV. *fig.* 4. *Geology*.) *a a a* reprefents a bed of chalk fingularly bent, and completely enveloped in the bafalt which forms a part of the bafaltic range extending from the Giant's Caufeway.

The beds of chalk and the other ftrata on this coaft are frequently interfected by whin-dykes, and a moft remarkable change is obferved in the ftructure of the chalk in the vicinity of thefe dykes. In immediate contact with the whin-ftone, and to a confiderable diftance on each fide, the chalk is converted into marble, having the granular texture of primitive lime-ftone, or what the French call calcaire faccaroide, from its refemblance to the grain of loaf-fugar, (fee *Plate* IV. *fig.* 5. *Geology*,) which reprefents two adjoining whin-dykes *a b*, interfecting the chalk *c c c* ; the dyke *a* is thirty feet in width, the dyke *b* twenty feet, and the intervening mafs of chalk twenty feet. The mafs of chalk between the two large dykes is interfected in a zigzag direction by a fmaller dyke. To a certain diftance from the whin-ftone, the chalk is perfectly cryftalline, but it gradually approaches to the character of the chalk at a greater diftance from the dyke. In various parts of the world we obferve trap or whin-ftone occurring in apparently regular beds, either covering ftratified rocks, or interpofed between them ; fuch have been called by the Wernerian geologifts flœtz trap-rocks, and their occurrence in this pofition has been urged as an argument for the aqueous formation of ſuch rocks. But it is well known to practical miners, that theſe beds are much more variable in their thickneſs than the regular ſtrata, ſometimes meaſuring twenty, thirty, or forty feet or more; and in other parts, the ſame bed will diminiſh to a few feet, or entirely terminate. In the iſle of Skye, according to the deſcription of Dr. Macculloch, in the third and fourth volumes of the Tranſactions of the Geological Society, the whin-ſtone is ſpread over the regular ſtrata in beds, or forms detached conical caps. It is alſo to be ſeen interpoſed between the ſtrata, and may be traced for more than a mile in continuous regular beds; but, ſays Dr. Macculloch, "there are no inſtances but where the alternating beds of trap detach veins or dykes from the lower to the upper beds; or the trap, quitting the interval between two given beds of lime-ſtone or ſand-ſtone, makes its way acroſs the one immediately above or below, and then proceeds with a regularity as great between ſome other pair of proximate ſtrata." And he adds, "I have no doubt, could ſuch extenſive expoſure of the ſtrata be oftener procured, all the inſtances of ſuppoſed alternating trap with regular ſtratified rocks would prove ſimilar to the above." Theſe obſervations, which might be confirmed by numerous other inſtances, tend to prove, that whin-dykes, and many of the interpoſed ſtrata of whin-ſtone, are of poſterior formation to the rocks in which they occur, and have been forced between the ſtrata in a fluid ſtate, and ſubſequently conſolidated. The whin-dykes, or perpendicular veins, are the channels through which the baſalt flowed up; but by ſuperincumbent preſſure, it has been driven laterally at different elevations. As beds of whin-ſtone occur in different rocks, it is probable, and almoſt certain, that they have had different epochs of formation; and of courſe ſome of the beds of whin-ſtone, which are covered by ſtratified rocks containing many organic remains, may have flowed as beds of lava under the ocean, and have been again covered with other ſtrata, on which again a ſecond torrent of lava burſting from below may have flown and formed an upper bed. It is well known that the beds of toad-ſtone in Derbyſhire, which are interpoſed between the mountain lime-ſtone of that diſtrict, cut off the metallic veins; but they are found again on ſinking through the toad-ſtone into the lower lime-ſtone. This ſtone, which varies from a hard, compact whin-ſtone or trap, to a ſoft amygdaloidal wacke, (ſee Toad-*Stone* and Wacke,) is ſuppoſed, by Mr. Whitehurſt, to have flowed between the beds of lime-ſtone after the formation of metallic veins; and, could we admit the hypotheſis, it would ſatisfactorily explain the cauſe of their diſappearance in the toad-ſtone. But though there are many inſtances of the vein entirely diſappearing in the latter rock, there are others in which a narrow vein paſſes through the toad-ſtone, though it is never productive of ore, being filled with calcareous ſpar, and a few particles only of galine. The occurrence of theſe veins in the toad-ſtone proves that this rock was not found between the lime-ſtone after the formation of metallic veins. Some ſofter whin-ſtone rocks, of the ſpecies called by mineralogiſts wacke, (ſee Wacke,) contain cavities lined, or partly filled with zeolites, agates, or calcareous ſpar; and ſome of theſe rocks envelope marine organic remains, particularly a rock of this kind near Berkley in Glouceſterſhire. The Euganean mountains are compoſed of a ſimilar rock, and alſo contain marine remains. Theſe rocks have probably been formed by muddy eruptions of ſubmarine volcanoes, ſimilar to what take place from ſome of the American volcanoes at the preſent time; and it is not improbable but that theſe two modes of formation may have given riſe to that diverſity which we obſerve in rocks of this claſs, the ſofter and more earthy being the products of aqueous and muddy eruptions, and the harder and more cryſtalline the products of igneous fuſion. See Trap, and Volcanic *Products*.

WHIP, or Whip-Staff, in a *Ship*, a piece of timber in form of a ſtrong ſtaff, faſtened into the helm, for the ſteerſman, in ſmall ſhips, to hold in his hand; thereby to move the rudder, and direct the ſhip.

Whip denotes alſo a ſort of ſmall tackle, formed by the communication of a rope either with a ſingle immoveable block, or with two blocks, one of which is fixed, and the other moveable. It is generally uſed to hoiſt light bodies, as empty caſks, &c. out of a ſhip's hold, which is accordingly called whipping them up. Falconer.

To whip is to tie a piece of pack-thread, ſpun-yarn, &c. about the end of a rope, to prevent it from being untwiſted and unlooſened.

Whip, in *Rural Economy*, the laſh attached to flexible rods or other ſubſtances and contrivances, for the purpoſe of driving teams.

Whip-*Grafting*, in *Gardening*, a particular mode of performing the operation. A ſort of root-whip-grafting is adviſed by Agricola, in which a graft or ſcion is taken from a young tree, and a ſmall piece of the root of another tree of the ſame kind, or like it; or otherwiſe, pieces of roots cut off from other trees in tranſplanting: theſe are whip-grafted together, taking care that the two but ends of the graft and root be united, and that the rind of the root join that of the graft; then plant the root with the part of the ſcion under-ground. See Grafting, and Stocks, *Apple-grafting in*.

Whip-*Poor-Will*. See Caprimulgus *Virginianus*.

Whip-*Rein*, in *Agriculture*, a term uſed to ſignify a rein formed of cord or leather, by which a plough or other ſort of team is directed in working. See Rein

Whip-*Rein-Plough*, a term applied to a ſmall plough, drawn by two horſes, or oxen, which are guided and directed by proper reins of this ſort, and ſo made as to ſerve the ploughman in the way of a whip, in driving them while he holds the plough.

Whip-*Saw*. See *Whip*-Saw.

WHIPLADE, in *Huſbandry*, a term uſed by the farmers in ſome places for a particular ſort of cart, whoſe hinder part is made up of boards after the manner of a dung-cart, having alſo a head of boards, and ſhambles over the thills; this head being ſo as either to be taken out or left in. The cart may be indifferently uſed to carry dung or other things; dung when the head is in, and corn, &c. when it is taken out.

WHIPPANY, in *Geography*, a town of New Jerſey; 20 miles W.N.W. of New York.

WHIPPER. See Fishing.

WHIPPING, a term uſed by *Anglers*, when they faſten a line to the hook or rod.

The word is alſo taken for the caſting in of the hook, and drawing it gently on the water.

Whipping, in *Law*, denotes an ignominious puniſhment inflicted on perſons guilty of petty larceny, &c.

Whipping *Wheat*, in *Agriculture*, a term applied to the practice in ſome of the northern diſtricts, by which the wheat-crops are laſhed or whipped out on a wooden or wattled frame-work contrived for the purpoſe. The former is conſtructed by nailing two or more thick boards in a ſlanting manner, to the height of about two and a half, or three feet, on a ſort of frame of ſuitable ſtrength, ſupported by legs, having the upper part a little rounded, and made ſmooth. This, which is termed the whipping or laſhing frame, is placed

placed in ſome convenient ſituation, ſo as to prevent the grain from flying about during the operation, which is then begun. Where the latter contrivance is made uſe of, the frame is woven with ſtrong ſticks, in the manner of a hurdle, being placed in the ſame ſituation when uſed.

The proceſs is performed by taking large handfuls of the corn in the ſtraw by the butt end, and ſtriking the top or ear-ends over the upper part of the frame, ſo as to force out the grain from the ears of the top part, without breaking the ſtraw, which in this way becomes much better for thatch, and at the ſame time the grain is leſs injured than by the flail method of threſhing it out. The butt parts of the ſtraw are ſometimes afterwards thraſhed over, in order to get out any wheat that may have been left in the ſhort ears. This is an excellent mode of providing ſeed-wheat, as the fineſt grain is chiefly procured.

And it is ſuggeſted, too, as a particularly good method in caſes where wheat is infected with the ſmut, as during the operation of threſhing, the flail breaks the ſmut-balls, and reduces them to a powdery ſtate, which cauſes the good wheat to have a blacker appearance than would otherwiſe be the caſe when ground. It may likewiſe be uſed to advantage with other ſorts of grain in ſome caſes.

The above is alſo a term ſometimes applied in the northern diſtricts, to the practice of ſtriking it over a ſtone or other ſuch contrivance, in order to get out the grain, and leave the ſtraw in an unbroken ſtate. In this way it is ſometimes termed laſhing. It is an excellent practice in getting out this ſort of grain in many points of view, when on a ſmall ſcale, but it is not well ſuited to large concerns. See THRESHING.

WHIPPLE-TREE, a term uſed to ſignify the bar or wooden part of the contrivance by which a horſe or team is attached to a plough, harrow, or any other ſort of implement of theſe kinds. They are of different ſizes and forms, according to the nature of the teams and other circumſtances. See SWINGLE-*Tree*, *Indented*.

WHIPSTITCH, a term not unfrequently uſed in ploughing to ſignify a ſort of half-ploughing, or what in many places is termed *raftering*. It is principally made uſe of for keeping the land more dry and healthy in the winter ſeaſon. See RAFTERING.

WHIPSTITCHING, the practice of working tillage-land in ſomewhat the raftering manner. It is a method often employed for turning up ſtubbles of the wheat and other kinds in the winter time, inſtead of making a fallow. The beſt mode of doing it in this intention is firſt to make what is called a whipſtitch, rafter, or ſort of half-ploughing of the land; and that when come back again to the ſame furrow, to turn them both over; the top parts of both furrows being thus turned in the middle, which leaves the ſpace of four inches betwixt each furrow: then ploughing the land acroſs the old furrows. If land lies ever ſo wet in winter, by ploughing in this manner, it may be kept dry and in a healthy ſtate. It is neceſſary, too, to ſtrike up the old furrows every day before leaving the ground; and to let the main drains be kept well open to receive the water from the furrows in the land: by this means, the froſt will be admitted four inches deeper than in the caſe of a flat fallow-work.

This mode of tillage is that which is ſometimes called double whipſtitching in ſome diſtricts and places.

Some prefer it before all other methods for winter-tillage, as it brings the land into much better condition for cultivation than twice fallowing.

WHIPT SYLLABUB. See SYLLABUB.

WHIRL-POOL, an eddy, vortex, or gulf, where the water is continually turning round. See GULPH, EDDY, VORTEX, &c.

Theſe in rivers are very common, from various accidents, and are uſually very trivial, and of little conſequence. In the ſea they are more rare, but more dangerous. Sibbald has related the effects of a remarkable marine whirlpool among the Orcades, which would prove very dangerous to ſtrangers, though it is of no conſequence to the people who are uſed to it. This is not fixed to any particular place, but appears in various parts of the limits of the ſea among thoſe iſlands. Wherever it appears, it is very furious, and boats, &c. would inevitably be drawn in and periſh with it; but the people who navigate them are prepared for it, and always carry an empty veſſel, a log of wood, or large bundle of ſtraw, or ſome ſuch thing, in the boat with them; as ſoon as they perceive the whirlpool, they toſs this within its vortex, keeping themſelves out; this ſubſtance, whatever it be, is immediately received in the centre, and carried under water; and as ſoon as this is done, the ſurface of the place where the whirl-pool was becomes ſmooth, and they row over it with ſafety; and in about an hour they ſee the vortex begin again in ſome other place, uſually at about a mile diſtant from the firſt. Sibbald's Prodr. Hiſt. Scotl.

WHIRLIGIG, in *Military Antiquities*, an inſtrument of puniſhment formerly much uſed for trifling offences, committed by petit ſutlers, Jews, brawling women, and ſuch perſons. This was a kind of circular wooden cage, which turned on a pivot; and when ſet in motion, whirled round with ſuch an amazing velocity, that the delinquent became extremely ſick, and commonly made diſcharges through every operation of the body.

WHIRLING-TABLE, a machine contrived for exhibiting and demonſtrating the principal laws of gravitation, and of the planetary motions in curvilinear orbits. A A (*Plate* XXI. *fig.* 13. *Aſtronomy*) is a ſtrong frame of wood, B a winch fixed on the axis C of the wheel D, round which is the catgut-ſtring F, which alſo goes round the ſmall wheels G and K, croſſing between them and the great wheel D. On the upper end of the axis of the wheel G, above the frame, is fixed the round board *d*, to which may be occaſionally fixed the bearer M S X. On the axis of the wheel H is fixed the bearer N T Z, and when the winch B is turned, the wheels and bearers are put into a whirling motion. Each bearer has two wires, W X and Y Z, fixed and ſcrewed tight into them at the ends by nuts on the outſide; and when the nuts are unſcrewed, the wires may be drawn out in order to change the balls U, V, which ſlide upon the wires by means of braſs loops fixed into the balls, and preventing their touching the wood below them. Through each ball there paſſes a ſilk line, which is fixed to it at any length from the centre of the bearer to its end by a nut-ſcrew at the top of the ball; the ſhank of the ſcrew going into the centre of the ball, and preſſing the line againſt the under ſide of the hole which it goes through. The line goes from the ball, and under a ſmall pulley fixed in the middle of the bearer; then up through a ſocket in the round plate (S and T) in the middle of each bearer; then through a ſlit in the middle of a ſquare top (O and P) of each tower, and going over a ſmall pulley on the top comes down again the ſame way, and is at laſt faſtened to the upper end of the ſocket fixed in the middle of the round plate above-mentioned. Each of theſe plates, S and T, has four round holes near their edges, by which they ſlide up and down upon the wires which make the corner of each tower. The balls and plates being thus connected, each by its particular line, it is plain that if the balls be drawn outward, or towards the ends M and N of their reſpective bearers,

bearers, the round plates S and T will be drawn up to the top of their reſpective towers O and P.

There are ſeveral braſs weights, ſome of two, ſome of three, and others of four ounces, to be occaſionally put within the towers O and P, upon the round plates S and T; each weight having a round hole in the middle of it, for going upon the ſockets or axes of the plates, and being ſlit from the edge to the hole, that it may ſlip over the line which comes from each ball to its reſpective plate.

For a ſpecimen of the experiments which may be made with this machine, we ſhall ſubjoin the following.

1. Removing the bearer M X, put the loop of the line *b*, to which the ivory ball *a* is faſtened, over a pin in the centre of the board *d*, and turn the winch B; and the ball will not immediately begin to move with the board, but, on account of its inactivity, endeavour to remain in its ſtate of reſt. But when the ball has acquired the ſame velocity with the board, it will remain upon the ſame part of the board, having no relative motion upon it. However, if the board be ſuddenly ſtopped, the ball will continue to revolve upon it, until the friction thereof ſtops its motion; ſo that matter reſiſts every change of ſtate, from that of reſt to that of motion, and *vice verſâ*.

2. Put a longer cord to this ball; let it down through the hollow axis of the bearer M X and wheel G, and fix a weight to the end of the cord below the machine; and this weight, if left at liberty, will draw the ball from the edge of the whirling-board to its centre. Draw off the ball a little from its centre, and turn the winch; then the ball will go round and round with the board, and gradually fly farther from the centre, raiſing up the weight below the machine; and thus it appears that all bodies revolving in circles, have a tendency to fly off from theſe circles, and muſt be retained in them by ſome power proceeding from or tending to the centre of motion. Stop the machine, and the ball will continue to revolve for ſome time upon the board; but as the friction gradually ſtops its motion, the weight acting upon it will bring it nearer and nearer to the centre in every revolution, till it brings it quite thither. Hence it appears, that if the planets met with any reſiſtance in going round the ſun, its attractive power would bring them nearer and nearer to it in every revolution, till they fell into it.

3. Take hold of the cord below the machine with one hand, and with the other throw the ball upon the round board as it were at right angles to the cord, and it will revolve upon the board. Then, obſerving the velocity of its motion, pull the cord below the machine, and thus bring the ball nearer the centre of the board, and the ball will be ſeen to revolve with an increaſing velocity, as it approaches the centre: and thus the planets which are neareſt the ſun perform quicker revolutions than thoſe which are more remote, and move with greater velocity in every part of their reſpective circles.

4. Remove the ball *a*, and apply the bearer M X, whoſe centre of motion is in its middle at *w*, directly over the centre of the whirling-board *d*. Then put two balls (V and U) of equal weights upon their bearing wires, and having fixed them at equal diſtances from their reſpective centres of motion *w* and *x* upon their ſilk cords, by the ſcrew-nuts, put equal weights in the towers O and P. Laſtly, put the catgut-ſtrings E and F upon the grooves G and H of the ſmall wheels, which, being of equal diameters, will give equal velocities to the bearers above, when the winch B is turned; and the balls U and V will fly off toward M and N, and raiſe the weights in the towers at the ſame inſtant. This ſhews, that when bodies of equal quantities of matter revolve in equal circles with equal velocities, their centrifugal forces are equal.

5. Take away theſe equal balls, and put a ball of ſix ounces into the bearer M X, at a ſixth part of the diſtance wz from the centre, and put a ball of one ounce into the oppoſite bearer, at the whole diſtance $xy = wz$; and fix the balls at theſe diſtances on their cords, by the ſcrew-nuts at the top: then the ball U, which is ſix times as heavy as the ball V, will be at only a ſixth part of the diſtance from its centre of motion; and conſequently will revolve in a circle of only a ſixth part of the circumference of the circle in which V revolves. Let equal weights be put into the towers, and the winch be turned; which (as the catgut-ſtring is on equal wheels below) will cauſe the balls to revolve in equal times: but V will move ſix times as faſt as U, becauſe it revolves in a circle of ſix times its radius, and both the weights in the towers will riſe at once. Hence it appears, that the centrifugal forces of revolving bodies are in direct proportion to their quantities of matter multiplied into their reſpective velocities, or into their diſtances from the centres of their reſpective circles.

If theſe two balls be fixed at equal diſtances from their reſpective centres of motion, they will move with equal velocities; and if the tower O has ſix times as much weight put into it as the tower P has, the balls will raiſe their weights exactly at the ſame moment: *i. e.* the ball U, being ſix times as heavy as the ball V, has ſix times as much centrifugal force in deſcribing an equal circle with an equal velocity.

6. Let two balls, U and V, of equal weights be fixed on their cords at equal diſtances from their reſpective centres of motion *w* and *x*; and let the catgut-ſtring E be put round the wheel K (whoſe circumference is only half that of the wheel H or G) and over the pulley *s* to keep it tight, and let four times as much weight be put into the tower P, as in the tower O. Then turn the winch B, and the ball V will revolve twice as faſt as the ball U in a circle of the ſame diameter, becauſe they are equi-diſtant from the centres of the circles in which they revolve; and the weights in the towers will both riſe at the ſame inſtant, which ſhews that a double velocity in the ſame circle will exactly balance a quadruple power of attraction in the centre of the circle: for the weights in the towers may be conſidered as the attractive forces in the centres, acting upon the revolving balls; which, moving in equal circles, are as if they both moved in the ſame circle. Whence it appears, that if bodies of equal weights revolve in equal circles with unequal velocities, their centrifugal forces are as the ſquares of the velocities.

7. The catgut-ſtring remaining as before, let the diſtance of the ball V from the centre *x* be equal to 2 of the diviſions on its bearer; and the diſtance of the ball U from the centre *w* be 3 and a ſixth part; the balls themſelves being equally heavy, and V making two revolutions by turning the winch, whilſt U makes one; ſo that if we ſuppoſe the ball V to revolve in one moment, the ball U will revolve in two moments, the ſquares of which are 1 and 4: therefore, the ſquare of the period of V is contained 4 times in the ſquare of the period of U. But the diſtance of V is 2, the cube of which is 8, and the diſtance of U is $3\frac{1}{6}$, the cube of which is 32 very nearly, in which 8 is contained 4 times: and therefore the ſquares of the periods of V and U are to one another as the cubes of their diſtances from *x* and *w*, the centres of their reſpective circles. And if the weight in the tower O be 4 ounces, equal to the ſquare of 2, the diſtance of V from the centre *x*; and the weight in the tower P be 10 ounces, nearly equal to the ſquare of $3\frac{1}{6}$, the

 diſtance

diſtance of U from w; it will be found, upon turning the machine by the winch, that the balls U and V will raiſe their reſpective weights at very nearly the ſame inſtant of time. This experiment confirms the famous propoſition of Kepler, *viz.* that the ſquares of the periodical times of the planets round the ſun are in proportion as the cubes of their diſtances from him; and that the ſun's attraction is inverſely as the ſquare of the diſtance from his centre.

8. Take off the ſtring E from the wheels D and H, and let the ſtring F remain upon the wheels D and G; take away alſo the bearer M X from the whirling-board *d*, and inſtead of it put on the machine A B (*Plate* XXI. *fig.* 14. *Aſtronomy*), fixing it to the centre of the board by the pins *c* and *d*, ſo that the end *e f* may riſe above the board to an angle of 30 or 40 degrees. On the upper part of this machine, there are two glaſs tubes *a* and *b*, cloſe ſtopped at both ends; each tube being about three-quarters full of water. In the tube *a* is a little quickſilver, which naturally falls down to the end *a* in the water; and in the tube *b* is a ſmall cork, floating on the top of the water, and ſmall enough to riſe or fall in the tube. While the board *b* with this machine upon it continues at reſt, the quickſilver lies at the bottom of the tube *a*, and the cork floats on the water near the top of the tube *b*. But, upon turning the winch and moving the machine, the contents of each tube will fly off towards the uppermoſt ends, which are fartheſt from the centre of motion: the heavieſt with the greateſt force. Conſequently, the quickſilver in the tube *a* will fly off quite to the end *f*, occupying its bulk of ſpace and excluding the water, which is lighter than itſelf: but the water in the tube *b*, flying off to its higher end *e*, will exclude the cork from that place, and cauſe it to deſcend toward the loweſt end of the tube; for the heavier body, having the greater centrifugal force, will poſſeſs the upper part of the tube, and the lighter body will keep between the heavier and the lower part.

This experiment demonſtrates the abſurdity of the Carteſian doctrine of vortices: for, if the planet be more denſe or heavy than its bulk of the vortex, it will fly off in it farther and farther from the ſun; if leſs denſe, it will come down to the loweſt part of the vortex, at the ſun: and the whole vortex itſelf, unleſs prevented by ſome obſtacle, would fly quite off, together with the planets.

9. If a body be ſo placed upon the whirling-board of the machine (*fig.* 13.) that the centre of gravity of the body be directly over the centre of the board, and the board be moved ever ſo rapidly by the winch B, the body will turn round with the board, without moving from its middle; for, as all parts of the body are in equilibrio round its centre of gravity, and the centre of gravity is at reſt in the centre of motion, the centrifugal force of all parts of the body will be equal at equal diſtances from its centre of motion, and therefore the body will remain in its place. But if the centre of gravity be placed ever ſo little out of the centre of motion, and the machine be turned ſwiftly round, the body will fly off towards that ſide of the board on which its centre of gravity lies. Then, if the wire C (*fig.* 15.) with its little ball B be taken away from the ſemi-globe A, and the flat ſide *e f* of the ſemi-globe be laid upon the whirling-board, ſo that their centres may coincide; if then the board be turned ever ſo quickly by the winch, the ſemi-globe will remain where it was placed: but if the wire C be ſcrewed into the ſemi-globe at *d*, the whole becomes one body, whoſe centre of gravity is at or near *d*. Fix the pin *c* in the centre of the whirling-board, and let the deep groove *b* cut in the flat ſide of the ſemi-globe be put upon the pin, ſo that the pin may be in the centre of A (ſee *fig.* 16. where the groove is repreſented at *b*), and let the board be turned by the winch, which will carry the little ball B (*fig.* 15.) with its wire C, and the ſemi-globe A, round the centre pin *c i*; and then, the centrifugal force of the little ball B, weighing one ounce, will be ſo great as to draw off the ſemi-globe A, weighing two pounds, until the end of the groove at *e* ſtrikes againſt the pin *c*, and ſo prevents A from going any farther: otherwiſe, the centrifugal force of B would have been great enough to have carried A quite off the whirling-board. Hence we ſee, that if the ſun were placed in the centre of the orbits of the planets, it could not poſſibly remain there; for the centrifugal forces of the planets would carry them quite off, and the ſun with them; eſpecially when ſeveral of them happened to be in one quarter of the heavens. For the ſun and planets are as much connected by the mutual attraction ſubſiſting between them, as the bodies A and B are by the wire C fixed into them both. And even if there were but one planet in the whole heavens to go round ever ſo large a ſun in the centre of its orbit, its centrifugal force would ſoon carry off both itſelf and the ſun: for the greateſt body placed in any part of free ſpace could be eaſily moved; becauſe, if there were no other body to attract it, it would have no weight or gravity of itſelf, and conſequently, though it could have no tendency of itſelf to remove from that part of ſpace, yet it might be very eaſily moved by any other ſubſtance.

10. As the centrifugal force of the light body B will not allow the heavy body A to remain in the centre of motion, even though it be twenty-four times as heavy as B; let the ball A (*fig.* 17.) weighing ſix ounces be connected by the wire C with the ball B, weighing one ounce; and let the fork E be fixed into the centre of the whirling-board; then, hang the balls upon the fork by the wire C in ſuch a manner, that they may exactly balance each other, which will be when the centre of gravity between them, in the wire at *d*, is ſupported by the fork. And this centre of gravity is as much nearer to the centre of the ball A than to the centre of B, as A is heavier than B; allowing for the weight of the wire on each ſide of the fork. Then, let the machine be moved, and the balls A and B will go round their common centre of gravity *d*, keeping their balance, becauſe either will not allow the other to fly off with it. For, ſuppoſing the ball B to be only one ounce in weight, and the ball A to be ſix ounces; then, if the wire C were equally heavy on each ſide of the fork, the centre of gravity *d* would be ſix times as far from the centre of B, as from the centre of A, and conſequently B will revolve with a velocity ſix times as great as A does; which will give B ſix times as much centrifugal force as any ſingle ounce of A has: but then, as B is only one ounce, and A ſix ounces, the whole centrifugal force of A will exactly balance that of B; and therefore each body will detain the other, ſo as to make it keep in its circle.

Hence it appears, that the ſun and planets muſt all move round the common centre of gravity of the whole ſyſtem, in order to preſerve that juſt balance which takes place among them.

11. Take away the forks and balls from the whirling-board, and place the trough A B (*fig.* 18.) thereon, fixing its centre to that of the board by the pin H. In this trough are two balls D and E of unequal weights, connected by a wire *f*, and made to ſlide eaſily upon the wire C ſtretched from end to end of the trough, and made faſt by nut-ſcrews on the outſide of the ends. Place theſe balls on the wire C, ſo that their common centre of gravity *g* may be directly over the centre of the whirling-board. Then, turn the machine by the winch ever ſo ſwiftly, and the trough

trough and balls will go round their centre of gravity, ſo as neither of them will fly off; becauſe, on account of the equilibrium, each ball detains the other with an equal force acting againſt it. But if the ball E be drawn a little more towards the end of the trough at A, it will remove the centre of gravity towards that end from the centre of motion; and then, upon turning the machine, the little ball E will fly off, and ſtrike with a conſiderable force againſt the end A, and draw the great ball B into the middle of the trough. Or, if the great ball D be drawn towards the end B of the trough, ſo that the centre of gravity may be a little towards that end from the centre of motion, and the machine be turned by the winch, the great ball D will fly off, and ſtrike violently againſt the end B of the trough, and will bring the little ball E into the middle of it. If the trough be not made very ſtrong, the ball D will break through it.

12. Mr. Ferguſon has explained the reaſon why the tides riſe at the ſame time on oppoſite ſides of the earth, and conſequently in oppoſite directions, by the following new experiment on the whirling-table. For this purpoſe, let *a b c d* (*fig.* 19.) repreſent the earth, with its ſide *c* turned toward the moon, which will then attract the water ſo as to raiſe them from *c* to *g*: and in order to ſhew that they will riſe as high at the ſame time on the oppoſite ſide from *a* to *e*; let a plate A B (*fig.* 20.) be fixed upon one end of the flat bar D C, with ſuch a circle drawn upon it as *a b c d* (*fig.* 19.) to repreſent the round figure of the earth and ſea; and an ellipſe as *e f g h* to repreſent the ſwelling of the tide at *e* and *g*, occaſioned by the influence of the moon. Over this plate A B ſuſpend the three ivory balls *e*, *f*, *g*, by the ſilk lines *h*, *i*, *k*, faſtened to the tops of the crooked wires H, I, K, ſo that the ball at *e* may hang freely over the ſide of the circle *c*, which is fartheſt from the moon M at the other end of the bar; the ball at *f* over the centre, and the ball at *g* over the ſide of the circle *g*, which is neareſt the moon. The ball *f* may repreſent the centre of the earth, the ball *g* water on the ſide next the moon, and the ball *e* water on the oppoſite ſide. On the back of the moon M is fixed a ſhort bar N parallel to the horizon, and there are three holes in it above the little weights *p*, *q*, *r*. A ſilk thread *o* is tied to the line *k*, cloſe above the ball *g*, and paſſing by one ſide of the moon M goes through a hole in the bar N, and has the weight *p* hung to it. Such another thread *n* is tied to the line *i*, cloſe above the ball *f*, and paſſing through the centre of the moon M and middle of the bar N, has the weight *q* hung to it, which is lighter than the weight *p*. A third thread *m* is tied to the line *h*, cloſe above the ball *e*, and paſſing by the other ſide of the moon M, through the bar N, has the weight *r* hung to it, which is lighter than the weight *q*. The uſe of theſe three unequal weights is to repreſent the moon's unequal attraction at different diſtances from her; ſo that if they are left at liberty, they will draw all the three balls towards the moon with different degrees of force, and cauſe them to appear as in *fig.* 21, in which caſe they are evidently farther from each other than if they hung freely by the perpendicular lines *h*, *i*, *k*. Hence it appears, that as the moon attracts the ſide of the earth which is neareſt her with a greater degree of force than ſhe does the centre of the earth, ſhe will draw the water on that ſide more than the centre, and cauſe it to riſe on that ſide; and as ſhe draws the centre more than the oppoſite ſide, the centre will recede farther from the ſurface of the water on that oppoſite ſide, and leave it as high there as ſhe raiſed it on the ſide next her. For, as the centre will be in the middle between the tops of the oppoſite elevations, they muſt of courſe be equally high on both ſides at the ſame time.

However, upon the ſuppoſition, the earth and moon would ſoon come together; and this would be the caſe, if they had not a motion round their common centre of gravity, to produce a degree of centrifugal force, ſufficient to balance their mutual attraction. Such motion they have; for as the moon revolves in her orbit every month at the diſtance of 240,000 miles from the earth's centre, and of 234,000 miles from the centre of gravity of the earth and moon, the earth alſo goes round the ſame centre of gravity every month at the diſtance of 6000 miles from it, *i. e.* from it to the centre of the earth. But the diameter of the earth being, in round numbers, 8000 miles, its ſide next the moon is only 2000 miles from the common centre of gravity of the earth and moon, its centre 6000 miles from it; and its fartheſt ſide from the moon 10,000 miles. Conſequently the centrifugal forces of theſe parts are as 2000, 6000, and 10,000; *i. e.* the centrifugal force of any ſide of the earth, when it is turned from the moon, is five times as great as when it is turned toward the moon. And as the moon's attraction, expreſſed by the number 6000, at the earth's centre, keeps the earth from flying out of this monthly circle, it muſt be greater than the centrifugal force of the waters on the ſide next her; and conſequently, her greater degree of attraction on that ſide is ſufficient to raiſe them; but as her attraction on the oppoſite ſide is leſs than the centrifugal force of the water there, the exceſs of this force is ſufficient to raiſe the water juſt as high on the oppoſite ſide.

To prove this experimentally, let the bar D C with its furniture be fixed on the whirling-board of the machine, (*fig.* 14.) by puſhing the pin P into the centre of the board; which pin is the centre of gravity of the whole bar with its three balls *e*, *f*, *g*, and moon M. Now, if the whirling-board and bar be turned ſlowly round by the winch, till the ball *f* hangs over the centre of the circle, as in *fig.* 22, the ball *g* will be kept towards the moon by the heavieſt weight *p* (*fig.* 20.), and the ball *e*, on account of its greater centrifugal force, and the leſs weight *r*, will fly off as far to the other ſide, as in *fig.* 22. And thus, whilſt the machine is kept turning, the balls *e* and *g* will hang over the ends of the ellipſe *l f k*. So that the centrifugal force of the ball *e* will exceed the moon's attraction juſt as much as her attraction exceeds the centrifugal force of the ball *g*, whilſt her attraction juſt balances the centrifugal force of the ball *f*, and makes it keep in its circle. Hence it is evident, that the tides muſt riſe to equal heights at the ſame time on oppoſite ſides of the earth. See Ferguſon's Lectures on Mechanics, lect. 2, and Deſag. Ex. Phil. vol. i. lect. 5.

WHIRL-WIND, a wind that riſes ſuddenly, and is exceedingly rapid and impetuous when riſen, but is ſoon ſpent. In this caſe, the guſts of wind proceed from different quarters at the ſame time, and meet in a certain place, where the air acquires a circular, or rotatory, or ſcrew-like motion, either aſcending or deſcending, as it were, round an axis, which axis is ſometimes ſtationary, and at other times moves on in a particular direction. This phenomenon, called a whirl-wind, gives a whirling motion to duſt, ſand, water, part of a cloud, and ſometimes even to bodies of great weight and bulk; carrying them either upwards or downwards, and laſtly, ſcattering them about in different directions.

There are divers ſorts of whirl-winds, diſtinguiſhed by their peculiar names: as, the *preſter*, *typho*, *turbo*, *exhydria*, and *ecnephias*.

The

The *prester* is a violent wind breaking forth with flashes of lightning. This is rarely observed; scarcely ever without the *ecnephias*. Seneca says, it is a *typho*, or *turbo*, kindled or ignited in the air.

The *ecnephias* is a sudden and impetuous wind, breaking out of some cloud; frequent in the Ethiopic sea, particularly about the Cape of Good Hope. The seamen call them *travados*.

The *exhydria* is a wind bursting out of a cloud, with a great quantity of water. This only seems to differ, in degree, from the *ecnephias*, which is frequently attended with showers.

A *typho*, or *vortex*, most properly called a *whirl-wind*, or *hurricane*, is an impetuous wind, turning rapidly every way, and sweeping all round the place. It frequently descends from on high. The Indians call it *orancan;* the Turks, &c. *oliphant*. It is frequent in the Eastern ocean, chiefly about Siam, China, &c. and renders the navigation of those parts exceedingly dangerous.

Dr. Franklin, in his Physical and Meteorological Observations, read to the Royal Society in 1756, supposes a whirl-wind and a water-spout to proceed from the same cause; their only difference being, that the latter passes over the water and the former over the land. This opinion is corroborated by the observations of M. de la Pryme, and many others, who have remarked the appearances and effects of both to be the same. They have both a progressive as well as a circular motion; they generally rise after calms and great heats, and occur most frequently in the warmer latitudes: the wind blows every way from a large surrounding space both to the water-spout and whirl-wind; and a water-spout has, by its progressive motion, passed from the sea to the land, and produced all the phenomena and effects of a whirl-wind: so that there is no reason to doubt their being meteors arising from the same general cause, and explicable upon the same principles, furnished by electrical experiments and discoveries. See HURRICANE, and *Water-Spout*.

For Dr. Franklin's ingenious method of accounting for both these phenomena, see his Letters and Papers, &c. vol. i. p. 191, &c. p. 216, &c.

WHISKET, or WISKET, in *Rural Economy*, a term often used provincially to signify a basket, especially in the northern counties. See BASKET.

WHISKY, a term signifying *water*, and applied in the Highlands and islands of Scotland and in Ireland to strong water or distilled liquor. The spirit drank in the North is drawn from barley, and is said to be preferable to any English malt-brandy: it is strong, but not pungent, and free from the empyreumatic taste or smell.

WHISPERING. See HEARING, ATTENTION, &c.

WHISPERING-*Places*, such as *domes* and *galleries*, depend on this principle, that the voice being applied to one end of an arch, easily passes by repeated reflections to the other.

Thus, let A B C (*Plate* XV. *Pneumatics*, *fig*. 8.) represent the segment of a sphere; and suppose a low voice uttered at D, the vibrations extending themselves every way, some of them will impinge upon the points E, E, &c. and thence be reflected to the points F, F, &c. thence to G, G, &c. till at last they meet in C; where, by their union, they cause a much stronger sound than in any part of the segment whatever, even at D the point whence they first proceeded.

Accordingly, all the contrivance in a whispering-place is, that near the person who whispers there be a smooth wall, arched either cylindrically, or elliptically; in which case he will be heard distinctly by another person, who places his ear pretty near the wall on the opposite side. A circular arch will do, but not so well. It is demonstrated by all the writers on CONICS (which see), that if from any point in the circumference of an ellipse two lines be drawn to the foci, those lines make equal angles with one curve at that point. Consequently, the sound which is produced in one focus of an elliptical chamber, and is reflected from the wall to the other focus, makes all the angles of incidence equal to the angles of reflection respectively. Hence that focus is the place where the sound is best heard.

Places famed for the conveyance of whispers are, the prison of Dionysius at Syracuse, which increased a soft whisper to a loud noise; the clap of one's hand to the sound of a cannon, &c.; the aqueducts of Claudius, which carried a voice sixteen miles; and divers others enumerated by Kircher in his Phonurgia.

The most considerable in England are, the dome of St. Paul's, London, where the ticking of a watch may be heard from side to side; and a very easy whisper be sent all round the dome: this Dr. Derham found to hold not only in the gallery below, but above upon the scaffold, where a whisper would be carried over one's head round the top of the arch, though there be a large opening in the middle of it into the upper part of the dome: and the famous whispering-place in Gloucester cathedral, which is no other than a gallery at the east end of the choir, leading from one side of it to the other. It consists of five angles and six sides, the middlemost of which is a naked window; yet two whisperers there hear each other at the distance of twenty-five yards. See Birch's Hist. of the Royal Society, vol. i. p. 120. See ECHO.

WHIST, or WHISK, a well-known game at cards. Mr. T. Matthews, one of the last and most approved writers on the game of whist, has published (1816) a tenth edition of his "Advice to the Young Whist Player, &c." in which he has comprised, under the detail of 108 maxims, such instructions as are necessary to be observed by those who wish to play this game with skill and success. It would far exceed our limits, if we attempted to follow him in this detail; and an abridgment, if it were practicable, would be of little use; nor indeed is it necessary, as those who are desirous of acquiring a knowledge of the minutiæ of the game will consult the author, whose "Advice" may be easily and cheaply procured. We shall, however, select some of those instructions that are the most important, and subjoin those laws of the game that serve to prevent or settle disputes among players.

The following maxims comprehend those instructions that relate to leads, to which we have annexed some other directions that are immediately connected with them. It is highly necessary, says Mr. M., to be correct in leads. When a good player plays an eight, and then a seven, it may be known that he leads from a weak hand; and the contrary, when he plays the seven first: the case is the same with a tray or a deuce.

Good players never lead a nine or ten, but for one of these reasons:

1st. From a sequence up to the king.

2d. From nine, ten, knave, and king.

3d. When the best of a weak suit not exceeding three in number.

1. The safest leads are those that are furnished by sequences of three or more cards; in which case the player is advised to lead the highest, and to put on the lowest to his partner's lead, and to put the highest on his adversary's; and with a tierce to the king and several others, to begin with

with the knave. If he has no fequences, he is inftructed to lead from his moft numerous fuit; if ftrong in trumps, to lead rather from one headed by a king than a queen; but with three or four fmall trumps, Mr. Matthews prefers leading from a fingle card to a long weak fuit. But the players of the old fchool never lead from a fingle card without fix trumps. In fome cafes, Mr. M. obferves, this may be occafionally done with very great, though not certain, advantage; *e. g.* when A has four fmall trumps, ace, queen, &c. of the fecond fuit; king, knave, &c. of a third; and a fingle card of the fourth. To lead from three cards, unlefs in fequences, is bad play, and only proper when you have reafon to think it is your partner's fuit, and then lead off the higheft. Unlefs, fays Mr. M., you have a ftrong fuit yourfelf, or have reafon to fuppofe that your partner has one, do not trump out unlefs you have fix trumps. It is generally right to return your partner's lead in trumps, unlefs he leads a nine or ten, called an equivocal card, becaufe it is led with propriety, both from ftrong and weak fuits.

2. With ace, king, knave, and three fmall trumps, play the ace and king; with only two, the king, and wait for the fineffe of the knave. In other fuits, without great ftrength in trumps, or with the hopes of a particular point, do not wait for the fineffe.

3. Ace, king, and five others, lead the ace in all fuits. With four or lefs, the loweft, if trumps. In other fuits always the ace, unlefs all the trumps remaining are with you and your partner; in this cafe, a fmall one.

Mr. M. advifes not to lead trumps merely becaufe an honour is turned up on your left, nor to be deterred from it if on your right-hand; either, he fays, is proper, if the circumftances of your hand require trumps to be led; but neither otherwife.

It is equally advantageous to lead up to an ace as through an ace; not fo much fo to a king, and difadvantageous to the queen turned up.

When cards are nearly equal, fays this author, the point to which all the manœuvres of good whift players tend, is to eftablifh a long fuit, and to preferve the laft trump, to bring it into play, and to fruftrate the fame play of their adverfaries. With an honour (or even a ten), with three other trumps, by well managing them, you have a right to expect fuccefs. In this cafe, do not over-trump your right-hand adverfary early in the hand; but throw away a lofing card, by which, there remaining but twelve trumps, your own hand is ftrengthened, and your partner has the tenace, in any fuit that is led; whereas, had you over-ruffed, you would have given up the whole game, to fecure one trick. But there are reafons for breaking this rule:—1ft. If your left-hand adverfary has fhewn a decided great hand in trumps, (in which cafe make your tricks while you can,) or 2d. If your partner decidedly means to force you,—to underftand if this is the cafe, you are to obferve, if your partner plays the winning or lofing card of the fuit you have refufed. If the former, it is by no means clear he means to force you, and you play your own game. If the latter, you are to fuppofe him ftrong in trumps, and depend on this, to protect your long fuit: a due reflection on this will convince you of the value of that maxim, which enjoins you never to play a ftrong game with a weak hand, or *vice verfâ.*

It is difficult to judge when to lead trumps. The following fituations will affift the beginner to reafon, and in general direct him properly:

1ft. With fix trumps, on fuppofition your partner has a ftrong fuit.

2d. If ftrong in other fuits, though weak in trumps yourfelf.

3d. If your adverfaries are playing from weak fuits.

4th. If your adverfaries are at the point of eight, and you have no honour, or probability of making a trump by a ruff.

With king, queen, ten, &c. in all fuits, lead the king; but if it paffes, do not purfue the lead, as certain the ace is in your partner's hand, as it is often kept up, but change your lead, and wait for the return from your partner when you have the fineffe of the ten, if neceffary.

King, queen, and five others, in all fuits, the king. With four or lefs in trumps, lead the loweft. In other fuits, always the king, unlefs you have the two only remaining trumps, if fo you may play a fmall one.

King, knave, ten, &c. in all fuits, lead the ten. King, knave, and two or more fmall ones, the loweft.

You fhould not lead from king, knave, and a fmall one, unlefs it is clearly your partner's fuit, in which cafes play off your king and knave.

Queen, knave, nine, and others, lead the queen. Queen, knave, with one other, the queen. Queen, knave, with two more, the loweft. Queen, ten, and two others, the loweft. Queen, and three fmall ones, the loweft. Queen, or knave, with only two, the queen, or knave.

The trump card fometimes occafions a deviation from thefe rules. A has the ace or king, with fequence from the ten downwards, of the fuit of which his left-hand adverfary turns up knave, or queen—A fhould lead the ten. If the knave or queen be put on, you have a fineffe on the return with the nine; if not, your partner, with an honour, will pafs it, and it is either way advantageous.

That which is denominated under-play, is returning the loweft of your left-hand adverfary's lead, though you have the higheft in your hand, with a view of your partner's making the third beft, if he has it, and ftill retaining the commanding card in your hand.

To explain this further, fuppofe A fourth player, has ace and king of his left-hand adverfary's lead; to under-play, he wins the trick with the ace, and returns the fmall one, which will generally fucceed, if the leader has not the fecond and third in his own hand. You will fee by this, if you lead from a king, &c. and your right-hand adverfary, after winning with a ten or knave, return it, you have no chance to make your king, but by putting it on.

The following is another fituation to under-play; A remains with the firft, third, and fourth cards of a fuit, of which he has reafon to fuppofe his left-hand adverfary has the fecond guarded; by playing the fourth, it is often paffed, and A makes every trick in the fuit.

When it is at your option to be 8 or 9, it is material always to choofe the former fcore. When at eight, with two honours, look at your adverfary's fcore, and confider if there is a probability they fhould fave their lurch, or win the game, notwithftanding your partner holds a third honour; if not you fhould not call, as it gives a decided advantage againft you in playing for tricks.

Laws of Whift.—1. If a card is turned up in dealing, the adverfe party on naming it may call a new deal, unlefs they have looked at or touched the cards, fo as to have occafioned it; but if any card except the laft is faced, it is undoubtedly a new deal.

2. Should any card-player have but twelve cards, and the others their proper number, the deal is good, and he who has the twelve cards pays for any renounce he may have

have made; but if either have fourteen cards, the deal is loſt.

3. If the dealer does not turn up the laſt card, the deal is loſt. But if the card is ſhewn, and falls on its face by accident afterwards, the deal in this caſe ſhall ſtand good.

4. The dealer ſhould leave the laſt card on the table till he has played; after which nobody can aſk for it, though they may inquire what is trumps at any time. Should he leave it on the table after the firſt round, it may be called, as if ſhewn by accident.

5. Every perſon has a right before he plays to call on the players to place their cards before them, which is, in other words, to aſk who played them. It is therefore a quibble to ſay they have no right to make that demand.

6. The partner who reminds his partner to call after the trump is turned up, forfeits a point.

7. If one of the players omit playing to a trick, and remains with a card too many, it is at the option of the adverſaries to call a new deal.

8. If A plays out of his turn to his partner's lead, the laſt player may play before the firſt: if to his adverſary's, his partner may be compelled to, or prevented from winning the trick at their option.

9. Miſtakes relative to tricks may be rectified at any time during the game, whether called or not. Alſo honours, if proved to have been called in time, though not ſcored; but they cannot be claimed after the trump is turned up.

10. If one party calls at any ſcore but eight, the adverſaries may, after conſulting, call a new deal; the ſame, if one calls without two, or the other anſwers without one honour.

11. If any player calls after he has played, the adverſaries may call a new deal; but not conſult together.

12. Whoever calls, having only one honour in his hand, ſhould forfeit in proportion to any advantage that actually does or may poſſibly accrue from the fault. If it ſhould prevent the adverſaries from calling, after the hand is played out, the honours ſhall take place of the tricks.

13. If any perſon plays out of his turn, the adverſaries have the option to call that card at any time, or direct the player whoſe turn it was, to play any ſuit they chooſe.

14. If A, ſuppoſing that he has won a trick, leads again before his partner has played to it, the adverſaries may oblige his partner to win it, if he can.

15. Any player may call a card from his adverſary, if he names it, and proves the ſeparation. Should he name a wrong one, he may have his beſt or worſt card called of any ſuit played during the deal.

16. Cards thrown down cannot be taken up again; but may be called by the adverſaries. They may be ſhewn down by the player, if ſure of every trick.

17. There are in fact four penalties on a revoke, which take place of every other ſcore. The adverſaries may take three tricks from the party revoking, or three from their ſcore, or add three to their own; and if there ſtill ſhould remain enough to make the party revoking game, they cannot win it, but remain at nine.

There is often judgment required in taking the penalties of a revoke. Before the ſcore is advanced, if the party revoking has won nine tricks, the leaſt conſideration will ſhew, that the adverſaries ſhould take three of them, for if they add three to their own ſcore, they ſtill leave the odd trick to the former; but if the revoking party be at eight, it is better for the adverſary to ſcore three points, as the odd trick leaves the former at nine, which is in every reſpect a worſe point than eight. On other occaſions, it is only to calculate how the different ſcores will remain after each mode of taking the penalty; and it will be obvious which will be the moſt advantageous—never loſing ſight of the points of the game; *i. e.* ſcoring eight or five yourſelf, or prevent your adverſary from doing ſo.

18. A revoke is not eſtabliſhed before the party revoking has played again, or the trick been turned and quitted; but the adverſaries, at their option, may call from the higheſt or loweſt of the ſuit at the time, or the card ſhewn at any time during the deal.

19. If a revoke is claimed, the adverſaries forfeit the penalties of a revoke, if they mix the cards before it is determined.

20. No revoke can be claimed after the cards are cut for the next deal.

21. A caſe having occurred in which A played out of his turn, and B, his partner, was directed to play a trump; but B had another ſuit, and three or four cards were played before it was diſcovered that B had a trump in his hand: it was decided, that the cards ſhould be taken up again, and a trump led by B as directed.

22. A caſe occurred in which A called at eight, but his partner did not anſwer, though he had an honour, becauſe he had a bet on the odd trick. The adverſaries contended that the deal ſhould not ſtand; and reference being made to Mr. M., he decided that the game was fairly won, becauſe there could be no poſſible advantage made of the circumſtance as far as related to the game, though it might as to the trick, if that had been the caſe referred; and their caſe produced the following law: *viz.* No one is obliged to anſwer to his partner's call, even though he has the other two honours in his hand.

23. No player, having three honours in his hand, can be precluded from taking advantage of them at any time previous to his playing a card. This law was grounded on the following caſe; *viz.* A at the ſcore of eight, on gradually opening his hand, ſaw two honours in it immediately, and told his partner of it, who did not anſwer: but A continuing to look over his cards found a third honour, and ſhewed them down. It was contended that he had no right to do this, as Mr. M. thought improperly, upon which he propoſed the above-mentioned law. We here ſubjoin a maxim connected with this caſe.

When at eight, with two honours, look at your adverſary's ſcore, and conſider if there is a probability they ſhould ſave their lurch, or win the game, notwithſtanding your partner holds a third honour; if not you ſhould not call, as it gives a decided advantage againſt you in playing for tricks.

24. Whoever ſhall by word or geſture manifeſtly diſcover his approval or diſapprobation of his partner's mode of play, or aſk any queſtions but ſuch as are ſpecifically allowed by the exiſting laws of whiſt, the adverſary ſhall either add a point to his own ſcore, or deduct one from the party ſo tranſgreſſing, at his option.

25. It is now ſettled, that either of the players may inſiſt on the cards being placed at any time previous to their being put together. It is alſo ſettled, that where a bet is made, that either of the parties ſcores two, the bet is won by honours, though the adverſary has won the game by cards—ſuppoſing it betted that A makes two points, if B, his

his adverfary, being at feven, makes three by cards, if A has two by honours, he ftill wins his bet.

The odds of this game are calculated according to the points, and with the deal, in the following manner:

1 love	- -	10 to 9
2 love	- -	10 to 8
	&c. &c.	

Except that 9 is confidered as fomething worfe than 8. It is 3 to 1 in favour of the firft game. The odd trick has been always fuppofed in favour of the leader; but Mr. M. is of opinion, that this is an error, as the dealer has the advantage in this, as in every other fcore.

We fhall here fubjoin an explanation of two terms that are univerfally ufed, but not generally underftood, *viz.* *tenace* and *fineffe*.

"The principle of the *tenace* is fimple. If A has the ace and queen of a fuit, and B, his adverfary, has the king and knave, the leaft confideration will fhew that if A leads, B wins a trick, and *vice verfâ* of courfe; in every fituation it is the mutual plan of players by leading a lofing card to put it into the adverfary's hand to oblige him to lead that fuit, whereby you preferve the tenace. So far is eafily comprehended; but it requires attention with practice to apply the principle, fo obvious in the fuperior, to the inferior cards, or fee that the fame tenace operates occafionally with the feven and five, as the ace and queen, and is productive of the fame advantage. A, laft player, remains with the ace and queen of a fuit not played, the laft trump, and a lofing card: B, his left-hand adverfary, leads a forcing card. *Query*—How is A to play? *Anfwer*—If three tricks win the game, or any particular point, he is not to ruff, but throw away his lofing card, becaufe his left-hand adverfary being then obliged to lead to his fuit, he remains tenace, and muft make his ace and queen. But upon a fuppofition that making the four tricks gains him the rubber, he fhould then take the force, as in thefe fituations you are juftified in giving up the tenace for an equal chance of making any material point.

"The *fineffe* has a near affinity to the tenace, except that the latter is equally the object where two, and the former only where there are four players. A has the ace and queen of a fuit led by his partner, now the dulleft beginner will fee it proper to put on the queen; and this is called fineffing it, and the intention is obvioufly to prevent the king from making, if in the hand of his right-hand adverfary. Should it not be there, it is evident you neither gain nor lofe by making the fineffe; but few players carry this idea down to the inferior cards, or fee that a trick might be made by a judicious fineffe, againft an eight, as a king; but to know exactly when this fhould be done, requires more fkill than in the more obvious cafes, united with memory and obfervation. Another cafe of fineffe even againft two cards frequently occurs, and the reafon on reflection is felf-evident.

"A leads the ten of a fuit, of which his partner has the ace, knave, and a fmall one; B fhould fineffe or let the ten pafs, even though he knows the king or queen are in his left-hand adverfary's hand, becaufe he preferves the tenace and probably makes two tricks; whereas, had he put on his ace, he could make but one—in fhort, tenace is the game of pofition, and fineffe, the art of placing yourfelf in the moft advantageous one." Matthews's Advice, &c. ed. 10. 1816.

M. de Moivre has folved this problem: To find the odds that any two of the partners, that are pitched upon, have not the four honours? M. de Moivre concludes from this folution,

1. That it is 27 to 2, nearly, that the dealers have not the four honours.

2. That it is 23 to 1, nearly, that the eldeft have not the four honours.

3. That it is 8 to 1, nearly, that neither one fide nor the other have the four honours.

4. That it is 13 to 7, nearly, that the two dealers do not reckon honours.

5. That it is 20 to 7, nearly, that the two eldeft do not reckon honours.

6. That it is 25 to 16, nearly, that either one fide or the other do reckon honours, or that the honours are not equally divided.

The fame learned author alfo determines, that the odds for the partners who have eight of the game, if dealers, againft thofe who have nine, is nearly as 17 to 11. But if thofe who have eight of the game are eldeft, the odds will be nearly as 95 to 77. And that without confidering whether thofe who have eight are dealers, or eldeft, there is one time with another the odds of fomewhat lefs than 7 to 5; and very nearly that of 25 to 18.

It is a queftion likewife belonging to this game, what the probability is that a player has a given number of trumps dealt him; particularly, it has been often taken as an equal wager, that the dealer has at leaft four trumps. M. de Moivre has computed the following tables; fhewing for the dealer, as well as the other gamefters, what the probability is of taking precifely any affigned number of trumps in one deal. And thence by a continual addition of the numbers, or of fuch part of them as is neceffary, it is eafily found what the probability is of taking at leaft that number.

Chances of the Dealer to have befides the Card turned up.	Trumps.	Chances of any other Gamefter to have precifely.
3910797436	0	8122425444
20112672528	I.	46929569232
41959196136	II.	110619698904
46621329040	III.	139863987120
30454255260	IV.	104897990340
12181702104	V.	48726808416
3014663652	VI.	14211985788
455999544	VII.	2583997416
Tab. I. 40714245	VIII.	284999715 Tab. II.
2010580	IX.	18095220
48906	X.	603174
468	XI.	8892
1	XII.	39
Sum = 158753389900 is the common denominator; being the combinations of 12 cards in 51.		476260169700 = fum, is the common denominator; being the combinations of 13 in 51.

By the help of thefe tables feveral ufeful queftions may be refolved; as, 1. If it is afked, what is the probability that the dealer has precifely III trumps, befides the trump card? The anfwer, by Table I., is $\frac{4662}{15875}$; and the probability of his having fome other number of trumps is

$\frac{11213}{15875}$. But if the queſtion had been, what is the probability that ſome other gameſter, the eldeſt hand for inſtance, has preciſely IV trumps? The anſwer, Table II., is $\frac{104898}{476260}$.

2. To find the chance of the dealer's not having fewer than IV trumps: add his chances to take o, I, II, which are 39108, 201127, 419592; and their ſum 659827 taken from the denominator 1587534, and the remainder made its numerator, the probability of the dealer having IV or more trumps will be $\frac{927707}{1587534} = \frac{329}{563}$, a little above $\frac{7}{12}$. The wager, therefore, that the dealer has not IV trumps, is ſo far from equal, that whoever lays it throws away above $\frac{1}{5}$ of his ſtake.

But if the wager is that the dealer has not V trumps, then 466213 (the chances of his having III beſides the trump card) is to be added to the chances for o, I, II; which will make the chance of him who lays this wager to be nearly $\frac{317}{455}$; and that of his adverſary $\frac{138}{455}$.

And hence, if wagers are laid that the dealer has not IV trumps, and has not V trumps, alternately; the advantage of him who lays in this manner will be nearly $11\frac{1}{4}$ *per cent.* of his ſtakes.

3. To find the odds of laying that the eldeſt hand has at leaſt III, and at leaſt IV trumps, alternately; the numerator of the one expectation is (by Table II.) 31501119, and of the other 17514720, to the denominator 47626017; whence the advantage of the bet will be $\frac{15}{514}$, or three *per cent.* nearly.

Again, if it is laid that the trumps in the dealer's hand ſhall be either I, II, III, or VI; the diſadvantage of this bet will be only 15*s.* 4*d.* or about $\frac{3}{4}$ *per cent.*

In like manner, the odds of any propoſed bet of this kind may be computed: and from the numbers in the tables, and their combinations, different bets may be found which ſhall approach to the ratio of equality; or if they differ from it, other bets may be aſſigned, which, repeated a certain number of times, ſhall balance that difference.

4. And if the bet includes any other condition beſides the number of trumps, ſuch as the quality of one or more of them; then proper regard is to be had to that reſtriction.

Let the wager be that the eldeſt has IV trumps dealt him; and that two of them ſhall be the ace and king. The probability of his having IV trumps preciſely is, by Table II., $\frac{104898}{476200}$: and the different fours in 12 cards are $\frac{12}{1} \times \frac{11}{2} \times \frac{10}{3} \times \frac{9}{4}$. But becauſe 2 out of the 12 trumps are ſpecified, all the combinations of 4 in 12 that are favourable to the wager, are reduced to the different twos that are found in the remaining 10 cards, which are $\frac{10}{3} \times \frac{9}{2}$. And this number is to the former as 1 to 11: the probability, therefore, is reduced by this reſtriction to $\frac{1}{11}$, of what elſe it had been: that is, it is reduced from near $\frac{1}{5}$ to about $\frac{1}{52}$. De Moivre's Doctrine of Chances, p. 172, &c. ed. 3d.

WHISTLE, Boatswain's. See Call.

Whistle-*Fiſh*, a name given by the people of Cornwall to a ſpecies of gadus, with only two fins on the back, otherwiſe called *muſtela fluviatilis*. See Gadus, and Mustela.

WHISTON, William, M.A. in *Biography*, an Engliſh divine and mathematician, was the ſon of the rector of Norton near Twycroſs, in Leiceſterſhire, and born in the year 1667. He finiſhed his education as a ſizer at Clare-hall, Cambridge, applying with great diligence to the ſtudy of mathematics, and compoſing devout meditations correſponding to the early bent of his diſpoſition. Having alſo received the degree of B.A. in 1690, and being elected fellow of his college, he took pupils; and in 1693 became M.A. and entered into holy orders. Soon afterwards he declined the office of tutor, and was appointed chaplain to Dr. More, biſhop of Norwich. His acquaintance with ſir Iſaac Newton commenced in 1694, and produced a change in his philoſophical ſyſtem, from that of Des Cartes to that of Newton. On the principles of this philoſophy, he publiſhed, in 1696, his "Theory of the Earth," which was refuted by Keill. Having been preſented by his patron, the biſhop, to the living of Loweſtoft in Suffolk, he reſigned his chaplainſhip, and in order fully to diſcharge his religious duties procured the aſſiſtance of a curate. Of his invincible and moral ſcrupulous integrity, he gave an early inſtance by refuſing his vote to a perſon who ſolicited a fellowſhip of Clare-hall, and who had abandoned the bacchanalian party with which he was connected, and which he apprehended to be the moſt powerful, and promiſed future ſobriety; and giving this reaſon for his refuſal: "Sir, you have confeſſed that you ſacrificed your integrity to your preferment, and thereby have made it impoſſible for me to ſerve you." Being obliged to vacate his fellowſhip by marriage, ſir Iſaac Newton nominated him his deputy as profeſſor of mathematics, allowing him all the profits of the office; and in 1703 he ſurrendered to him the profeſſorſhip itſelf. Upon this acceſſion, he reſigned his living, ſettled at Cambridge, and was appointed by Dr. More, biſhop of Ely, catechetical lecturer of St. Clement's. Having already publiſhed "A Short View of the Chronology of the Old Teſtament, and the Harmony of the Four Evangeliſts," and "Tacquet's Euclid," he preſented to the public in 1706 his "Eſſay on the Revelation of St. John;" and in the following year he preached the Boyle's lecture ſermon on the ſubject of the "Accompliſhment of Scripture Prophecies." In the year 1706 he began to entertain doubts concerning the divinity of Chriſt, and in the proſecution of his inquiries he was led to adopt Arian opinions, which were further confirmed by the peruſal of the "Apoſtolical Conſtitutions," reckoned ſpurious by moſt writers, but pronounced by Whiſton to be "the moſt ſacred of the canonical books of the New Teſtament." In 1708 he offered an "Eſſay on the Apoſtolical Conſtitutions" to be printed at the Univerſity preſs, but it was rejected; however, in 1709, he publiſhed ſermons and eſſays ſupporting theſe opinions. His invincible perſeverance cauſed him to be deprived

deprived of the catechetical lecture, and at the same time he declined receiving the salary which the bishop wished to continue. His situation at the University became very precarious, and in October 1710 he was expelled from it, in conformity to a statute against maintaining doctrines contrary to the established religion. In the following year he also lost his professorship; and having no further employment at Cambridge, he removed to London, and published an account of the proceedings against him, and also books in defence of his sentiments, which he retained without regarding any worldly considerations. His purposes were fixed, and he declared to two friends, who wished him to pay some attention to his present welfare, "you may as well persuade the sun to come down from the firmament, as turn me from this my resolution." Hoadly and Clarke remonstrated; but all their pleas were unavailing. All his future prospects seemed now to depend on his knowledge of mathematics, and accordingly in 1710 he published his "Prælectiones Physicæ-Mathematicæ; five Philosophia Clarissimi Newtoni Mathematica illustrata." At this time Addison and Steele, and several other persons, exerted themselves in procuring a subscription to his astronomical lectures. But at the close of this year he published the "Historical Preface" to a proposed work on Primitive Christianity, which subjected him to the inquisitorial animadversion of the lower house of convocation. Escaping, however, the apprehended consequences of their interference, he persisted in his course, and in 1711 printed this work which he had announced, and which had occasioned an alarm, in 4 vols. 8vo. The convocation, not sufficiently informed with regard to the extent of their power in cases of heresy, addressed the queen in order to obtain the opinion of the judges, who disagreed upon the subject, and no further measures were pursued by this body. However, in 1713, Whiston was prosecuted in the spiritual court; and as he did not appear to its citation, he was declared contumacious. Difficulties occurring on the part of the lay-judges, the business was deferred, and the prosecution was terminated by an act of grace in 1715. Whiston was at this time a professed member of the established church, and attended its worship, till at length he was refused admission to the sacrament; and therefore he opened an assembly for worship at his own house, and used a liturgy of his own composing. He also established a weekly meeting for the promotion of primitive Christianity, which subsisted for two years. Whilst he was thus occasionally engaged, he devoted himself to mathematical and philosophical pursuits; and in concert with Mr. Ditton, who was his colleague in his lectures, published a project for discovering the longitude at sea. But as their speculations were of no use, it will be sufficient to observe, that he published at last a method of ascertaining the longitude by observations of the eclipses of Jupiter's satellites, with tables of such eclipses for four years from the year 1738.

His zeal in religious discussions and projects remained unabated; and, among other publications in 1716 and the two following years, appeared several pieces founded on the supposed genuineness and authority of the apostolical constitutions. In 1719 he published a letter addressed to Finch, earl of Nottingham, on the "Eternity of the Son of God and his Holy Spirit," which received an answer from his lordship, that induced the clergy and universities to return him public thanks, and which caused Whiston's exclusion from the Royal Society, when he was proposed as a candidate in 1720. Sir Isaac Newton, it is said, who was of a very timid temper, took measures for defeating his election. As he was of opinion that the Jews would be speedily restored to their native land, he procured models of the tabernacle of Moses and the temple of Jerusalem, upon which he read public lectures. In 1741 he undertook a survey of the coasts of England, in order to fix the longitude of places, and a chart to this purpose was published in 1745. It was in the year 1747 that he discontinued his attendance on the service of the church of England, and joined a Baptist church, in which connection he continued. In 1749 he published two volumes of memoirs of his own life, to which a third was added in 1750. Having attained to the 85th year of his age, he died at London in 1752, and was interred at Lyndon, where his daughter was married, and where a handsome tomb was erected in honour of his memory. "Fancy," says one of his biographers, "predominating over judgment, a warm head and honest heart, enthusiastic fervour, and disregard to common forms and worldly consequences, were the leading features of his character." He never hesitated in giving his opinion to all persons on all subjects, freely and without discrimination. Being once asked, in the presence of Addison, Pope, Walpole, Craggs, and others, "whether a secretary of state could be an honest man consistently with the duties of his station?" He gave his opinion that it would be of advantage to such an officer to speak openly what he knew, and declare his intentions without disguise. Mr. Craggs replied, "It might answer for a fortnight, but no longer." "Did you never, Mr. Secretary," returned Whiston, "try it for a fortnight?" When queen Caroline, who honoured Whiston's integrity, and was fond of his conversation, desired him to acquaint her what was particularly found fault with by censurers on her conduct; he replied, that her habit of talking at chapel was mentioned with disapprobation. She promised amendment, and wished him to point out any other faults. "When your majesty," said he, "has amended this, I will tell you of the next." A catalogue is given of Whiston's writings, which are very numerous, at the close of his "Memoirs of Dr. Clarke." He has also given a valuable "English Translation of Josephus," with plans, notes, and illustrations, to which are prefixed eight dissertations. Biog. Brit. Memoirs of his Own Life.

WHITAKER, John, B.D. a divine of the established church, was born at Manchester, about the year 1735, and educated at Oxford, where he became fellow of Corpus-Christi college, taking the degree of M.A. in 1759, and of B.D. in 1767. His first work, *viz.* "The History of Manchester," appeared in 1771, 4to., in which he takes occasion to give a view of the state of the kingdom in general. This work, abounding in literary research and ingenious conjecture, gave reputation to the writer, and was followed in the same year by "The Genuine History of the Britons asserted." However, it is said that Mr. Whitaker's imagination in the progress of his years misled his judgment, of which he gave evidence in the second volume of his "History of Manchester," printed in 1775, though he still maintained his character for deep and learned investigation. As a clergyman, he became morning-preacher of Berkeley chapel, London, in 1773, from which situation he was soon after removed; and he resented his removal with the natural warmth of his temper. Such was his orthodoxy, that he declined accepting a valuable living that was offered to him by an Unitarian patron. In 1778 he succeeded, as fellow of his college, to the rectory of Ruan-Lanyhorne in Cornwall, where his contest about tithes was the occasion of much uneasiness to him. When mutual conciliation took place between him and his parishioners, he published in 1783 a course of Sermons on Death, Judgment, Heaven,

 and

and Hell, which were rendered peculiarly impreſſive by the fervid eloquence with which he treated the ſubject, naturally awful and intereſting. In 1787 he publiſhed his "Mary Queen of Scots vindicated," 3 vols. 8vo., in which he ſurpaſſed former writers in the zeal with which he vindicated this unfortunate queen, and criminated her enemies, Elizabeth, Cecil, Morton, and Murray. He alſo preſented to the public the fruit of his learned reſearch in "The Courſe of Hannibal over the Alps aſcertained," 2 vols. 8vo. 1794; and in 1795 he advanced the higheſt monarchical principles in his work, entitled "The real Origin of Government," and alſo his orthodoxy in his "Origin of Arianiſm," zealouſly defending his ſentiments in both theſe reſpects by contributions to the Engliſh and Jacobin Reviews, and Britiſh Critic. At length a paralytic ſtroke warned him of his approaching end, and after a gradual decline he imperceptibly cloſed life at his rectory in October 1808, at the age of 73, leaving a widow and two daughters. Gen. Biog.

WHITBREAD, SAMUEL, an eminent brewer, claims a place in a work devoted to the record and promotion of the arts and ſciences, on account of the talents which he diſplayed and the character which he maintained in his advancement from ſmall beginnings, to the poſſeſſion of a fortune, that ſet him on a level with ſome of the firſt nobility of the country. The family from which he ſprung belonged to the claſs of yeomanry, in the county of Bedford, which poſſeſſed ſome ſmall property, and aſſociated with that deſcription of moderate diſſenters, who occaſionally conformed to the Church of England. Born in the village of Cardington near Bedford, about the year 1720, and educated probably with a view to trade, for which his family deſigned him, he was bound apprentice at a ſuitable age, for the term of ſeven years, to an opulent brewer in London; and after the expiration of that period, he remained for ſome time unſettled, as he was cautious in commencing buſineſs on his own account. At length, however, actuated by the laudable ambition of tracing the footſteps of thoſe, who, in a ſimilar department, had riſen to opulence and rank, he determined to make trial for himſelf, how far induſtry and activity, aided by economy, would avail to his ſucceſs. Having diſpoſed of his own patrimony, which could not have been very conſiderable, and deriving aſſiſtance from perſons of opulence, who were encouraged to repoſe confidence in him by his known diſpoſition and habits, he laid the foundation of a ſuperſtructure of fortune and reputation, which has had few parallels in the hiſtory of commerce. Simple in his manners, he was accuſtomed to appear at the corn-market in Mark-lane with a white apron, as the emblem of his occupation; and liberal in his diſpoſition, he contrived to ſecure the attachment and active ſervices of thoſe with whom he was connected in his domeſtic arrangements, and in the conduct of his buſineſs. He well knew that by making thoſe whom he employed partakers of his bounty, he gave them a kind of intereſt in his proſperity; and therefore on ſettling the annual balance of his accounts, he diſtributed amongſt them donations, correſponding to their reſpective ranks and ſervices. Whilſt he gave 500*l.* to a confidential clerk, he extended his bounty even to the horſe-feeders, to each of whom he uſually gave 5*l.*

Advancing with ſure, but rapid progreſs, his brew-houſe in Chiſwell-ſtreet became a ſpacious quadrangle, conſiſting of an ample dwelling-houſe, work-houſes, ſtoves, cellars, and every other kind of convenience both for habitation and buſineſs; while the ſtock, the plant, the dray-horſes that would have mounted a regiment of cavalry, the caſks, &c. might in proceſs of time be eſtimated at nearly half a million of pounds ſterling. To this immenſe property, we might add a floating capital amounting to from 80 to 100,000*l.* ſerving to ſupply the demand of malt, hops, oats, &c. as well as the payment of clerks and ſervants. Thus by the direction and ſuperintendance of a ſingle individual, with the co-operation of a number of coadjutors in various ranks of ſubordination, the brew-houſe in Chiſwell-ſtreet became the firſt eſtabliſhment of the kind, not only in London, but in Europe, depending for its ſubſiſtence and ſingular proſperity on the approved quality of the article which it furniſhed. To the founder and principal proprietor, it became a mine of wealth, and an immenſe ſource of ſupply for purchaſes of land and houſes, donations and bequeſts, that have given diſtinguiſhed celebrity to the name of Whitbread. It is needleſs to recount the various eſtates which he purchaſed in his native county; we ſhall content ourſelves with mentioning merely the Torrington manors and eſtates, for which he paid the ſum of 120,000*l.*, beſides 5000*l.* as a preſent to alderman Skinner the auctioneer, when the negotiation reſpecting it was completed. Of his benefactions and bequeſts to various objects of public utility and of private charity, it will be ſufficient to ſay, that they indicated the liberality of his diſpoſition, and the amplitude of the means which he derived from his ſingular proſperity. Mr. Whitbread was twice married; by his firſt wife he had ſeveral children: but his ſecond wife, who was daughter of the firſt earl, and ſiſter of the firſt marquis Cornwallis, and to whom he was married Auguſt 12, 1769, died December 27, 1770. He was for ſome years one of the repreſentatives of the town of Bedford, and afterwards returned for the borough of Steyning. For the abolition of the ſlave-trade, he was a ſteady and ardent advocate; and as ſuch he generouſly undertook from his private purſe to make good all injuries that might be ſuffered by thoſe who attended to give their teſtimony for this purpoſe. With this expreſſion of benevolence he cloſed a life, during the progreſs of which he had amaſſed landed and chattel property to an immenſe amount, without any of thoſe penurious habits, which have been in many inſtances the means of accumulating large fortunes, and of enabling thoſe to die rich who have lived meanly and miſerably. His death happened June 11th, 1796.

In 1799 his ſon, the ſubject of the next article, erected a ſplendid monument to his father's memory, in the church of Cardington; which monument was the laſt, and has been thought by ſome perſons to be the beſt work of the late J. Bacon, R.A. The principal figure repreſents a dying man, ſupported by religion, in the form of a female, who points to the glory of heaven as a reward for his good actions; while the figure of benevolence, in a reclining poſture, is weeping at his feet.

WHITBREAD, SAMUEL, a diſtinguiſhed ſenator, was the ſon of the preceding by his firſt wife, and born in the year 1758. Deſtined to the inheritance of a large fortune, and poſſeſſing talents which by due cultivation would qualify him for a conſpicuous ſtation in public life, his father ſpared no expence in his education. At a proper age he was ſent to Eton, where he alſo enjoyed the benefit of private tuition, and where he commenced an intimate acquaintance with Mr. W. H. Lambton, afterwards M.P. for the city of Durham, and Mr. now earl Grey, with whoſe family he became connected by a double alliance. From Eton he removed to Chriſtchurch college, Oxford, and from thence to St. John's college, Cambridge, where he finiſhed his education, and was graduated B. A. Mr. Whitbread ſenior, ſagacious in diſcerning the early dawnings of his ſon's future celebrity, liberally offered him all the advantages which might be derived from foreign travel, and felected for his tutor and companion the prefent archdeacon Coxe, well known by a variety of valuable publications. Having travelled together through France, Germany, and Switzerland, they afterwards feparated with profeffions of mutual regard. Mr. Whitbread, foon after his return, formed, in 1788, a matrimonial connection with Mifs Grey, the fifter of his Eton affociate, who afterwards, by the advancement of her father, general fir Charles Grey, to an earldom, became lady Elizabeth Whitbread: his fifter alfo, in procefs of time, married the prefent fir George Grey, bart. then a captain in the navy. Having acquired every neceffary qualification for occupying a feat in the great council of the nation, and interefted by an ample fortune either in poffeffion or in profpect, as well as by genuine fentiments of patriotifm, in its deliberations and refolutions, Mr. Whitbread offered himfelf, on the diffolution of parliament in 1790, as a candidate for Bedford, a borough which had been reprefented by his father, who at the fame time offered himfelf for the borough of Steyning. Both elections were contefted; but both father and fon finally obtained their refpective feats. Mr. Whitbread, junior, commenced his political career in parliament with an animated fpeech againft the unconftitutional doctrine of "confidence," affumed on the part of minifters, who claimed an entire reliance on their wifdom and integrity. The occafion of this claim was a propofed war againft Ruffia, for which the minifter (Mr. Pitt) urged the houfe of commons to vote money, without previous and fatisfactory information of the neceffity, and much lefs of the juftice or policy of this war, the object of which was the reftoration of Oczakow to the Turks. The meafure was unpopular; and though the minifter obtained a majority, when the queftion was debated, he thought it moft prudent to give up his object, and a pacification enfued, which prevented much calamity to the nation. About this time the abolition of the flave-trade occupied the public attention, and this was a meafure to which the member for Bedford had always avowed himfelf a fteady and zealous friend. In parliament he fupported it not only by his vote, but by a difplay of eloquence which commanded univerfal applaufe. As an active magiftrate, he directed his particular attention to the occurrences that took place in confequence of the fcarcity in the year 1795; and in devifing means of relief, he propofed that as the magiftrates were empowered to fix a *maximum* of wages, fo far as refpects the hufbandman, a *minimum* fhould be alfo preferved by law, in order thus to eftablifh a more accurate proportion between the price of labour and that of the means of fubfiftence. With this view he introduced into the houfe a bill, which was approved by Mr. Fox and many other members; but as it was oppofed by Mr. Pitt, his efforts were unavailing. The minifter was no lefs unfuccefsful in his plan for amending the poor laws, and meliorating the condition of the peafantry and working clafs. His plan indeed was much more extenfive and complicated than that of Mr. Whitbread, which was fimply calculated to enable the labourer to maintain himfelf by his wages, without the degrading as well as difpiriting neceffity of feeking parochial relief.

The fubject of this article was an undifguifed and uniform oppofer of the French war in 1793, becaufe he thought it to be unneceffary and unjuft; and yet he was a zealous advocate for meafures of felf-defence againft the fecret machinations and open attacks of a powerful and vindictive enemy. Accordingly he condemned the negligence of minifters, on occafion of the French attempt at invafion in 1797, by means of a fquadron which appeared off Bantry bay, and moved the houfe for a committee of inquiry into their conduct. His motion was evaded by the previous queftion. In every ftage of the conteft with France, and under every varying form of its government, he was anxious for peace, and an advocate for treating with its rulers in order to terminate hoftilities, and to put a ftop to the wafte of national treafure and the effufion of human blood. His opinion on the conduct of minifters in the profecution of this war, and their reluctance to enter into treaty for terminating it, was explicitly avowed in an eloquent fpeech, which he delivered on occafion of a motion by Mr. Dundas (then fecretary of ftate) for an addrefs to the throne in 1800, for the purpofe of approving the conduct of his majefty's government. Anxious, however, as he was for peace, becaufe he difapproved the war from its commencement, and becaufe he thought it effential to the true intereft of the country, he was no lefs folicitous to maintain the honour of the nation in obtaining it. No man in this refpect was a more nobleminded patriot than himfelf; and if he confented to make any facrifice, it was becaufe he thought it abfolutely neceffary to the permanent profperity of his native country. Whilft he claimed and exercifed the privilege of pronouncing his own opinion of public men and political meafures, he was a zealous advocate for the liberty of others, and interpofed with his moft vigorous exertions for the refcue of thofe who fuffered imprifonment at home or exile to Botany bay, for too freely and imprudently divulging their opinions. During the fhort interval of the adminiftration of Mr. Addington, (the prefent lord Sidmouth,) who fucceeded Mr. Pitt in the year 1801, and made peace with Buonaparte, feveral popular meafures were adopted, in which Mr. Whitbread cordially concurred; and in the year 1805 he diftinguifhed himfelf as the public accufer of Mr. Dundas (created lord Melville) for malverfations that had occurred, whilft he had occupied the poft of treafurer of the navy. His charges againft this nobleman were founded on a report of the commiffioners of public accounts, from which it appeared that, during the exercife of his office, this noble lord had violated the law, by conniving at mal-practices and participating in unwarrantable emoluments; and that he was refponfible for deficiencies amounting to 697,500*l*. Thefe charges alfo implicated Meff. Trotter, Wilfon, and Sprott; and the former in particular, who was paymafter of the navy department under lord Melville, and had taken out large fums of money on his own private account. In the inveftigation of this bufinefs, it was difcovered, that the fums officially depofited in the Bank had been withdrawn, lodged with private bankers, and applied to other purpofes befides thofe that were properly naval. Mr. Whitbread founded on feveral facts which he ftated, a variety of refolutions which impeached the fidelity and honour of his lordfhip. To his motion relative to this bufinefs, Mr. Pitt moved an amendment, which was negatived by a majority of one (217 to 216), in confequence of the vote of the fpeaker. In confequence of thefe proceedings, the vifcount refigned his office at the Admiralty-Board, and his name was expunged from the lift of privy-counfellors. Upon the fudden demife of the premier, and a coalition between lord Grenville and Mr. Fox, the two latter came into office; and Mr. Erfkine, being raifed to the peerage, and appointed lord high chancellor, was deftined to prefide at lord Melville's trial. This nobleman having made his defence within the bar of the houfe of commons was replied to by the member for Bedford; and an impeachment being agreed upon, proceedings commenced in Weftminfter-hall, April 29th, 1806. The refult, after a fhort trial, was the acquittal of his lordfhip by a majority, from all the charges alleged againft him. Notwithftanding the unexpected termination of this trial, neither the friends nor the enemies of the ſuppoſed delinquent attached any blame to the public accuſer; but he was allowed to have conducted the buſineſs aſſigned to him with a dignity and propriety ſuitable to its delicacy and importance. In the caſe of lord Melville, as well as in that of Mr. Pitt, he knew how to diſtinguiſh between the man and the miniſter; and to pay a juſt tribute to the talents and diſpoſitions of the former, whilſt he criminated and condemned the latter. Having differed with Mr. Pitt with regard to his political meaſures almoſt through the whole of his public life, he took the opportunity which the trial of lord Melville afforded him of paying a juſt tribute of reſpect to his abilities and virtues, when his premature death muſt have vindicated the eulogiſt from the ſlighteſt ſuſpicion of inſincerity and adulation.

Of the new adminiſtration, he was a ſteady ſupporter; but though he had at an early period enliſted himſelf under the banners of Mr. Fox, and the earl Grey, his ſchool-aſſociate and brother-in-law, who was one of its diſtinguiſhed members: he was their friend as miniſters, not from perſonal and ſelfiſh motives, but from a conviction of his judgment that their principles and views were moſt favourable to the liberty and welfare of the Britiſh empire. Indeed he was regarded by many as an impracticable man, becauſe in all great queſtions he was influenced by principle more than by any private and party attachment. What were his ſentiments of the coalition miniſtry, and what were the grounds of the ſupport which he afforded them, he had an opportunity of ſtating in the moſt explicit manner. At this time ſir Francis Burdett offered himſelf a candidate for the county of Middleſex, and tranſmitted a circular letter to Mr. W., who had voted for him twice before, ſoliciting his ſupport. This letter contained reflections on the coalition miniſtry, which led the ſubject of this article to decline giving his vote for ſir Francis, and alſo to expreſs his ſentiments of the coaleſcing parties, which had been ſeverely cenſured. "I have ſupported the preſent adminiſtration," ſays Mr. W., "from a conviction that they were united upon principles of real public utility, and for the purpoſe of carrying into execution plans of great national improvement, both in our foreign and domeſtic circumſtances; and I cannot abandon them, becauſe in a ſituation more difficult than that in which any of their predeceſſors have ever ſtood, they have not been able to effect what I believe to have been neareſt the hearts of them all—I mean a peace with France; ſeeing ſuch a peace could not have been obtained on terms conſiſtent with national honour, and becauſe time has not ſufficed to mature and execute the ſchemes of internal improvement, which they have manifeſted their determination to purſue," &c. Having ſtated ſome other opinions with regard to the union of parties, in which he ſeems to have diſagreed with ſir Francis, he concludes: "Theſe radical differences render it impoſſible for me to aſſiſt you in becoming a member of parliament. Different opinions may be maintained conſiſtently with mutual and entire perſonal reſpect; ſuch as I unfeignedly profeſs towards you. The determination you have taken to avoid the expence of conveyance and decorations ſo conſpicuous at your former elections, does you honour; and I wiſh ſuch an example could be followed by all other candidates," &c. The publication of this correſpondence threatened a very undeſirable termination; but it was happily prevented by the interpoſition of friends.

During this period, Mr. Whitbread took an active part in public affairs, and diſtinguiſhed himſelf on a variety of occaſions, guarding on the one hand with vigilant jealouſy againſt an undue exertion of the royal prerogative, and on the other againſt its infringement by the democratical part of the conſtitution. In February 1807, he renewed his attention to the exiſting ſyſtem of poor laws, as it was his wiſh and inceſſant endeavour to improve it, and in ſo doing to render the peaſantry happier, better, and leſs dependent. It was alſo an object, which he conceived to be of eſſential importance, to controul the ſeveral branches of public expenditure, and thus to relieve the diſtreſſes of the country. Much depended, he well knew, on peace with France, and to this deſideratum his views and efforts were conſtantly directed. But he was almoſt ready to deſpair of this deſirable event, "from the awful moment that death cloſed the ſcene upon the enlightened ſtateſman (Mr. Fox) who had firſt commenced the negociation." When the Grenville adminiſtration was obliged to retire, and a new parliament was convoked by their ſucceſſors, he publiſhed a ſpirited addreſs to his conſtituents, in which he ſtated the meaſures which had been projected and wholly completed or commenced during the exiſtence of the late miniſtry, and the part which he had taken in the deliberations of the preceding parliament, cloſing with theſe memorable words: "I court your inquiry, and if you are ſatisfied in the reſult of it, I hope for your votes in the preſent election. If you do me the honour again to return me, I ſhall indeed be proud of it, and I will again endeavour to do my duty." The next important object of his attention was the education of the poor, as intimately connected with their morals and religion; but unable to obtain a legiſlative ſanction to his plan, he was under a neceſſity of recurring to individual exertions and private ſubſcription. During the important debates that occurred in 1809, with regard to the orders in council, he concurred with thoſe who condemned this meaſure, and contributed firſt to their ſuſpenſion, and at length to their utter diſcontinuance. With regard to the ſituation of Spain, he was one of thoſe who cenſured the conduct of the French government, and who wiſhed the natives to be ſtimulated to new exertions in behalf of the independence of their native country. "In 1809," ſays one of his biographers, "he took an active part in the inquiry and examination into the conduct of the royal duke who preſided over the army, and although he found much to blame on that occaſion, yet, at a future ſeaſon, he ſeized the firſt opportunity to afford his teſtimony in behalf of his royal highneſs, whoſe adminiſtration as commander-in-chief had contributed not a little to the happy and glorious termination of the late conteſt. That event did not prevent him, however, after the overthrow of Buonaparte's government, from blaming the conduct of the Congreſs, and expoſing the ambitious views of ſome of the ſovereigns, particularly in reſpect to Saxony. On the return of the emperor from his exile in the iſland of Elba, the member for Bedford ſtrongly and emphatically cenſured the declaration of the allies, more eſpecially that part of it which ſeemed to recommend the deteſtable principle of aſſaſſination. He alſo loudly inſiſted both on the impolicy and injuſtice of a new war, on the ground that the executive power of the enemy was veſted in the hands of any one particular perſon. But above all things he proteſted againſt the forcible reſtoration of the Bourbons by a foreign force, and the aſſumed right of dictating a government to France. Yet he moſt cordially joined in a vote of national gratitude to the duke of Wellington, for the memorable victory at Waterloo, although he at the ſame time boldly avowed that events had not altered his ſentiments in reſpect to the pretended juſtice of the original conteſt."

In the variety of his perſonal and domeſtic concerns, in his attendance on parliamentary duties, and in his efforts for eſtabliſhing and promoting inſtitutions of public utility, and more eſpecially ſuch as pertained to the inſtruction

inſtruction of the poor, Mr. Whitbread was aſſiduous and indefatigable; and whilſt he was overwhelmed by a multiplicity of occupations, he voluntarily undertook a more Herculean labour than any other, which was the arrangement of the perplexed concerns of Drury-lane theatre. With every moment of his time thus occupied, and his mental powers unremittingly exerted, it is no wonder that his health ſhould decline, and that his mind itſelf, though naturally vigorous and ardent, ſhould be impaired by exceſs and intenſeneſs of application. The conſequence that might have been apprehended unhappily occurred, and the world was prematurely deprived of the benefit of his valuable ſervices. "His countenance changed; he became drowſy, lethargic, and irritable; and he even ſuppoſed himſelf to have fallen into contempt." Theſe indications of corporeal and mental decay were alas! too ſoon ſucceeded by that fatal cataſtrophe, which occurred on Thurſday, July 6, 1815. "An inqueſt having been ſummoned by Mr. Gell, the coroner, met at eight o'clock the ſame evening, at the houſe of the deceaſed, No. 35, Dover-ſtreet, Piccadilly, and having entered his ſtudy, beheld Mr. Whitbread lying on his back, his arms and legs extended, with a deep inciſion on his throat from ear to ear, a ſmall part in the front of the throat excepted. A looking-glaſs was oppoſite to him; his apparel and the floor were covered with blood; and the fatal razor was found at ſome diſtance!"

The verdict of the jury was as follows:—"That the deceaſed Samuel Whitbread, eſq. died by his own hand; but that he was in a deranged ſtate of mind at the time the fatal act was committed." His principles and character have been juſtly delineated by one of his biographers, and we ſhall ſelect ſuch particulars as are conſiſtent with our contracted limits. "In politics he was a whig; yet a whig of the old ſchool; one who wiſhed to balance the royal power, by means of a due influence of the popular branch: but at the ſame time firmly and ſtedfaſtly to uphold both. Accordingly, he was always a ſtrenuous, conſtant, and uniform advocate for a reform of the houſe of commons: but this great meaſure was grounded on the ancient and acknowledged baſes; not on the viſionary plans of annual parliaments and univerſal ſuffrage! As a patriot, he wiſhed for the happineſs and proſperity of his country; but theſe, he deemed moſt likely to be acquired, and moſt permanently enjoyed by cultivating the arts of peace; advancing the commerce; cheriſhing the manufactures; and encouraging the agriculture of his native land. Wars might indeed be popular, ſucceſsful, glorious; but it was alſo incumbent and imperative that they ſhould be both juſt and neceſſary. It was his firm opinion, that economy was to the full as proper for a ſtate as for a private family: he was always, therefore, a decided friend of order, regularity, and good management. He hated jobs; he viewed placemen, courtiers, and contractors, with a jealous eye; and he diſliked both unneceſſary and exceſſive penſions, not only on account of the ſums thus perverted from the public revenue; but alſo from their obvious tendency to produce meanneſs, ſycophancy, and dependance.

"Mr. Whitbread was a ſtrenuous advocate for national education, or inſtruction on a great ſcale. But finding himſelf unable to obtain a national ſanction to this meaſure, he contented himſelf with his aſſiſtance and ſupport as a private individual.

"He was an encourager of the fine arts; and always deſirous that they ſhould enjoy protection and applauſe."—"To agriculture, as a ſcience calculated to advance the beſt intereſts of the nation, he paid particular attention."—"Horticulture alſo engaged his notice, and the gardens, and lawns, and groves of Southwell, might have all been exhibited as ſo many perfect ſpecimens of care, neatneſs, and propriety.

"Although always doubtful of the juſtice of the late war, he never heſitated for a ſingle moment as to the propriety of arming and defending his native country againſt the menaces and attacks of her enemies. He himſelf raiſed and commanded a body of ſturdy yeomanry; and while he thus excited a martial ardour in his neighbourhood, he forgot not to enforce his favourite plan of fitting men, by means of education, for their reſpective ſituations in life. On this occaſion, he inſtituted a ſchool for the benefit of the noncommiſſioned officers; and contributed by all the means in his power to render it effectual.

"An only ſon, born and matured with the expectations of great opulence; it is but little ſurpriſing if he occaſionally diſplayed a certain degree of haughtineſs in his demeanour. Indeed it cannot be denied, that at times he appeared ſomewhat harſh and overbearing; but on the other hand, he muſt be allowed to have been admirably fitted for command; and was ſeldom known to exceed the bounds of moderation, but when he combated the injuſtice of power, aſſailed the inſolence of office, or endeavoured to expoſe ſucceſsful guilt to ſhame and to puniſhment.

"His heart conſtantly glowed with all the ſocial affections. He was zealous in his friendſhips; while his enmities were tranſient and ſhort-lived. His ear was ever ready to liſten to the tale of the oppreſſed: his purſe always open to ſuccour thoſe who had been reduced to diſtreſs by unexpected calamities. At length, after having lived and acted during the ſtormy politics of the French revolutionary conteſt, he was ſuddenly cut off, at a period when his ſervices might have proved highly advantageous to his country; when the deceitful calm of peace ſeemed pregnant with greater and more formidable dangers than thoſe ariſing out of a long, wide-ſpreading, expenſive, and deſtructive warfare!

"On the 11th July, 1815, when the marquis of Taviſtock, on moving for a new writ for the borough of Bedford, deſcanted on the character, worth, and talents of the late member, his encomium was liſtened to amidſt the loud cheerings of both ſides of the houſe of commons:

"'Accuſtomed to defend his opinions with warmth and earneſtneſs,' ſaid he, 'the energies of his ample and comprehenſive mind, would never permit the leaſt approach to tameneſs or indifference. But no particle of animoſity ever found a place in his breaſt, and he never carried his political enmities beyond the threſhold of this houſe. It was his uniform practice to do juſtice to the motives of his political opponents; and I am happy to feel, that the ſame juſtice is done to his motives by them. To thoſe who were more immediately acquainted with his exalted character; who knew the directneſs of his mind, his zeal for truth, his unſhaken love of his country, the ardour and boldneſs of a diſpoſition incapable of diſmay, his unaffected humanity, and his other various and excellent qualities, his loſs is irreparable. But moſt of all, will it be felt by the indigent in his neighbourhood. Truly might he be called the poor man's friend. Only thoſe who, like myſelf, have had the opportunity of obſerving his conduct nearly can be aware of his unabated zeal, in promoting the happineſs of all around him. His eloquent appeals to the houſe in favour of the unfortunate, will adorn the pages of the future hiſtorian; while at the preſent moment, they afford a ſubject of melancholy retroſpect to thoſe who have formerly dwelt with delight on the benevolence of a heart that always beat, and on the vigour of an intellect which was always employed for the benefit of his fellow-creatures!'"

He left behind him by lady Elizabeth, his mourning widow, two fons and two daughters.

The following memorandum of Mr. Whitbread's fudden death was written immediately after the lamentable event was afcertained, in the title-page of a very ancient edition of Cicero's "Paradoxa," by a friend who highly refpected the ftern virtues both of his public and his private character:—

SAMUEL WHITBREAD, armiger;

Vir illuftris ifte, quem omnes liberales brevi in tempore appellabunt

ANGLICUM CATONEM,

E terra fuit ereptus die fexto Julii, anno Chrifti 1815.

Ann. Biog. and Obit. for 1817.

WHITBURN, in *Geography*, a townfhip of England, in the county of Durham; 4 miles N. of Sunderland.

WHITBY, DANIEL, a learned divine of the church of England, was born at Rufhden, in Northamptonfhire, in 1638, and admitted to Trinity college, Oxford, in 1653, where he took the degree of M.A. in 1660, and became fellow of his college in 1664, in which year he firft appeared as a writer againft popery. In 1668 he was appointed chaplain to Dr. Seth Ward, bifhop of Salifbury, and collated to a prebend in his church. In 1672 he took the degree of D.D., and about this time was made rector of St. Edmund's parifh in Salifbury. From this time he became a confiderable writer in the popifh controverfy, publifhing "A Difcourfe concerning the Idolatry of the Church of Rome," 1674; "The Abfurdity and Idolatry of Hoft-Worfhip proved," 1679; "The Fallibility of the Roman Church demonftrated," 1687; and "A Treatife of Traditions," in two parts, 1689. He alfo expreffed, in common with feveral other liberal perfons at this period, his wifhes for an union of all Proteftants, in a piece publifhed in 1683, and intitled "The Proteftant Reconciler; humbly pleading for Condefcenfion to Diffenting Brethren in Things indifferent and unneceffary, for the Sake of Peace, &c." This publication was too liberal for the times, and called forth a hoft of adverfaries. But the moft formidable attack was that of the famous Oxford decree, which paffed a cenfure on the following propofitions contained in it; *viz.* "It is not lawful for fuperiors to impofe any thing in the worfhip of God that is not antecedently neceffary:"—"The duty of not offending a weak brother is inconfiftent with all human authority of making laws concerning indifferent things;" which propofitions were denominated in the decree falfe, impious and feditious doctrines; and the book was burnt in the quadrangle of the univerfity fchools. But it was ftill more humiliating to the author to be required by his patron, the bifhop, to declare his forrow for having written the work, and to renounce by name the two preceding propofitions. This conduct was very unworthy of a Chriftian bifhop, and fixes a permanent ftigma on the memory of Ward. It reminds us of the Inquifition and Galileo. (See GALILEO.) Dr. Whitby, actuated probably by a defire to conciliate his adverfaries, or urged to adopt this meafure, publifhed in the fame year a fecond part of the book, in which he ftrongly preffes the diffenting laity to join in full communion with the eftablifhed church, and replies to all the objections of the Non-conformifts againft the lawfulnefs of their complying with its rites and ceremonies.

No man could more fincerely rejoice in the Revolution than Whitby, nor more cordially welcome the emancipation of Britifh fubjects from all kinds of tyranny. Accordingly he publifhed two tracts in favour of the oath of allegiance required on the acceffion of king William; and in one of thefe tracts he maintains the principle in the Englifh government of an original contract between the prince and the people.

His capital work, however, was the refult of fifteen years' ftudy, and is intitled "A Paraphrafe and Commentary on the New Teftament," 2 vols. fol. printed in 1703, feveral times reprinted, and held in high eftimation by biblical ftudents. To the edition of 1710 he annexed a Latin appendix, containing an examination of Dr. Mill's various readings, under an apprehenfion that they might prove injurious to the authority of Scripture. This great work of Dr. Whitby was followed by feveral tracts on theological fubjects, in which he feems to value himfelf on that freedom of difcuffion which, with new times, he was allowed to indulge, more efpecially as he occafionally ftrays beyond the fixed boundaries of what has been called orthodoxy. Among thefe tracts were, "The Neceffity and Ufefulnefs of the Chriftian Revelation;" "A Difcourfe concerning the true Import of the Words Election and Reprobation;" "The Extent of Chrift's Redemption;" "The Grace of God;" "The Liberty of the Will;" "The Perfeverance or Defectibility of the Saints;" "Four Difcourfes on Election and Reprobation;" "A Treatife on Original Sin," in Latin, in which he denies that the imputation of Adam's fin to his pofterity has any fair ground in Scripture. Upon the publication of Dr. Clarke's "Scripture Doctrine of the Trinity," Dr. Whitby adopted his opinion, and wrote a Latin treatife, intended to prove that the controverfies refpecting the Trinity could not with certainty be determined from fathers, councils, or Catholic tradition. In connection with this fubject of controverfy, he publifhed "A Diffuafive from Inquiry into the Doctrine of the Trinity; or, the Difficulties and Difcouragements which attend the Study of that Doctrine." In the Bangorian controverfy, he was one of the auxiliaries of Dr. Hoadly, and printed feveral tracts. He alfo publifhed feveral fermons. But his laft work, which did not appear till after his death, was "The laft Thoughts of Dr. Whitby, containing his Corrections of feveral Paffages in his Commentary on the New Teftament; to which are added Five Difcourfes; publifhed by his exprefs Order." In the preface to this work, written at the clofe of a long life of learned and laborious inquiry, the author fays, "when he wrote his Commentaries, he went on too haftily in the common beaten road of other reputed *orthodox* divines; conceiving firft, that the Father, Son, and Holy Ghoft, in one complex notion, were one and the fame God, by virtue of the fame *individual* effence communicated from the Father; which confufed notion (he adds) he is now fully convinced to be a thing impoffible, and full of grofs abfurdities." A fhort illnefs clofed the life of this eminent biblical fcholar, on March 24, 1725–6, at the age of 88. He is reprefented by a biographer as a man of great fimplicity of character, fingularly ignorant of worldly affairs, entirely devoted to his ftudies, but affable, pious, and charitable. He preferved a tenacious memory to the laft, but through a defect of fight was obliged to employ an amanuenfis. Biog. Brit.

WHITBY, in *Geography*, is a confiderable fea-port town of the North-Riding of Yorkfhire, England, fituated between Flamborough-head and the entrance of the river Tees. Confidering the ruins of the ancient abbey as the principal object of the town, the latitude of Whitby is 54° 29′ 24″ N., and the longitude 0° 35′ 59″ W. from the meridian of Greenwich. It is 47 miles N.E. of York, and

246 miles from London. The town is placed at the mouth of the ſmall river Eſk, which divides it into two unequal parts. The direction of the river, running nearly due north towards the ſea, determines that of the town, which extends along its banks. Theſe banks riſe almoſt ſuddenly from the river on both ſides; particularly on the eaſt, ſo as to leave but a very narrow ſtretch of level ground at the bottom, of which, indeed, a great part has, at different times, been gained from the bed of the river. This narrow ſpace is literally covered with houſes; but the town aſcends the ſteep banks on both ſides, and thus preſents a romantic appearance, eſpecially when viewed from the ſea; the whole ſurmounted by the old weather-beaten church, on the verge of the eaſtern cliff, and the venerable remains of the abbey behind. The eaſtern half of the town extends about three-quarters of a mile; but the breadth where greateſt does not exceed 150 yards. The weſtern diviſion is the largeſt, the moſt compact, and the moſt elegant. Although now of importance, Whitby was but inconſiderable in trade and population, until towards the beginning of the laſt century. Its origin may, however, be carried back to the foundation of the celebrated monaſtery in the ſeventh century. That the Romans, or the original Britons, had any eſtabliſhment at Whitby, we have no grounds to affirm; although the opening of the river into the ſea muſt have afforded a convenient ſtation for fiſhing and navigation; of which, had the Romans been a commercial people, they would doubtleſs have availed themſelves, eſpecially on a tract of coaſt ſo little furniſhed with harbours adapted to their ſhipping. On this part of the coaſt may, perhaps, be placed the bay mentioned by Ptolemy, under the romanized name *Dunum Sinus*, of which the moſt commodious inlet was the mouth of the river, now, by a peculiar appropriation of a generic Britiſh name for water, called the Eſk. After the eſtabliſhment of the monaſtery of St. Hilda in the ſeventh century, the vicinity began to be inhabited. Under her ſucceſſor Ælfleda, daughter of Oſwy, the port had ſome ſhare of ſhipping; for, in 684, the abbeſs took a voyage, with ſome monks of the abbey, to the iſle of Coquet, on the coaſt of modern Northumberland, to have an interview with St. Cuthbert. Suffering and again reſtored with the abbey, after the devaſtation by the Danes in 867, Whitby obtained its preſent name, ſignifying the White town. It was alſo from the monaſtery occaſionally called Preſteby, or Prieſttown. Although unnoticed in Domeſday-book, Whitby, prior to 1189, had become of ſuch importance, that the abbot erected it into a borough, with the cuſtomary privileges. Thoſe privileges were ſoon after confirmed by a royal charter; and had no unfair means been employed to ſet them aſide, Whitby might now have been a royal borough. But the liberties of Whitby were of ſhort duration: the monks repented of their liberality to the town, and Peter, the ſucceeding abbot, in 1200, procured from king John a repeal of the charter of his predeceſſor. About the year 1538, Whitby is deſcribed by Leland as a "great fiſchar toune;" and nothing more is added by Camden, who mentions the place fifty years later. For many years after the diſſolution of the abbey, the veſſels of the port were few and ſmall; and the trade was inconſiderable until the eſtabliſhment of the alum-works at Guiſborough, at the cloſe of Elizabeth's reign. A ſpirit of emulation being excited by the ſucceſs of thoſe works, a ſimilar eſtabliſhment was formed in 1615 at Sand's-end, within three miles of the town. The vicinity of Whitby abounding with the alum-mineral, other undertakings of the ſame kind were begun. Hence two important branches of induſtry were formed in the town; the one to ſupply the alum-works with coal, the other to export the alum to diſtant parts. From theſe beginnings, the trade of Whitby increaſed; the ſchemes of the inhabitants were enlarged; the number of ſhipping was augmented; and new ſhips were conſtructed, for which timber was drawn from the oak-woods of the vicinity. In this manner, the trade and navigation of the town grew up to ſuch a height, that, in the beginning of the preſent century, Whitby was the ſeventh in rank for tonnage among the ports of England. In 1816, the number of veſſels belonging to the town was 280, carrying 46,341 tons, and navigated by 2674 ſeamen. Beſides the carrying of coal, with the alum trade, and a ſhare of foreign commerce, the number of veſſels fitted out from Whitby for the Greenland whale-fiſhery, begun in 1753, was, in 1800, next to that of thoſe ſailing from London. As early as the middle of the 16th century, ſmall wooden piers were conſtructed at the mouth of the Eſk, for the protection of the fiſhing-craft: but in 1632 ſtone piers were begun, through the exertions of ſir Hugh Cholmley, who, by the favour of the earl of Strafford, his relation, obtained a general contribution over England in aid of the work, when nearly 500*l.* were collected. The navigation of Whitby becoming of importance, acts of parliament were obtained, in 1702 and 1723, for conſtructing a pier, which now extends above two hundred yards from the cliff on the eaſt ſide of the harbour, weſtward to the channel of the Eſk. By this work, ſecurity was obtained for the town as well as the ſhipping, both of which were greatly expoſed to north-eaſterly winds. Another pier, on the weſt ſide, was afterwards added, running out about an equal diſtance towards the ſea. By ſubſequent additions and improvements, the harbour has been eſſentially benefited. The weſt pier, now carried out to the length of three hundred and forty yards, is conſtructed with large blocks of ſquared ſtone, and terminates in a circular head, with embraſures for a battery. Within the piers, veſſels to the number of five hundred may lie, but all on the ground at low water. The harbour is divided into the outer and the inner by a drawbridge, ſo conſtructed as to allow ſhips of two hundred tons to paſs through. In the latter, which is capacious and ſecure, on both ſides of the river are conſtructed ſeveral dry docks, and other accommodations for ſhip-building. The veſſels built for the coal-trade are particularly valued for their ſtrength and durability. One built in 1724 was loſt on the Lincolnſhire coaſt in 1810, but did not go to pieces: another, wrecked a few years ago, was above one hundred years old. In neap-tides the water riſes from ten to twelve feet at the entrance of the harbour; but in ordinary ſpring-tides the depth extends from fifteen to eighteen feet. In the equinoctial gales, the depth of water is ſometimes increaſed to twenty-three or twenty-four feet. The trade of the port of Whitby is but ſmall in proportion to its ſhipping, as many of the largeſt veſſels are employed in time of war as tranſports, and at other times by the merchants of London, and of other ports. The trade of the town is, however, conſiderable for its ſituation, in a country abounding with moors, where few manufactures are carried on. The alum-works in the environs are of great antiquity, and may not improbably be carried back to the Roman times. But the firſt work eſtabliſhed in Britain, in later times, was begun by ſir Thomas Chaloner in 1595, on his eſtate at Belman-rock, near Guiſborough, twenty miles to the weſtward of Whitby. Since that period, alum-mineral has been extracted in various other places, particularly at Sand's-end, three miles weſt from Whitby, where the work is ſtill in a proſperous ſtate. Until the year 1789, the alkaline lees employed

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employed in the manufacture were prepared from kelp, or sea-weed, burnt on the shore: but since that period kelp has been gradually superseded by black-ashes, made from the refuse of soap-boilers' lees. The average annual quantity of alum manufactured in the Whitby district, for the last twelve years, was 2840 tons; but in 1816 the quantity was 3155 tons. Little alum is now exported, nearly the whole being sent to London. The number of persons, including artificers and boys, belonging to the works, is about 600. (See ALUM.) Thin seams of coal have, for upwards of seventy years, been wrought in the environs of Whitby, but of a very inferior quality, and used only in the interior parts of the country.

Whitby contains no public building of note. The town-hall, erected by the late Mr. Cholmley, is a heavy pile of the Tuscan order. The poor-house, extensive, and judiciously managed, affords a comfortable refuge for the distressed, and tends to diminish the heavy burthen of the parish-rates. A dispensary, liberally supported, for distributing advice and medicines to the poor, was established in 1780. The parish-church stands near the top of a hill, on the east side of the town, a little to the northward of the ruins of the abbey, accessible from the bottom by an inconvenient ascent of 190 stone steps. The architecture of the edifice was originally what is absurdly styled Gothic; but it has gone through so many alterations, that little of its ancient appearance now remains. The church-yard is excessively crowded with grave-stones; but the sea-air of Whitby is so destructive of stones, that inscriptions are soon effaced. For the use of the numerous inhabitants, a spacious chapel of ease has been erected in the lower part of the town; and for the country part of the parish, which is of great extent, three others have been built. That at Sleights, four miles from the town, is a handsome edifice. Roman Catholics, Quakers, and various other classes of dissenters, have their respective places of worship in the town. According to the parliamentary returns of 1811, the houses of this town were 1393, and the inhabitants 6969: but in the spring of 1816, the population was found, by a careful inquiry, to have increased to 10,203. The inhabitants of the country part of the parish were then estimated at 1477 persons.

The town of Whitby is close, irregular, and unpleasant; but the environs are romantic and beautiful. These are embellished with the country-residences of the opulent inhabitants, mostly erected on commanding situations: the most interesting object of all, however, is the celebrated Abbey, of great antiquity, having been originally founded in the year 655. Before the sanguinary but decisive battle of Leeds, on the banks of the Oire, in which he utterly overthrew and slew his invading foe, Penda, king of the Mercians, Oswy, king of the Northumbrians, vowed, if successful, to erect and endow a monastery, and to consecrate to the service of religion in it his daughter Ælfleda, then scarcely a year old. In discharge of this engagement, he founded the monastery of Streoneshalh, of the Benedictine order; with this peculiarity, that it was to contain both monks and nuns, all under the government of St. Hilda, the first abbess. It is, nevertheless, probable, that the introduction of the monks, by which the institution became in all respects similar to that of the celebrated abbey of Fontevraud, in the west of France, did not take place till several years after its establishment. The monastery was began in 657, and dedicated to St. Peter; but such was the veneration entertained for St. Hilda, that it was always called by her name, and to her was the foundation usually ascribed. While Hilda was abbess, the synod of Whitby was held in 664, in which, notwithstanding her opposition, strengthened by that of Colman, the festival of Easter was directed to be celebrated at the time adopted by the sovereign pontiff, instead of that which had been in general observance in Britain. Dying in 680, Hilda's place as abbess was filled by Oswy's daughter, Ælfleda. Till the year 867, the abbey continued to prosper; but it was then overthrown by the sons of Lodbrog the Dane. In this state it remained until after the Norman Conquest: the lands in the neighbourhood were granted to Hugh, the first earl of Chester, from whom they passed to William de Percy, ancestor of the Percys of Northumberland. By him the monastery was restored from its ruins under a prior; but in the reign of Henry I. it was again raised to the rank of an abbey. Although pillaged by a Norwegian fleet in the time of abbot Richard, who died in 1175, its revenues at the dissolution, under Henry VIII., amounted to 505*l.* 9*s.* 1*d.* At this epoch, the scite and lands, partly by grant and partly by purchase, became the property of sir Richard Cholmley, a descendant of the family of Cholmondeley, in Cheshire.

Of Whitby-abbey, the ruins of the church alone remain; but by these, which are still considerable and conspicuously picturesque, it appears to have been a magnificent structure. The exterior length of the church, which is built in the usual form of a cross, is 310 feet; the breadth at the west end, including the buttresses, is 84 feet; the length of the cross 153 feet. The church probably occupies the scite of the Saxon building erected before the Conquest; but of it, nor even of the edifice constructed immediately after the revival of the monastery, no vestige now remains. The present structure is of different ages, and exhibits different styles of architecture. The eastern part, or choir, evidently the oldest, was probably built by Richard de Burgh, who was abbot from 1148 to 1175, and who rebuilt the chapter-house. The lower part of the tower, and most of the pillars, which are all clustered, were perhaps erected at the same time: but the north transept and the upper part of the tower are of a later date. The ornaments of the windows in those parts, the beautiful range of niches on the walls within, the tracery of the circular window in the north end, &c. seem to indicate the work of the close of the 13th or the beginning of the 14th century. The west front is the latest part of the whole, probably of the time of Edward III., or in the end of the 14th century.

The alum-rocks in the vicinity of Whitby are not less curious than valuable, from the variety of petrified substances they contain. Besides the usual petrifactions of shells and other marine bodies, parts of the human skeleton have been occasionally discovered. In the early part of the last century, Dr. Woodward, the celebrated naturalist, dug up on the scar, or cliff, on the east side of the harbour, the petrified arm and hand of a man, having all the bones and joints very visible. About 1743 was found, in the alum-rock, the complete skeleton of a man; but it was broken to pieces by taking from the bed. A similar discovery is said to have been made about nine years ago; but the skeleton was broken without any scientific person having examined it. In 1758, the bones of a crocodile, as they were imagined to be, were drawn from the rock, and transmitted to the Royal Society, by whom an account of them was published in the 50th volume of the Philosophical Transactions. About four years afterwards, the skeleton of a horse was found in the alum-works at Salt-wick, thirty yards under the surface. Ammonites, or cornua-ammonis, vulgarly called snake-stones, abound, with other testaceous petrifactions, in the aluminous schistus in the vicinity of Whitby;

Whitby; on which account, probably, the town has chofen three ammonites for its arms.

Robin-Hood's Bay, fix miles fouth-eaft from Whitby, is a noted fifhing-ftation, frequented for protection by many a veffel paffing along that extended tract of inhofpitable fhore. Among the country-feats in the vicinity of Whitby, which are not numerous, is Mulgrave caftle, the manfion of the earl of Mulgrave, fituated five miles weftward from the town, on a lofty eminence, commanding a moft extenfive profpect both by land and fea. Near to the fouthward ftand the remains of the ancient baronial caftle of Mulgrave. Manifeft evidences of Roman occupation are to be feen in various parts of the furrounding country. The Roman road from *Eboracum* (York), northwards by the vicinity of New Malton, (perhaps the *Derventio* of Antonine,) and apparently terminating at Durnfley, near the fea, three miles W. from Whitby, is in many places very perceptible. Along its courfe ftill remain traces of Roman encampments, of which the camps at Cawthorn, 19 miles S.W. from Whitby, fuppofed to be the *Delgovitia* of Antonine, are very perfect. Thefe works are noticed in general Roy's "Military Antiquities of the Romans in Britain;" but much more particularly in "The Hiftory of Whitby and Streonefhalh-abbey, with a Statiftical Survey of the Vicinity," by the Rev. George Young, in 2 vols. 8vo. Whitby, 1817.

WHITCHURCH, a populous market-town in the north part of the hundred of North Bradford, and county of Salop, England, at the northern extremity of the county, is fituated 20 miles N. by E. from Shrewfbury, and 160 miles N.W. by N. from London. The church, the chief object of notice, feated on the top of the hill over the town, is a fpacious modern ftructure, erected in 1722, with a fquare tower 108 feet in height. Two recumbent ftone figures are preferved from the ruins of the old church; of which one reprefents the celebrated John Talbot, the firft earl of Shrewfbury, and marfhal of the realm of France in the reign of Henry VI.: he was called the Englifh Achilles, and was greatly renowned in the wars of France. Shakfpeare, in his play of Henry VI., defcribes Talbot as a moft formidable and magnificent character: "the terror of the French:—the fcare-crow that affrights their children:—whofe grifly countenance made others fly:—none durft come near him for fear of fudden death." Another effigy reprefents Chriftopher Talbot, fourth fon of John Talbot, fecond earl of Shrewfbury, and who was rector of Whitchurch and archdeacon of Chefter. The rectory of this parifh is one of the richeft in the county. The caftle has long been in ruins. Whitchurch has a very refpectable free-fchool, in which many perfons of eminence have been educated. Here are alfo meeting-houfes for Proteftant diffenters, a charity-fchool for children of both fexes, and fix alms-houfes for aged women, endowed by Mr. Samuel Higginfon. A weekly market is held on Friday; and here are two annual fairs. The town is a place of much public refort during the horfe-races which are occafionally held here. Among the natives of Whitchurch, was diftinguifhed the celebrated linguift Abraham Whelock, who tranflated the New Teftament into Perfian, and affifted Dr. Brian Walton in the compilation of his polyglot Bible. Whelock publifhed alfo an edition of the writings of the venerable Bede. He died in 1654. The population return of the year 1811 ftates the town of Whitchurch to contain 552 houfes, and 2589 inhabitants: but the parifh comprehends, befides the town, thirteen townfhips. The whole population is returned as 5332; the number of houfes as 1107.

About nine miles to the northward of Whitchurch is Hawkftone-park, long the refidence of the ancient family of the Hills, and a place celebrated for its natural and artificial beauties and curiofities. The manfion, an elegant modern building fituated on the north fide of a romantic hill, is adorned with a lofty portico of the Compofite order. With the beauty of the exterior of the edifice, the interior fully correfponds: the chapel and the faloon are particularly elegant, and the latter is ornamented with valuable paintings. The grounds around the manfion are particularly interefting for their affemblage of naturally romantic fcenes, to which art has greatly contributed. The grotto, the view from the cliff, called Paoli's-point, the retreat, or hermitage, St. Francis's cave, the Swifs bridge, the terrace, the obelifk, and the widely-extended profpect it prefents over the furrounding country, the tower, the artificial river, the cottage, or whim, are among the many attractive features of Hawkftone-park, which owes much of its embellifhment to the tafte and munificence of the late fir Richard Hill, bart. The beautiful and romantic fcenery of this noble place is fully detailed in T. Rodenhurft's "Defcription of Hawkftone."—Beauties of England and Wales, vol. xiii. Shropfhire; by R. Rylance, 1811.

WHITCHURCH, a fmall but ancient borough and market-town in the upper half hundred of Evingar, Kingsclere divifion of Hampfhire, England, is fituated on the borders of Chute Foreft, at the diftance of 13 miles N. from Winchefter, 24 miles N. by E. from Southampton, and 57 miles W.S.W. from London. It poffeffes the rights of a borough by prefcription; and has fent two members to parliament fince the twenty-feventh year of queen Elizabeth. The borough is the joint property of lord Sidney and lord Middleton; the freeholds, which give the right of voting, being conveyed by them to their refpective friends for the purpofe of performing the ceremony of an election. The freeholders are nominally about feventy, but the real electors are faid to be appointed and influenced by the noblemen before-mentioned. The government of the town is vefted in a mayor, annually chofen at the court-leet of the dean and chapter of Winchefter, to whom the manor belongs. The town, though fmall, is remarkable for a variety of religious fects; there being, befides the church, places of worfhip for the Independents, Anabaptifts, Quakers, Methodifts, and Sandimanians. A market is held weekly on Friday, and three fairs annually. The population of the parifh, as afcertained by the return of the year 1811, was 1407; the number of houfes 281: the labouring claffes are chiefly employed in woollen manufactures, and in agriculture.

Adjoining to the weftern end of Whitchurch is one of the entrances to the earl of Portfmouth's diftinguifhed refidence, Hurftbourne-park. Of late years the park has been much enlarged. The grounds contain confiderable diverfity of furface and fcenery; and the converfion of a fmall ftream into a broad piece of water, has tended very much to improve the place. In the old part of the park, trees have attained a fize much beyond what might be expected from the chalk and flint which conftitute fo great a portion of the foil of North Hampfhire. An old manfion-houfe ftood in the bottom near the prefent parifh-church and village: but the late lord Portfmouth pulled it down and erected the prefent building in a much more eligible and healthy fituation. It ftands on elevated ground, commanding extended and varied profpects, particularly to the fouth and the north. This manfion, erected by Mr. Meadows from the defigns of James Wyatt, efq. confifts of a centre and two correfpondent wings connected to it by colonnades. The eaftern wing contains the library and a chapel, and in

 the

the weftern are apartments for fervants. In the library were preferved a confiderable body of the MSS. on various matters, philofophical and theological, of the illuftrious Newton. They came into the poffeffion of this family in confequence of the marriage of John, vifcount Lymington, (fon of the firft earl of Portfmouth,) in 1740, with Catharine Conduit, great niece and coheirefs of fir Ifaac. Thofe papers were examined by the late learned bifhop (then doctor) Horfley, while preparing his edition of Newton's works. See Newton, *Sir Ifaac.*

A little to the eaftward of Whitchurch, near the London road, is Freefolk, noted for the paper-mills belonging to John Portal Bridges, efq. where the paper for the notes of the bank of England has been manufactured ever fince the reign of George I. At Laverftock is the feat of William Portal, efq.; and in the adjoining parifh of Overton is a handfome new houfe, the feat of —— Jarvis, efq. In the village a filk-mill has been eftablifhed. In various fpots at no great diftance from Whitchurch, are ftill vifible evidences of Roman occupation. The great fofs-way, a Roman road leading from Sorbiodunum, or Old Sarum, to Vindonum, or Silchefter, paffes acrofs the downs two miles to the northward of the town. Near the courfe of this way, at Egbury, a Roman encampment, forming an irregular quadrangle, may be eafily traced, the rampart in moft parts is ftill lofty; the longeft fide meafures about 300 yards. On feveral eminences within the extent of a few miles from Whitchurch are circular or ring-pofts, commonly called beacons; but evidently military ftations of the ancient inhabitants of the country, to which they could refort, and on which they could fecure their families and property, in the event of hoftile affault from domeftic or foreign foes.—Beauties of England and Wales, vol. vi. Hampfhire; by J. Britton, F.S.A. and E. W. Brayley.

WHITE, Gilbert, M.A. in *Biography*, an agreeable writer of natural hiftory, was born at Selborne in Hampfhire in 1720, and completed his education at Oriel college, Oxford, of which he was elected fellow in 1744. In 1746 he took the degree of M.A., and in 1752 became one of the fenior proctors of the Univerfity. Unambitious in his temper, and fond of rural fcenery, he fixed his refidence in his native village, and devoted his time to literary purfuits, and particularly to the inveftigation of thofe fubjects of natural hiftory, which furnifhed him with leffons of piety and benevolence. The refult of his obfervations was communicated to the public in his " Natural Hiftory and Antiquities of Selborne," 1789, 4to.; the firft and principal part of which confifted of letters addreffed to Mr. Pennant, and affords a variety of remarks, chiefly in the zoological departments, peculiarly amufing and no lefs inftructive: and the fecond part treats of the antiquities of the place. Highly efteemed by all who knew him, he died in 1793; but after his deceafe, the natural hiftory of his work was publifhed feparately in 2 vols. 8vo. 1802, with the addition of mifcellaneous obfervations, and a Naturalift's Calendar, extracted from his papers, and of parallel remarks communicated by W. Markwick, efq., an accurate obferver of nature in the county of Suffex. Gen. Biog.

White, Joseph, Regius profeffor of Hebrew, and Laudian profeffor of Arabic, in the univerfity of Oxford, was born in Gloucefterfhire in 1746, and being of humble origin, but devoted to reading whilft he was purfuing his father's occupation as a weaver, attracted the notice of a neighbouring gentleman, who fent him to Wadham college, Oxford. Having graduated M.A. in 1773, and chofen fellow of his college, he directed the main bent of his ftudies to the oriental languages, under the advice of Dr. Moore, afterwards archbifhop of Canterbury. Such was his proficiency in this department of literature, that in 1775 he was elected Laudian profeffor of Arabic, on which occafion he delivered and printed an oration on the utility of that language in theological ftudies. By the recommendation of bifhop Lowth, he was appointed editor of the Philoxenian Syriac verfion of the four gofpels, which he publifhed in 1778. About this time he was nominated one of the king's preachers at Whitehall; and in a fermon preached before the univerfity of Oxford, he recommended a revifal of the Englifh tranflation of the Old Teftament. In 1780 he publifhed a " Specimen of the Civil and Military Inftitutes of Timour," tranflated from a Perfian verfion of the Mogul original, written by the conqueror himfelf. He alfo added a fpecimen of Perfian poetry, and recommended the ftudy of this language. Thefe Inftitutes having been tranflated entire by major Davy, were publifhed from the Clarendon prefs in 1783, under the infpection of profeffor White, who annexed a preface, indexes, and geographical notes.

As Bampton lecturer, to which office he was appointed in 1781, he preached a courfe of fermons before the univerfity, which were printed in 1784, and much admired for their learning and eloquence. The general defign of thefe fermons was to evince the excellence of the Chriftian religion, on a comparifon with that of Mahomet. (See Alcoran.) It was difcovered, however, fomewhat to the difgrace of the profeffor, that he had derived very confiderable affiftance in the compofition of thefe fermons from the mafterly pen of Mr. Badcock, who had been a diffenting minifter at South Molton, and afterwards conformed to the church, and that feveral of them were actually written by him. It was alfo known, that Dr. Parr, from his ample ftore of Greek literature, had furnifhed the materials that had been wrought up into two of thefe fermons. Thefe facts were inveftigated and afcertained; and the charge againft the profeffor was fufficiently fubftantiated, and it was founded, not fo much on his want of ability for fuch productions, as on his indolence, and on certain habits unfavourable to ftudy. His reputation, however, as a defender of Chriftianity was acknowledged, and he was prefented to a prebend of Gloucefter, and foon after was graduated D.D. About the year 1790 he married, and accepted a college-living in Suffolk. In this fituation he profecuted his ftudies, and having fet up a prefs in his houfe, and furnifhed himfelf with oriental types, he and his wife performed the bufinefs of compofitors, and a man and maidfervant that of the prefs. Hence originated his " Ægyptiaca," relating to the antiquities of Egypt; and an edition, with a verfion, of an account of that country by an Arabian writer named Abdollatif. In 1799 Dr. White publifhed from the Clarendon prefs his " Diateffaron," or the harmony of the four evangelifts, in Greek, a work ufeful to biblical ftudents. He died in 1814, at the age of 68. Gen. Biog.

White, one of the colours of natural bodies.

White is not fo properly faid to be any one colour, as a compofition of all the colours; it being demonftrated by fir Ifaac Newton, that thofe bodies only appear white, which reflect all the kinds of coloured rays alike, and that the light of the fun is only white, becaufe it confifts of all colours.

From the multitude of rings of colours, which appear upon compreffing two prifms, or object-glaffes of telefcopes together, it is manifeft, that thefe do fo interfere and mingle with one another at laft, as, after eight or nine reflections, to dilute one another wholly; and conftitute an even and uniform whitenefs: whence, as well as from other experiments, it appears that whitenefs is certainly a mixture of all colours; and that the light which conveys it to the eye is a mixture of rays endued with all thofe colours.

The fame author fhews, that whitenefs, if it be moft ftrong and luminous, is to be reckoned of the firft order of colours; but if lefs, as a mixture of the colours of feveral orders: of the former fort, he reckons white metals; and of the latter, the whitenefs of froth, paper, linen, and moft other white fubftances. And as the white of the firft order is the ftrongeft that can be made by plates of tranfparent fubftances, fo it ought to be ftronger in the denfer fubftances of metals, than in the rarer ones of air, water, and glafs.

Gold or copper mixed either by fufion or amalgamation with a very little mercury, with filver, tin, or regulus of antimony, become white; which fhews, both that the particles of white metals have much more furface, and therefore are fmaller than thofe of gold or copper; and alfo, that they are fo opake, as not to fuffer the particles of gold or copper to fhine through them. And as that author doubts not, but that the colours of gold and copper are of the fecond or third order, therefore the particles of white metals cannot be much bigger than is requifite to make them reflect the white of the firft order. See COLOUR, and *Colours from* METALS.

Hevelius affirms it as a thing moft certain, that, in the northern countries, animals, as hares, foxes, bears, &c. become white in the winter time; and in fummer refume their natural colours.

Black bodies are found to take heat fooner than white ones; by reafon the former abforb or imbibe rays of all kinds and colours, and the latter reflect all.

Thus, black paper is fooner put into a flame, by a burning glafs, than white; and hence black cloths, hung up by the dyers in the fun, dry fooner than white ones. See BLACK.

WHITE *of the Eye*, denotes the firft tunic or coat of the eye, called *albuginea* and *conjunctiva*, becaufe it ferves to bind together or inclofe the reft. See ADNATA, and EYE.

WHITE *Ale*, in *Rural Economy*, a liquor of the malt kind, which is faid to be prepared fomewhat in the following manner. Twenty gallons of malt are mafhed with the fame quantity of boiling water; when after ftanding the ufual time, the wort is drawn off, and fix eggs, four pounds of flour, a quarter of a pound of falt, and a quart of *grout*, are well beaten up together, and mixed with the above quantity of wort, which, after ftanding twelve hours, is put into a cafk, and is ready for ufe the day afterwards.

It is obferved by the writer of the Devonfhire Corrected Report on Agriculture, who has fupplied the above account, that this liquor is almoft exclufively confined to the neighbourhood of Kingfbridge, in that county; and that it is a beverage which poffeffes a very intoxicating quality, and which is much admired by thofe who drink not merely to quench thirft. A myftery, it is faid, hangs over the ingredient called grout, and the fecret is faid to be confined to one family in the above diftrict only. No difficulty, however, it is fuppofed, could arife in afcertaining its component parts, by fubmitting a certain portion of it to the teft of chemical examination. It is plain, it is faid, that this liquor is of confiderable antiquity, from the *terrier* of the advowfon of Dodbrook, which exprefsly calls for the tithe of white ale.

This mild pleafant liquor may eafily be made in other places.

WHITE *Antimony Ore*, in *Mineralogy*, *Antimoine Oxydé*, Hauy, generally occurs diffeminated and cryftallized in veins along with other ores of antimony on primitive rocks. See ANTIMONY.

WHITE *Arfenic*, and *Afhes*. See the fubftantives.

WHITE *Bait*, in *Ichthyology*. See CLUPEA.

WHITE *Beam*. See CRATÆGUS.

WHITE *Bear*. See POLAR *Bear*.

WHITE *Brant*, the *Anas Hyperborea*. See DUCK.

WHITE *Bug*, in *Gardening*, an infect of the bug kind, which is often very troublefome and hurtful in vineries, peach-houfes, and other fuch forts of houfes for fruit-trees.

It is obferved in the firft volume of the "Memoirs of the Caledonian Horticultural Society," that the caufe of this infect fo frequently making its appearance in thefe houfes, is much owing to the neglect in not wafhing the trees properly every day with the engine in many cafes. That when a vinery is much overrun with it, in order to its removal, all the old bark fhould be ftript from off the vines, and all the fhoots and trellis be properly fponged over with black foap and warm water. The writer always makes it a rule, at the time of the winter-pruning, to take off the outer bark, whether infefted with them or not, as thefe bugs lodge between the old and new bark. That in regard to peach-trees, which are infefted in this way with the white bug, they fhould be fponged all over in the fame manner in the winter feafon; and if any bugs fhould appear in the fpring, it is a good way, it is faid, to tie pieces of mat round the ftems and large branches of the trees; as about thefe parts thefe infects take fhelter from the heat of the fun. Once every day thefe portions of mat fhould be taken off, and thrown away out of the houfes. That foon after forcing is begun, the female of thefe bugs will be obferved to be much larger than the male, at which time fhe conftantly goes into fome hollow of the trees or bark, and depofits her ova or eggs moftly in fome thoufands. Thefe are eafily capable of being difcovered, and may be picked out of fuch hollows or crevices by means of a large pin, or fmall piece of fharpened ftick; which is an effectual way of getting quit of them, and of preventing their future increafe. See WASHING *Fruit-Trees*.

WHITE *Campion*, in *Agriculture*, a pernicious perennial weed in corn lands, paftures, and hedges, which is often difficult to deftroy, except by good fummer tillage of the ground. See WEED, and WEEDING.

WHITE *Caterpillar*, or *Borer*, in *Gardening*, a very deftructive fort of infect of this kind, but which is not fo numerous as thofe of the other kinds, nor does it attack and deftroy the fame parts of goofeberry-bufhes, though equally injurious on others. It is of comparatively a fmall fize too, in relation to thofe of the other forts, the black and green, that infeft thefe bufhes; the former of which, the large or black, may be obferved, it is faid in a paper in the Horticultural Tranfactions of Scotland, lying during the winter months in large clufters on the under parts, and in the crevices of the bufhes of thefe forts; and that even in the month of February they have been found in that ftate. But that in the courfe of eight or ten days after that, if the weather be favourable, they will creep up the bufhes in the day-time, feed on the young buds, and return to their neft during the night. That whenever leaves appear upon the bufhes, they feed upon them until they arrive at maturity, which is generally about the month of June; after which they creep down upon the under fides of the branches, where they lodge until the cruft or fhell is formed over them. That in July they become moths, and lay their ova or eggs on the under fides of the leaves and of the bark. That the produce

produce of thefe ova or eggs, which come into life during the month of September, feed on the leaves fo long as they continue green, and afterwards collect and gather together in clufters on the under fides of the branches, and in the cracks and openings of the bark, where they abide all the winter, as has been already feen. Confequently that winter is the moft proper time for attacking and deftroying this fort of thefe infects with fuccefs, as their deftruction is then moft effectually and completely accomplifhed by merely the fimple operation of fprinkling and pouring a quantity of boiling hot water over and upon them, from a watering-pan or pot, by which no injury, it is faid, will thereby be done to the bufhes or goofeberry fruit-fhrubs.

That the latter or green fort are in the fhelly ftate in February, when they lie about an inch under the ground. That in the following month they come out fmall flies, and immediately lay their ova or eggs on the veins and under fides of the leaves. That thefe ova or eggs produce young caterpillars in the month of May, which feed on the leaves of the bufhes until June or the fucceeding month, when they caft off a blackifh kind of fkin, and afterwards crawl down from the bufhes into the earth, where a fort of cruft or fhell grows over them, and in that ftate they continue until the following April.

The only method which this writer has hitherto found effectual in deftroying this fort of thefe goofeberry-caterpillars, is firft to dig the ground all around the bufhes very deep during the winter feafon, by which means the greater part of them are either deftroyed, or buried too deep ever to rife to the furface : or, fecondly, in the month of April, when the flies make their appearance, to pick off all the leaves on which any ova or eggs are to be difcovered, which is a tedious operation, but may be performed by children. If any of the infects fhould efcape both thefe operations, they will, it is faid, be difcernible as foon as they come into life, by their eating holes through the leaves, and may then be eafily deftroyed, without the leaft injury to the bufhes or fruit.

That this white kind bores the berry, and caufes it to drop off from the bufh. That they preferve themfelves during the winter feafon in the chryfalis ftate, about an inch under ground, and become flies nearly at the fame time with the latter of the above kinds. That they lay their ova or eggs on the bloffoms, and that thefe eggs produce young caterpillars in May, which feed on the berries until they are full grown, and then creep down into the earth, where they remain for the winter in the fhell ftate.

This fort of thefe caterpillars, too, may be beft deftroyed in the winter feafon, by having the land well and deeply dug all about the goofeberry-bufhes at that time of the year, and by preventing them from climbing up the ftems of the plants in the early fpring feafon, for the purpofe of laying their eggs, by every poffible means that can be devifed and reforted to by the gardener.

Thefe are the beft and moft effectual methods that have yet been difcovered by this writer, for the deftruction of this and the two other forts of goofeberry-caterpillars. For though many other modes of doing it have been tried, none have been found fo certain and complete as thefe ; and they have this advantage and confideration to recommend them, that they injure neither the bufh nor the fruit. That the fame thing cannot be faid either of tobacco-liquor, fnuff, or foap-fuds, all which render the fruit conftantly bitter and ill-tafted ; and which, whatever may be the effect that they may have upon the fmaller kind of caterpillars, it is certain, the writer thinks, that they have none upon the larger kinds, and that foot, lime, and lime-water, do not affect any fort of caterpillar whatever, as the writer has fufficiently proved by repeated experiments with fuch fubftances.

WHITE *Centaury*, in *Agriculture*, an annual weed in woods and other fuch places ; of which animals in general are not fond. It is faid to form the bafis of the famous Portland powder for the gout. See WEED.

WHITE *Cinnamon*. See CINNAMON.

WHITE *Clover*, in *Agriculture*, a well-known plant of the clover kind, which is perennial, and confequently lafts a number of years in the foil or land. It is faid to require a deep free foil to bring it to any degree of luxuriant growth. Confequently but little of the land in many diftricts fuits it ; but it is fometimes fown with the common clover in about half the quantity. In the Berkfhire Report on Agriculture, it is ftated, that it is frequently confounded with the Dutch clover, that it affects a light foil, that it is much improved by rolling, and that it yields a very fweet hay when mixed with red clover, rye-grafs, and nonfuch. That fheep are not very fond of it ; and this is, probably, one reafon why it is lefs cultivated than it deferves to be. It appears, it is faid, to be the Irifh fhamrock ; and that the powdered flowers of this clover being made into bread, were eaten by the natives of the fifter ifland before the introduction of potatoes. It may be noticed, too, that it is capable of bearing flooding, which the red clover is not, and this is a very great advantage in its favour.

It is remarked alfo, that the real Dutch clover is not unfrequently fown with other graffes, in a larger or fmaller proportion, as the farmer may think proper. That in fome places of the above county it is the common practice to fow of broad clover eight pounds, yellow trefoil, or hop clover, four pounds, and of Dutch or white clover, two pounds, to the acre. If it be fown alone, about eight or nine pounds will be fufficient. It is getting into high eftimation in the neighbourhood of Bray, in the above diftrict, and in other places, and is fometimes called honey-fuckle grafs, from the fweetnefs of its fmell. That to all forts of cattle it forms an agreeable pafture, and efpecially to fheep, which thrive on it prodigioufly. Even fwine will fatten on this grafs, the feed of which was imported from Flanders for fome time after it began to be cultivated in this country, though it appears to be an indigenous plant. It has the excellent property of never wearing out by being clofe fed. See TRIFOLIUM *Repens*, and HYBRIDUM. Alfo CLOVER.

White clover is faid, in the Gloucefterfhire Agricultural Report, to be injurious to cow-ftock, by *hoving* them when in abundance after rain in paftures.

WHITE *Colours*, in *Painting*, comprehend the following ; *viz.* FLAKE-*White*, *White*-LEAD or CERUSSE, calcined or burnt *Harts*-HORN, the perfection of which depends upon its whitenefs and firmnefs, diftinguifhable both by fight and touch, PEARL-*White*, TROY-*White*, and EGG-*Shell White*. (See the feveral articles.) The moft delicate and perfect white in ufe, in its application to the purpofes of painting in water-colours, is the artificial fulphate of barytes. According to Mr. Parkes (Eff. vol. ii.), it was firft recommended and brought forward by Mr. Hume, of Long-Acre, who has long fupplied the public with it under the name of "Permanent White." The fame ingenious practical chemift fays, that he knows of nothing fo well calculated as this for marking bottles in a chemical laboratory, where the gafes foon deftroy the ink of common labels, and render them illegible. It is equally ufeful for marking jars, bottles, or boxes, which muft be kept in a damp cellar, for it is not only imperifhable in fuch fituations, but preferves its extreme whitenefs, and confequently the diftinctnefs of the characters. We learn alfo from fir Humphrey Davy's

Davy's "Elements of Chemical Philofophy," that the combination of barytes and carbonic acid, made artificially by pouring a folution of carbonate of ammonia into a folution of nitrate of barytes, forms alfo a pigment of a very white colour.

WHITE *Colours*, in *Dyeing*. See COLOUR.

WHITE *Copper Ore*, in *Mineralogy*, is one of the rareft ores of copper, and has frequently been confounded with copper pyrites, and other ores of that metal. (See COPPER *Ores*.) Its colour is between filver-white and bronze-yellow; it occurs maffive and diffeminated; it has a metallic luftre. The fracture is fine-grained and uneven; it yields eafily to the knife. The fpecific gravity of this ore is 4.5. It contains about 40 *per cent*. of copper mixed with iron, arfenic, and fulphur.

WHITE *Copperas*, *Cordage*, *Eagle*, and *Egg-Shell*. See the fubftantives.

WHITE *Cofs-Lettuce for Hogs*, in *Agriculture*, the ufe of it in feeding thefe animals. A trial of it in this way is ftated to have been made in Suffex, which is particularly deferving of attention: the weaning of young pigs, without much milk and fome corn, is often a difficult bufinefs; but if this fort of lettuce will do it, which feems to be the cafe, no farmer fhould ever be without a rood, or half an acre of this fort of crop for this ufe.

In this trial, four ounces of this fort of lettuce-feed were fown very thick over two perches of ground in the beginning of March. A crop of potatoes was in rows at three feet diftance; between which a double row of thefe lettuces was planted in May; both crops being afterwards kept clean by hand-hoeing. In the June following, they were begun to be ufed for three fows with little pigs, which were kept on thefe lettuces for fix weeks; but thefe fows had wafh in addition: the pigs were then weaned a fortnight earlier than ufual; and after the weaning, the great ufe of the lettuces was found, for the pigs did admirably well upon them, until they all were gone in the middle of Auguft. They were then fed as ufual, with cabbage, turnip-tops, and other fuch vegetable matters, but fell off at once for want of the lettuces. See LACTUCA, and LETTUCE.

WHITE *Crops*, a term applied to all forts of grain-crops, as wheat, rye, barley, oats, and fome others, in contradiftinction to thofe of the green and culmiferous kinds, fuch as cabbages, turnips, rape, tares, beans, and fome others of a fimilar nature.

WHITE *Darnel*, a very troublefome and prolific weed among corn-crops, efpecially of the wheat kind. See WEED, &c.

WHITE *Enamel*. See ENAMEL, and ENAMELLING.

WHITE *Face*, or *Blaze*, in the *Manege*, a white mark upon a horfe, defcending from the forehead almoft to the nofe. It is called in French *chanfrin blanc*.

WHITE *Film*, or *Blindnefs*, a difeafe in fheep, which is occafioned by a white film growing over their eyes, in confequence of fome fort of inflammation, as arifing from different caufes, taking place in them.

The appearances by which it is fhewn to be prefent are, according to fome, that the animal cannot bear the light, that the white part of the eye is red and inflamed, and that it waters a great deal. That this ftate is fucceeded by a fort of membrane or coat formed by the inflamed veffels, which firft covers the white, but gradually extends over the eye, until total blindnefs is the confequence. That this is noticed to be the cafe, when in folding, the fheep run againft dykes, or any other fuch obftacles, and ftart when they approach them; that they do not follow the flock, and that they frequently ftumble. That when the eye is infpected, it is generally found, that a blue flough covers the whole of the eye, without any intermixture of red veffels. That in the worft cafes, the coloured and tranfparent part of the eye becomes of a reddifh-white; by which time, the film on the eye has acquired confiderable thicknefs and hardnefs. That the inflammation is produced in various ways, and by various means; as during the fummer feafon by the reflection of heat and light in very funny and dry weather, as it is found to be more frequent when the hilly fheep-walks become fcorched, and on hard rocky foils, than on the dark-coloured hills which are covered with heather. Others fuppofe, that the difeafe is fometimes caufed by the pollen or duft of flowers irritating the eyes of the fheep, when blown into them, in confiderable quantities, by the wind. That in the winter, the blindnefs is caufed and occurs when the days are very funny, and the evenings frofty and cold; or when the fheep have been long buried under fnow, and the ground is ftill white and glaring when they get out.

But by ftill others, the blindnefs in fheep is believed to arife from a caufe wholly different from any of thefe. That it is induced by a continued fatigue for a length of time, which is capable of bringing it on at any feafon of the year. Thus, fheep that are long and hard driven, or fuch as are daily dragged from one part of the ground to another, ewes that are *cild*, or old, and roughly handled and ufed by the women in milking, during the operation, where that practice is in ufe, and hog-fheep which are tired by driving through fnow, in order to preferve their fubfiftence, are all liable to this affection of the eyes. That their eyes at firft become fore, and emit a fort of ropy humour; after which a white film fettles over them, and if they continue to be fatigued, it grows thicker, the eyes appearing perfectly white; in which cafes, they are faid to be proportionably longer in getting better. The difeafe, too, may proceed from many other caufes of different kinds, as all fuch as tend to caufe local inflammation in the parts, as cold, moifture, and many others of the fame fort.

In the cure of the difeafe, where it is fufpected to arife from the irritating powdery matter of flowers, the fheep fhould be immediately removed to other proper paftures for a time, until the danger from that caufe is over; and in cafes of fnow-blindnefs of this kind, it is always proper to bring them down, as foon as poffible, from the high fnowy walks, where they occupy them, to the bare grounds below.

The inflamed veffels on the white of the eye, efpecially thofe next the nofe, are alfo fometimes advifed to be cut with a lancet or fharp penknife every fecond morning; while the eyes are to be kept defended againft the light, by a fhade tied over the head, or a piece of crape over the eyes. The eyes may likewife be bathed two or three times a-day, with a folution of half a drachm of fugar of lead, or of two drachms of alum, and the fame quantity of white vitriol, in a pint of foft-water. At the fame time purgatives may be given internally, fuch as two ounces of fome purging falts, or, what is better, a fcruple of calomel, once a day for four or five times. When, by thefe means, the inflammation is got the better of, but the flough ftill remains, a little ointment, compofed of eight parts of fome mild unctuous fubftance, and one of red precipitate of mercury, made fine by rubbing, may be infinuated into the eyes every morning; or a little finely powdered cryftal and loaf fugar be blown into them twice in the day.

With fome, it is at firft the practice to bleed the fheep below the eyes, and to let fome of the blood run into each of them; but it is fuppofed that care will infallibly cure the difeafe in a fpace of time proportioned to the debility that has

has induced the complaint without any thing elfe. The beft and moft proper means of cure in thefe cafes are, in the firft place, local or general bleeding, then the ufe of fome fuch folutions and internal remedies as the above, after fome time having recourfe to ftronger wafhes and powders of the fame nature, with fmall quantities of opium, and keeping the animals all the while as much as poffible from the light, and the glare of the ground. (See a paper in the third volume of the Tranfactions of the Highland Society of Scotland.) It is obferved, that certain parcels of fheep are very liable to blindnefs of this fort, and that although it is not a fatal difeafe in itfelf, it frequently occafions confiderable lofs by the fheep drowning themfelves, or breaking their necks in falling down precipices and other fuch places.

White *Flag*, *Flake*, and *Froft*. See the fubftantives.

White *Foot*, in the *Manege*, called in French *balzana*, is a white mark that happens in the feet of a great many horfes, both before and behind, from the fetlock to the coffin. The horfes thus marked are either tramelled, crofs-tramelled, or white all four. Some horfemen place an unlucky fatality in the white of the far foot behind. See Chausse' *Trop haut*, and Tramelled.

White *Friars*, a name common to feveral orders of monks, from their being clothed in a white habit.

Such are, the regular canons of St. Auguftine, the Premonftratenfes, and Bernardines. See Carmelites.

White *Glafs*. See Glass.

White-*Hart Silver*, *candidi cervi argentum*, a tribute or mulct paid into the exchequer, out of certain lands in or near the foreft of White-hart, in Dorfetfhire; which was continued from Henry III.'s time, who firft impofed it upon Thomas de la Linde, and others, for killing a beautiful white hart, which that king had purpofely fpared in hunting.

White *Hellebore*. See Hellebore.

White *Honeyfuckle*, in *Agriculture*, a term often applied to the white clover. It is ftated, in the Agricultural Report for the County of Gloucefter, to be a plant which is brought forward by manure and fheep-ftock, and a proof of good land, at leaft of land in a high ftate of cultivation; and that, on this account, it has, when it abounds in dairy paftures, a tendency to raife the quality of the milk, and make the cheefe hove or heave which is made from it. See Dairying, and White *Clover*.

White *Horfe-Fifh*, in *Ichthyology*, a common Englifh name for the raia afpera noftras of Willughby, and the raia fullonica of Rondeletius and Linnæus. Its back is rough and fpiny; the nofe is fhort and fharp; at the corner of each eye are a few fpines; the nictitating membrane is fringed; the teeth are fmall and fharp: on the upper part of the pectoral fins are three rows of fpines pointing toward the back, and crooked, like thofe of the fuller's inftrument; whence its name *fullonica* and *fuller*. On the tail are three rows of ftrong fpines: the tail is flender, and rather longer than the body. The colour of the upper part of the body is cinereous, ufually marked with many black fpots; the lower part white. This fifh grows to a fize equal to that of the fkate. Pennant.

White *Jafper*, in *Mineralogy*, or agate jafper, has a pale yellowifh-white colour, and fometimes occurs reddifh-white. It is opaque, and has fmall imperfectly conchoidal fractures. See Jasper.

White *Land*, in *Agriculture*, a tough clayey foil, naturally of a fomewhat whitifh hue when dry, efpecially when it has lain fome time untilled, but becoming blackifh after rain: this appears of a light greyifh colour when turned up by the plough, and flides off from the plough-fhare with eafe, and with a fmooth gloffy furface. It has often a yellowifh hue with the grey, and is often veined with large parcels of a blue marly earth. See *Clay* Soil.

White *Lead* is a fort of ruft of lead, or lead diffolved with vinegar; much ufed by painters. See Lead, and Cerusse.

White *Leaf*. See Cratægus.

White *Line*, among *Printers*, a void fpace, greater than ufual, left between two lines. See Printing.

White *Line*, in *Anatomy*. See Linea *Alba*.

White *Linen* is cloth of hemp, or flax, bleached by divers leys, and waterings on the ground.

White *Manganefe*, in *Mineralogy*, manganefe oxydé carbonaté, Hauy. Red manganefe ore of fome mineralogifts. This ore occurs of various colours, from yellowifh-white to rofe-red. See *Ores of* Manganese.

White *Meats* include milk, butter, cheefe, white pots, cuftards, and other foods confifting of milk, or eggs. Some add, alfo, fifh, veal, and chickens.

White *Mortar*. See Mortar.

White *Muft-Apple*, in *Rural Economy*, a very fine cider-fruit in field fruit-grounds. This, with the fox-whelp, redftreak, and fome others, are fine old fruits, but which are now going off, and afford the beft cider, when mixed in the mill: the proportions in which they are to be ufed have never, however, been defined, but depend probably a good deal on the quantity to be ground at the fame time.

White *Muftard*, in *Agriculture*, a fort of plant which is often cultivated in the field for the ufe of the feed in different places.

The beft fort of foil for it is that of the light loam, which fhould be well broken down and reduced by ploughing and harrowing. Some, on frefh broken up land, make a winter fallow for this crop.

It is moftly put in after a wheat-crop, but may fucceed others where the land is clean and well prepared. In Kent, they ftrike furrows about eleven or twelve inches apart, and then fow the feed, two or three gallons to the acre, in the month of March.

The culture of it while growing is to hoe it, and keep it free from weeds, to fet it out in the way of turnips, not too thick on the ground, as that draws up the plants weak. The crop is reaped about July. In fome cafes, it is laid in gavels or handfuls upon the ftubble, in the fame manner as cole-feed. It is ufually threfhed out on a fail-cloth in the field.

The produce differs from eight to twenty bufhels the acre.

It is a ticklifh fort of crop, as one frofty morning will kill it, and it is liable to be injured and eaten by the black caterpillar; but when it turns out well is very profitable.

It is faid not to exhauft the land much, which is greatly in its favour.

White *Nebbed-Crow*, a term provincially applied to the rook in fome cafes.

White *Order*. See Order.

White *Paper* is that intended for writing, printing, &c. in contradiftinction to *brown paper*, *marbled paper*, *blotting paper*, &c.

White, *Pearl*. See Pearl.

White *Pepper*. See Pepper.

White *Poplar*, in *Agriculture*, a tree of the poplar kind, in which the wood is foft, but convertible to various ufes in hufbandry, as it grows quickly and bears cropping well. It is beft grown in low fituations, where the foil is of a clayey nature. It is fometimes called the abele tree.

WHITE *Poppy*, a plant fometimes cultivated in the garden and the field for the ufe of the opium which is obtained from its juice by means of evaporation. It might be largely cultivated in many fituations with great advantage, as it contains this fubftance or principle in great abundance. See PAPAVER *Album*.

WHITE *Porcelain*. See PORCELAIN.

WHITE *Pot*, denotes milk or cream baked with the yolks of eggs, fine bread, fugar, and fpice, in an earthen pot.

The cooks furnifh us with a variety of difhes under this form and denomination: fuch are, Norfolk white-pot, Weftminfter white-pot, rice white-pot, &c.

WHITE *Pottery*. See POTTERY.

WHITE *Precipitate*. See *Carbonate of* MERCURY.

WHITE *Pyrites*, in *Mineralogy*; Fr. fulfuré blanc, Hauy. The colour of this ore when pure is of a tin-white colour, paffing into brafs-yellow and fteel-grey. It occurs in fmall octohedral cryftals varioufly modified, alfo ftalactitical and botryoidal. It is hard, brittle, and eafily frangible. It melts before the blow-pipe, giving out a fulphureous vapour; it then acts on the magnetic needle. It decompofes much eafier than common pyrites. It contains 46 parts of iron and 54 of fulphur. See PYRITES.

WHITE *Rent*, in *Rural Economy*, a rent or duty of 8*d*. payable yearly, by every tinner in the counties of Devon and Cornwall, to the duke of the latter, as lord of the foil. See BLANCH *Fermè*.

WHITE *Salt* is common or fea-falt dried and calcined by the fire, fo as not to leave any moifture therein. The chemifts call it *decrepitated falt*.

There are fome falts naturally white, and others that need to be whitened, either by diffolving and purifying them in fair water, which is afterwards evaporated; or by means of fire; or by the fun. See SALT.

WHITE *Salt*, a term applied to the fine purified falt, in contradiftinction to that of the rock kind. The former is faid in Chefhire to form a much more important object in the way of commerce than the latter. See SALT.

WHITE *Sauce*, a fort of fauce made of blanched almonds, and the breaft of a capon, pounded together with cloves, cinnamon, &c. We alfo hear of white broth, which is a fort of broth enriched with fack and fpices, having blanched almonds fcraped into it, and the whole thickened with the yolks of eggs, &c.

WHITE *Scour*. See SCOUR.

WHITE *Silver Ore*, in *Mineralogy*, an ore of filver always affociated with lead and antimony. (See SILVER *Ores*.) Dark white filver contains, according to Klaproth, 9.25 parts in the hundred of filver. Light white filver ore contains 20.40, affociated with the fame minerals as the dark ore, but in different proportions.

WHITE *Soap*. See SOAP.

WHITE, *Spanifh*, is a kind of fucus ufed by the ladies to whiten their complexion, and hide the defects of it, called alfo *magiftery of bifmuth*.

The ufe of this, as well as of ceruffes, is pernicious; and fhould be particularly avoided during the taking of any fulphureous water, which may change the complexion quite black. Indeed, all phlogiftic vapours, and even the fun itfelf, tend to give both the magiftery of bifmuth and ceruffe a yellow colour: an obfervation which ferves to explain a paffage in Martial, where a cerufed lady is faid to fear the fun.

"Cretata timet Fabulla, nimbum,
Cerufata timet Sabella, folem.
Ep. lib. ii. Ep. 41.

WHITE, *Spanifh*, is alfo a name given to troy white.

WHITE *Spurs*. See SPUR, and ESQUIRE.

WHITE *Star*, and *Sugar*. See the fubftantives.

WHITE *Stone*, in *Geology*; *Weifs ftein*, Werner; *Eurite* of fome French geologifts; a rock enumerated by Werner as a diftinct fpecies among the primary rocks. It is effentially compofed of felfpar, but contains mica and other minerals. We think it may fairly be doubted whether white-ftone ought to be confidered as a diftinct fpecies of rock, or only as an occafional mode in which gneifs and granite fometimes occur. According to the account given by M. Bonnard of the Saxon Erzgeberge, in the Journal des Mines, 1815, the gneifs of that diftrict often lofes its mica, and paffes into a rock effentially the fame as white-ftone or eurite. In other inftances, the granite, by lofing a great part of its mica and quartz, paffes into the fame rock, ftill retaining the geological pofition of granite, and including immenfe beds of granite within it. The north-weftern acclivity of the Saxon Erzgeberge is almoft entirely compofed of white-ftone, including maffes of granite, from a few feet to fome miles in extent. This rock forms the bafis on which the other rocks are placed. Bonnard gives the following defcription of white-ftone or eurite in the above diftrict:—It is compofed of very fine granular felfpar, which is fometimes compact, of a whitifh-grey or yellowifh-grey colour; the mica is brownifh. It occurs in layers, and is fometimes fiffile when the mica is abundant. In this cafe, the felfpar is almoft as friable as dolomite. When the felfpar is compact, and the mica more rare, the rock nearly lofes its fiffile property. This rock contains fappare and other minerals diffeminated. The rock on which it refts is unknown, as the white-ftone ferves as a bafis for the gneifs and other rocks. In the greater part of the diftrict a granitic rock occurs in the white-ftone, which is fometimes a true granite and fometimes a granular eurite. This granite is compofed of felfpar, which is rarely of a red colour, but often brown, which is alfo generally the colour of the mica; the proportion of the quartz is variable, and fometimes is entirely wanting. In the few places where the two rocks can be feen together, the granite appears not only to alternate with the eurite, but to pafs into it; or rather the two rocks may be faid to pafs infenfibly into each other, both in the fmall and large maffes. The grain of the granite is often very fine; but near Penig it contains cryftals of felfpar of a foot in cubic fize. The only beds which occur in the white-ftone are of ferpentine; thefe are in the upper part of it, and dip to the north. There have been no metallic veins difcovered in the white-ftone rock. From the above defcription, there can be little doubt that white-ftone ought, when viewed geologically on a large fcale, to be confidered only as a particular form of granite arifing from the diminution of the quartz and mica. The circumftances, whatever they may have been, which firft difpofed the granite to folidify, permitted the conftituent parts to arrange themfelves in different proportions in various parts of the mafs. Thus in extenfive granite formations, nothing is more frequent than to fee the quartz and felfpar collected in large maffes nearly pure, or with a very fmall admixture of the other component parts; and in the white-ftone of Saxony precifely the fame facts are exhibited on a larger fcale. See ROCKS, STRATA, and SYSTEMS *of Geology*.

WHITE *Styre Apple*, in *Rural Economy*, a rich cider-fruit in field orchards. It is faid to be the boaft of the foreft diftrict in Gloucefterfhire, and that under proper management, it affords a cider fo rich and ftrong, that it is often valued equally with foreign wine, and fold at extravagant prices.

WHITE-*Swelling*, in *Surgery*. When a difeafe is attended with great varieties, not only with regard to its progrefs and fymptoms, but alfo its caufe, and the diforder which it produces in the parts which are the feat of it, there is as much difficulty in fixing upon a name that will convey an exact idea of it, as in offering a definition or defcription of it applicable to all the cafes which may prefent themfelves to the attentive obferver. Such are the circumftances of the difeafe of which we are about to fpeak in the prefent article. Surgeons have given it a variety of appellations, derived from fome one particular fymptom with which it is accompanied. Thus, it has been called *white-fwelling*, (a name which is ftill moft generally adopted,) becaufe the fkin which covers it retains its natural colour, and exhibits no appearance of inflammation. It is alfo fometimes termed *fungus articuli*, on account of its foftnefs and elafticity, which allow it readily to yield to preffure, but make it rife up again immediately when the compreffion is difcontinued, like the fungous excrefcences which grow upon the oak. The diforder is likewife often named by foreign writers the *lymphatic tumour*, or *ferous fwelling of the articulations*, in confequence of the great quantity of thick lymph which appears to be effufed in the cellular fubftance around the ligaments, and upon the ligaments themfelves. Sometimes the difeafe is called *fpina ventofa*. (See that article.) The cafe is occafionally denominated a *falfe anchylofis*, becaufe the difeafe caufes more or lefs interruption of the motions of the joint. Laftly, the diftemper is often called a *rheumatic*, or *fcrofulous difeafe of a joint*, according as rheumatifm, or fcrofula, is fufpected of being concerned in its origin.

White-fwellings are ufually defined to be chronic enlargements of the joints; circumfcribed; without any alteration in the colour of the fkin; fometimes hard, and refifting the preffure of the fingers; fometimes lefs firm, elaftic, yielding to preffure, and afterwards rifing up again in the manner of a fungus, which grows upon certain trees; fometimes fo foft as to prefent a deceitful feel of fluctuation, although there is no fluid in the part. In particular inftances, thefe fwellings are indolent; but, moft frequently, they are attended with great pain, efpecially when the joint is moved, fo that the patient either cannot exercife the limb at all, or does it at the expence of confiderable fuffering, and with imperfection and difficulty. The difeafe has its feat in the ligaments, cellular fubftance, fynovial glands, cartilages, and even the bones. All thefe parts, however, are not affected in every inftance; and fometimes the diftemper commences in the bones; fometimes in the cartilages and ligaments, according to the peculiarity in the nature of the cafe. The foregoing definition is obvioufly merely an enumeration of the principal fymptoms of white-fwellings, and is far from giving an exact idea of a difeafe which prefents fo many varieties in different individuals, that there are fcarcely two patients to be met with in whom the complaint follows precifely the fame courfe, or exhibits altogether fimilar phenomena.

There is no joint which may not be attacked by this inveterate difeafe; but experience proves, that the ginglymoid articulations are more frequently affected than the orbicular. We are, however, to except from this remark the articulation between the femur and os innominatum, in which the difeafe is very common, and often called by the French furgeons *fpontaneous diflocation of the femur*, becaufe the cafe generally terminates in a difplacement of the head of the thigh-bone. (See HIP-*Joint*, *Difeafe of*.) Amongft the ginglymoid joints, the knee is oftener affected than any other. Then come the joints of the elbow, foot, and hand. White-fwellings attack the fmall joints, like thofe of the fingers and toes, with far lefs frequency.

White-fwellings may occur at every period of life; but they are more common in infancy and youth than in adults and old fubjects. It is conceived alfo by fome writers, that thefe cafes begin more frequently in autumn and winter, or when the atmofphere is damp and variable, than in the other feafons. But the difeafe is on the whole fo common in this climate, that it muft be difficult to eftablifh the truth of the foregoing conjecture.

The difeafe fometimes begins with a more or lefs acute pain in the articulation, ufually extending along the fafciæ and tendons of the neighbouring mufcles. Sometimes the pain is of a dull kind, being fuperficial, feated in the foft parts, and reaching all round the joint. On other occafions, it is acute, deeply fituated, and confined to a fmall fpace, which is moftly the very centre of the articulation. In particular examples, the fwelling of the joint fucceeds a pain which has been experienced in another part of the body, and fuddenly ceafed. Sometimes the difeafe begins in fo unexpected a manner, that the patient, who went to bed perfectly well, rifes in the morning with a ftiff painful knee. Cafes of the latter kind are generally rheumatic.

Whatever may be the manner in which the complaint originates, and whatever the circumftances which precede the attack, it always comes on in the form of a tumour, which prefents the following characters:—The fwelling feldom reaches all round the articulation; but is almoft always limited to a more or lefs extenfive portion of the circumference of the part. In the knee, it occurs above the patella, and alfo below this bone, at the fides of the ligament, which connects it with the tibia. In the elbow, it chiefly occupies the fides of the joint, efpecially the inner fide. In the ankle, it takes place below and behind the malleoli. Laftly, in the fingers, it commonly affects the whole circumference of the difeafed joint. Such fwelling is circumfcribed, immoveable, and more or lefs hard and elaftic, not retaining the impreffion of the finger, as in œdema (fee ŒDEMA), but generally communicating, when handled, a fenfation of foftnefs, which leads to a fufpicion of the prefence of a fluid, when none in reality exifts. The fwelling is more or lefs painful, efpecially when compreffed. Sometimes, however, it is indolent; the heat of the part is not increafed, and the integuments continue of their natural colour. The motion of the joint is impeded, and if the patient will not abftain from moving the part, he is put to excruciating pain. There are fome white-fwellings of the knee, in which the leg is fixed in the extended pofture; but, moft commonly, the limb is bent, even in a confiderable degree, and when an endeavour is made to ftraighten it, great fuffering is excited. In white-fwellings of the elbow, the fore-arm is conftantly obferved in a ftate of flexion. In thofe of the wrift, the hand has a ftrong propenfity to fall into the bent pofition; and in order to prevent this occurrence, and hinder an incomplete luxation of the carpus from taking place backwards, the furgeon is fometimes obliged to fupport the hand upon a fplint.

The conftant flexion of the limb produces a confiderable retraction of the flexor mufcles and their tendons, together with a rigidity which can be felt through the integuments, which are raifed up by the finews fo affected. The total lofs of exercife always arifing from this ftate of the mufcles and tendons, generally foon renders the joint ftiff and motionlefs, fo that it frequently has the appearance of being in a ftate of real and complete anchylofis. See ANCHYLOSIS.

The ſwelling may remain a long while in the condition which has been deſcribed; it may even ceaſe to be painful; and it may cauſe only a ſerious weakneſs of the knee, and more or leſs difficulty in walking. But moſt commonly it continues to make uninterrupted progreſs; or, if its advances ſhould happen to be checked, and the diſeaſe be for a time ſtationary, it frequently occurs, that, in conſequence of a fall, a bruiſe, or even without any external cauſe, and, as it were ſpontaneouſly, the complaint afterwards increaſes again. The articulation ſwells more and more, and, if it be the knee which is affected, the hollow of the ham alſo ſwells up and becomes effaced. The pain likewiſe augments, being felt ſometimes at one point of the circumference of the joint, ſometimes at another; occaſionally in the ham, and, in other examples, in the very cavity of the articulation. There are, however, ſome patients who ſeem to ſuffer little or no pain of any conſequence. The hardneſs of the tumour is ſubject to great variety. The older the diſeaſe is, the more conſiderable is in general the degree of induration. Yet there are certain white-ſwellings which are extremely hard, although they have not exiſted a long while; and other caſes which are very ſoft, notwithſtanding they are of long ſtanding. Boyer thinks, that this difference depends upon the ſeat of the diſeaſe, which is ſometimes in the bones; ſometimes in the ligaments and ſurrounding cellular membrane. The ſkin which covers the ſwelling grows thin, pale, and ſhining; the cutaneous veins become dilated and varicoſe; and the muſcles of the leg waſte and dwindle away, ſo that the ſize of this part of the limb is ſtrikingly diminiſhed. Sometimes, however, it is affected with œdema, and has the appearance of being enlarged. The lower part of the thigh alſo frequently undergoes a very conſiderable diminution. This waſting of the limb above and below the diſeaſe, makes the joint alſo ſeem much more ſwelled than it is in reality. Sometimes the lymphatic glands in the groin become enlarged and hardened; and when the diſeaſe makes much progreſs, the bones are frequently ſoftened and carious, and the cartilages deſtroyed. Laſtly, abſceſſes, more or leſs conſiderable, are formed in different parts of the tumour; and their formation is attended with a great deal of acute pain, inflammation, and fever. Theſe abſceſſes are more or leſs deeply ſituated, and often communicate with the interior of the joint. When they burſt, or are opened, a large quantity of matter is diſcharged, which is hardly ever of healthy conſiſtence, being moſtly a ſero-purulent yellowiſh fluid, ſomewhat reſembling turbid whey, and containing flakes of albumen. Sometimes, however, it preſents very nearly the appearances of healthy pus; but it ſoon changes into a thin fetid ſanies of very bad quality. Its diſcharge, although very conſiderable, is followed by ſcarcely any perceptible diminution in the ſize of the ſwelling. The openings by which it eſcapes ſometimes ſoon cloſe, and freſh collections of matter enſue which burſt of themſelves, and then heal up like the former; but, in general, the apertures, inſtead of healing, become converted into incurable fiſtulæ.

Mr. Brodie has paid conſiderable attention to the ſeveral diſeaſes of the joints, which uſually go under the name of white-ſwelling. In particular, he has carefully examined the morbid appearances which are found upon diſſection; and his obſervations have led him to propoſe a claſſification of theſe diſeaſes.

1. The firſt caſe which Mr. Brodie deſcribes is, *inflammation of the ſynovial membrane*, which may occur as a ſymptom of a conſtitutional diſeaſe, where the ſyſtem is affected with rheumatiſm; where mercury has been improperly exhibited, or in large quantities; or where there is general debility from any other cauſe. But, in theſe caſes, the inflammation is ſeldom ſevere; it occaſions an effuſion of fluid into the joint, but rarely terminates in the extravaſation of coagulating lymph, or thickening of the inflamed membrane. Sometimes it leaves one joint to attack another; or, it ſuddenly ſubſides without another joint becoming affected.

At other times, ſays Mr. Brodie, the inflammation occurs as a local affection produced by a ſprain, the application of cold, or ariſing from no evident cauſe. It is then, for the moſt part, more ſevere, and of longer duration; it leaves the joint with its functions more or leſs impaired, and occaſionally terminates in its total deſtruction. In itſelf, it is a ſerious diſeaſe; but it is often confounded, under the general name of white-ſwelling, with other diſeaſes ſtill more ſerious. In ſome caſes, it aſſumes the form of an acute; but in the greater number of inſtances, it has that of a chronic inflammation.

When the caſe is acute, the ſkin is in general red, and the joint tender and painful. The pain, which is not confined to any particular point, and aggravated by motion of the limb, is ſoon followed by ſwelling. The patient is alſo affected with inflammatory fever. In a few days, the diſeaſe either ſubſides altogether, or aſſumes the chronic form.

According to Mr. Brodie, when the inflammation is chronic, the pain and tenderneſs are leſs, ſo that the patient is able to walk about, and often without experiencing any ſevere diſtreſs. There is no fever, and the ſkin retains its natural colour. The ſwelling alſo increaſes leſs rapidly than in acute caſes. Theſe ſymptoms are generally rendered worſe by expoſure to cold and exertions. In the firſt inſtance, the ſwelling of the joint ariſes entirely from a preternatural quantity of ſynovia. But when the inflammation has exiſted ſome time, the fluid is not ſo plainly perceptible, becauſe the ſynovial membrane is now thickened, which likewiſe augments the ſtiffneſs of the articulation. The ſhape of the ſwelling is not that of the articulating ends of the bones, but ariſes chiefly from the diſtended ſtate of the ſynovial membrane, and hence depends in a great meaſure on the ſituation of the ligaments and tendons, which reſiſt it in certain directions. Thus, when the knee is affected, the ſwelling is principally obſervable in the ſame places where it occurs in caſes of hydrops articuli.

After the inflammation of the ſynovial membrane has ſubſided, the fluid is abſorbed, and, in ſome inſtances, the joint recovers its natural figure and mobility; but in the majority of caſes, the ſtiffneſs and ſwelling continue. Whenever the patient is expoſed to cold, or exerciſes the limb much, the pain returns, and the ſwelling is increaſed. Such caſes are of frequent occurrence, and, as Mr. Brodie obſerves, they form a large proportion of thoſe diſeaſes which are called white-ſwellings.

Long-continued and neglected inflammation of the ſynovial membrane ſometimes terminates in the formation of an abſceſs in the joint, in ulceration of the cartilages, and deſtruction of the articular ſurfaces. Medico-Chir. Tranſ. vol. v. p. 240, &c.

2. The ſame gentleman has favoured the public with a very circumſtantial hiſtory of another deſcription of caſes, where the diſeaſe originates in the ſynovial membrane, which loſes its natural organization, and becomes converted into a thick pulpy ſubſtance of a light brown colour, interſected by white membranous lines, and from one-fourth to one-half of an inch, or more, in thickneſs. As this diſeaſe advances, it involves all the parts of which the joint is compoſed, producing ulceration of the cartilages, caries of the

 bones,

bones, wasting of the ligaments, and abscesses in different places. The complaint has invariably proved slow in its progress, and sometimes has remained nearly in an indolent state for many months, or even for one or two years; but Mr. Brodie informs us, that he has never met with an instance in which a real amendment was produced, much less a cure. (See Medico-Chir. Trans. vol. iv. p. 220, &c.) Mr. Brodie also remarks, that the above-described affection of the synovial membrane is rarely met with, except in the knee, and that it generally takes place in young persons under, or not much above the age of puberty. In the origin of this disease, there is a slight degree of stiffness and tumefaction, without pain, and producing only the most trifling inconvenience. These symptoms gradually increase, so that, at last, the joint scarcely admits of the smallest motion, the stiffness being greater than what is the usual result of common inflammation. The form of the swelling bears some resemblance to that in cases of inflammation of the synovial membrane; but it is less regular. The swelling is soft and elastic, and gives to the hand a sensation as if it contained fluid. If only one hand be employed in making the examination, the deception may be complete, and the most experienced surgeon may be led to suppose that there is fluid in the joint when there is none; but if both hands be employed, one on each side, the absence of fluid is distinguished by the want of fluctuation.

"The patient experiences little or no pain, until abscesses begin to form, and the cartilages ulcerate; and even then the pain is not so severe as where the ulceration of the cartilages occurs as a primary disease, and the abscesses heal more readily, and discharge a smaller quantity of pus than in cases of this last description. At this period, the patient becomes affected with hectic fever, loses his flesh, and gradually sinks, unless the limb be removed by an operation." See Brodie's Obs. in Medico-Chir. Trans. vol. v. p. 251, &c.

3. Another form of white-swelling described by the same writer, is that which is more particularly characterized by ulceration of the articular cartilages. This change occurs in the advanced stage of several diseases of the joints, and it also exists in many instances as a primary affection, in the early stage of which the bones, synovial membrane, and ligaments, are in a natural state; but which, if neglected, ultimately occasions the entire destruction of the articulation. When ulceration of the cartilages occurs in the superficial joints, it constitutes one of the diseases which have been known by the name of white-swelling. From cases which Mr. Brodie has seen, he is led to conclude, that when it takes place in the hip it is this disease, which has been variously designated by writers, the "*morbus coxarius*," the "*disease of the hip-joint*," the "*scrofulous hip*," the "*scrofulous caries of the hip-joint*," &c. At least, Mr. Brodie conceives, that it is to this disease such names have been principally applied, though he acknowledges that there are probably other morbid affections which have been confounded with it. (Op. Cit. vol. iv. p. 236.) The ulceration of the articular cartilages takes place as a primary disease, chiefly in children or adults under the middle age. "Of sixty-eight persons affected with this disease, fifty-six (according to Mr. Brodie) were under thirty years of age: the youngest was an infant of about twelve months; the oldest was a woman of sixty." As the knee is more frequently affected with inflammation of the synovial membrane, so is the hip more liable than other joints to ulceration of the cartilaginous surfaces. In general, the disease is confined to a single joint; but it is not very unusual to find two or three joints affected in the same individual, either at the same time or in succession. Sometimes the patient traces the beginning of his symptoms to a local injury, or to his having been exposed to cold; but, for the most part, no cause can be assigned for the complaint. See Medico-Chir. Trans. vol. vi. p. 319.

For a description of the disorder as it occurs in the hip, the reader is referred to the article HIP-*Joint, Disease of*. At present, we shall merely notice the symptoms which, according to the investigations of Mr. Brodie, particularly characterize ulceration of the cartilages of the knee. They differ from the symptoms of inflammation of the synovial membrane, by the pain being slight in the beginning, and gradually becoming very intense, which is the reverse of what happens in the latter affection. The pain also in the commencement is unattended with any evident swelling, which never comes on in less than four or five weeks, and often not till after several months. It is not to be inferred, however, that every slight pain of the joint unaccompanied with swelling, must of course arise from ulceration of the cartilages. But, says Mr. Brodie, when the pain continues to increase, and at last is very severe; when it is aggravated by the motion of the bones on each other; and when, after a time, a slight tumefaction of the joint takes place, we may conclude that the disease consists in such ulceration. The swelling arises from a slight inflammation of the cellular membrane on the outside of the joint; it has the form of the articulating ends of the bones; and for the most part it appears greater than it really is, in consequence of the muscles being wasted. No fluctuation is perceptible, as where the synovial membrane is inflamed; nor is there the peculiar elasticity, which exists, where the synovial membrane has undergone a morbid alteration of its structure.

Mr. Brodie, however, has explained, that, in some cases, the swelling has a different shape, and communicates the feel of a fluctuation. This happens when inflammation of the synovial membrane, attended with a collection of the synovia of the joint, or abscesses in the surrounding soft parts, or in the articulation itself, occur as secondary diseases. When there has been considerable destruction of the soft parts from abscesses and ulceration, the head of the tibia may become dislocated and drawn towards the ham. See Medico-Chir. Trans. vol. vi. p. 326, &c.

4. There is another species of white-swelling which is peculiarly different from others, in being attended with ulceration of the synovial membrane. As, however, it does not appear to us to need a description in a work not expressly devoted to surgery, we shall only add, that the reader may find Mr. Brodie's account of the case in the Medico-Chir. Transactions. Those white-swellings which are reputed to be scrofulous, form a subject, however, on which we cannot be silent. In the scrofulous diseases of the joints, the bones are primarily affected, in consequence of which ulceration takes place in the cartilages covering their articular surfaces. The cartilages being ulcerated, the subsequent progress of the disease is, according to Mr. Brodie, the same as where this ulceration takes place in the first instance.

It has been a very prevalent opinion, that, in cases of white-swelling, the heads of the bones are always enlarged. Mr. Russell is, perhaps, the first writer who expressed an opposite sentiment, and he absolutely declares, that he had never heard nor known of an instance, in which the tibia was enlarged from an attack of white-swelling. (On Diseases of the Knee, p. 37.) We believe, that a regular expansion of the heads of the bones, in cafes of white-fwelling, is far from being an ufual occurrence, although it may fometimes happen. It is frequent, however, to meet with a fort of enlargement, which arifes from fpiculæ of bony matter, depofited on the outfide of the tibia, ulna, &c., which alteration is materially different from a regular expanfion of the heads of thofe bones. We have, however, lately feen an inftance, in which the upper head of the ulna is confiderably increafed in fize by a regular kind of expanfion. The preparation is in Mr. Abernethy's mufeum; and a few other fpecimens have, we believe, been occafionally noticed. Yet, as a general fact, we may ftill remark, that an enlargement of the heads of the bones in the difeafes called white-fwelling, is far from being the ufual ftate of things. The change which the head of the tibia undergoes in many cafes, is firft a partial abforption of the phofphate of lime throughout its texture, while a foft kind of matter is fecreted into its fubftance. In a more advanced ftage, and, indeed, in that ftage which moft frequently takes place before the limb is amputated, there are deep excavations in the head of the bone, arifing from caries, and its ftructure is now fo foftened, that when a probe is preffed againft the carious part, it readily penetrates deeply into the bone.

Mr. Brodie alfo joins in the opinion, that the morbid affection has its origin in the bones, "which," he fays, "become preternaturally vafcular, and contain a lefs than ufual quantity of earth, while, at firft, a tranfparent fluid, and afterwards a yellowifh cheefy fubftance, is depofited in their cancelli. From the difeafed bone, veffels, carrying red blood, fhoot into the cartilage, which afterwards ulcerates in fpots, the ulceration beginning on that furface which is connected to the bone." Med. Chir. Tranf. vol. iv. p. 272.

With refpect to the expanfion of the heads of the bones, we ought to have mentioned, that the late Mr. Crowther entirely difbelieved the reality of the occurrence, and every body knows, that he paid very confiderable attention to the fubject. (See Pract. Obf. on White-Swelling, &c. edit. 2. p. 14.) The event, however, fhould have been defcribed as unufual, and not as never happening, fince, as we have already ftated, a few fpecimens of fuch a change have now been collected.

Mr. Ruffell has particularly noticed how much the foft parts frequently contribute to the fwelling: "the great mafs of the fwelling," he obferves, "appears to arife from an affection of the parts exterior to the cavity of the joint, and which, befides an enlargement in fize, feem alfo to have undergone a material change in ftructure. There is a larger than natural proportion of a vifcid fluid, intermixed with the cellular fubftance; and the cellular fubftance itfelf has become thicker, fofter, and of a lefs firm confiftence than in a ftate of health." (On the Morbid Affections of the Knee, p. 30.) The manner in which the foft parts are affected is alfo defcribed by Mr. Brodie. "Inflammation takes place of the cellular membrane, external to the joint. Serum, and afterwards coagulable lymph, are effufed; and hence arifes a puffy elaftic fwelling in the early and an œdematous fwelling in an advanced ftage of the difeafe. Scrofula attacks only thofe bones, or portions of bones, which have a fpongy texture, as the extremities of the cylindrical bones, and the bones of the carpus and tarfus; and hence the joints become affected from their contiguity to the parts which are the original feat of the difeafe." Med. Chir. Tranf. vol. iv. p. 273.

All white-fwellings which make confiderable progrefs, and occafion fevere pain, long confinement, abfceffes, &c. unavoidably bring on that impairment of the general health, which is well known by the name of hectic fever. The patient gradually lofes his appetite and natural reft and fleep; his pulfe is fmall and frequent; an obftinate debilitating diarrhœa, and profufe nocturnal fweats, enfue. Such complaints are fooner or later followed by diffolution, unlefs the conftitution be relieved in time, either by the amendment or removal of the difeafed part. In different patients, however, the courfe of the difeafe, and its effects upon the fyftem, vary confiderably in relation to the rapidity with which they occur.

Rheumatic white-fwellings are very diftinct difeafes from the fcrofulous diftemper of the large joints. In the firft, the pain is faid never to occur without being attended with fwelling. Scrofulous white-fwellings, on the other hand, are always preceded by a pain, which is particularly confined to one point of the articulation. In rheumatic cafes, the pain is more general and diffufed over the whole joint.

It feems probable, that all cafes in which the ftructure of the bones is found quite undifeafed, and in which all the mafs of difeafe appears to be confined to the foft parts, are not fcrofulous white-fwellings. Few perfons who have attained the age of five-and-twenty, without having had the leaft fymptom of fcrofula, ever experience, after this period of life, a firft attack of the white-fwelling of the ftrumous kind. All cafes, in which the internal ftructure of the heads of the bones becomes foftened, are probably fcrofulous.

Mr. Ruffell has noticed the frequent enlargement of the lymphatic glands in the groin, in confequence of the irritation of the difeafe when in the knee; but, he juftly adds, that this fecondary affection never proves long troublefome.

When the bones are difeafed, the head of the tibia always fuffers more than the condyles of the thigh-bone. (*Ruffell.*) The articular furface of the femur fometimes has not a fingle rough or carious point, notwithftanding that of the tibia may have fuffered a great deal. The cartilaginous coverings of the heads of the bones are generally eroded firft at their edges; and in the knee, the cartilage of the tibia is always more affected than that covering the condyles of the thigh-bone. Indeed, when white-fwellings have their origin in the bones, and the knee is the feat of the diforder, there is fome ground for fuppofing that it is in the tibia that the morbid mifchief firft commences.

The ligaments of the knee are occafionally fo much weakened or deftroyed by this terrible malady, that the tibia and fibula become more or lefs diflocated backward, and drawn towards the tuberofity of the ifchium, by the powerful action of the flexor mufcles of the leg.

We have feen a curious fpecies of white-fwelling, in which the leg could be moved to each fide a very confiderable diftance, both when the knee was extended and bent. Such a ftate implies a preternatural loofenefs of the ligaments of the articulation.

Scrofulous white-fwellings, no doubt, are under the influence of a particular kind of conftitution, termed a fcrofulous or ftrumous habit. In this fort of temperament, every caufe capable of exciting inflammation, or any morbid and irritable ftate of a large joint, may bring on fuch diforder as may end in the fevere difeafe of which we are now fpeaking.

In a man of a found conftitution, an irritation of the kind alluded to might only induce common healthy inflammation of the affected joint.

In fcrofulous habits, it alfo feems probable, that irritation

tion of a joint is much more eaſily produced than in other conſtitutions; and no one can doubt, that when once excited in the former claſs of ſubjects, it is much more dangerous and difficult of removal than in other patients.

The doctrine of particular white-ſwellings being ſcrofulous diſeaſes, is ſupported by many weighty reaſons, the opinions of the moſt accurate obſervers, and the evidence of daily experience. Wiſeman (book iv. ch. 4.) calls the ſpina ventoſa a ſpecies of ſcrofula, and tells us, that infants and children are generally the ſubjects of this diſeaſe. The diſorder is ſaid by Severinus to be exceedingly frequent in young ſubjects. Petrus de Marchettis has obſerved both male and female ſubjects affected with what are called ſtrumous diſeaſes of the joints, as late as the age of five-and-twenty; but not afterwards, unleſs they had ſuffered from ſcrofula before that period of life, and had not been completely cured. R. Lowerus alſo entertains a ſimilar opinion. Even though a few perſons may have ſcrofulous diſeaſes of the joints, for the firſt time, after the age of twenty-five, this occurrence, like the firſt attack of ſcrofula after this period, muſt be conſidered as extremely uncommon.

Another argument in favour of the doctrine, which ſets down particular kinds of white-ſwellings as ſcrofulous, is founded on the hereditary nature of ſuch forms of diſeaſe.

Numerous continental ſurgeons, particularly Petit and Brambilla, have noticed how very ſubject the Engliſh are both to ſcrofula and white-ſwellings of the joints. We every day ſee, that young perſons afflicted with the preſent diſeaſe, are generally manifeſtly ſcrofulous, or have once been ſo. Very often enlarged lymphatic glands in the neck denote this fatal peculiarity of conſtitution; very often the patients are known to have deſcended from parents who had ſtrumous diſorders. Crowther.

Beſides the general emblems of a ſcrofulous conſtitution, we may often obſerve a ſhining, coagulated flaky ſubſtance, like white of egg, blended with the contents of ſuch abſceſſes as occur in the progreſs of the diſeaſe. This kind of matter is almoſt peculiar to ſcrofulous abſceſſes, and forms another argument in ſupport of the foregoing obſervations relative to the ſhare which ſcrofula frequently has in the origin and courſe of many white-ſwellings. Cooper's Dict. of Practical Surgery.

The cauſes of white-ſwellings are divided by ſurgical writers into external and internal. Amongſt the former are reckoned mechanical injuries of the joints, ſuch as wounds, contuſions, ſprains, immoderate exerciſe in cold damp weather, reſiding continually in a low humid ſituation, &c. It is certain, however, that theſe tumours are ſeldom produced altogether by external cauſes; and even when their formation has been preceded by ſome external violence, this is rather to be regarded only as the determining cauſe of the diſeaſe, while the real cauſe in this, as well as in other caſes where the complaint begins ſpontaneouſly, is of an internal kind. Rheumatiſm and ſcrofula are the ordinary cauſes of white-ſwellings; and it may be alleged, without riſk of error, that more than three-fourths of theſe tumours are owing to theſe conſtitutional diſeaſes. Thoſe white-ſwellings which attack ſtrong plethoric ſubjects of adult age, commonly depend upon rheumatiſm; while other caſes which happen in children, are almoſt always cauſed by ſcrofula. It is well known that rheumatiſm is particularly diſpoſed to make its attack upon the large joints, and that it eſpecially affects the ligaments and neighbouring cellular ſubſtance, which it thickens and hardens, by cauſing an effuſion of coagulable lymph. Hence, ſays Boyer, in ſuch white-ſwellings as ariſe from rheumatiſm, theſe parts alone are found diſeaſed in the early ſtage of the complaint. Traité des Mal. Chir. t. iv. p. 501.

With reſpect to ſcrofula, every ſurgeon is aware that it frequently attacks the heads of the bones, particularly in children, occaſioning thoſe morbid changes which we have already endeavoured to deſcribe. We have likewiſe mentioned what is now generally admitted, that in white-ſwellings originating from ſcrofula, the diſeaſe commences in the bones, the ſoft parts becoming affected only ſecondarily. The contrary is ſaid to happen in all rheumatic caſes, the diſeaſe beginning in the ſoft parts, and only affecting the bones in a ſubſequent advanced ſtage of the complaint.

The prognoſis in caſes of white-ſwelling is, generally ſpeaking, unfavourable; but it is more or leſs ſo, according to the cauſe of the diſeaſe, its duration, the accompanying ſymptoms, the patient's conſtitution, &c. White-ſwellings ariſing from rheumatiſm are the leaſt alarming, eſpecially when they are recent. The progreſs of the complaint may then be often ſtopped, and ſometimes a perfect cure accompliſhed. In this kind of caſe, the joint ſometimes returns to its natural ſtate, and regains the power of freely performing every motion; while in other inſtances, it continues affected with a greater or leſſer degree of ſtiffneſs. White-ſwellings, which appear to depend altogether upon an external cauſe, in perſons in other reſpects healthy and ſound, may terminate well. The worſt white-ſwellings of all are thoſe which originate from ſcrofula; for they are very ſeldom cured, and when they do admit of amendment, the joint is always left in a ſtate of anchyloſis.

Whatever may be the cauſe of white-ſwellings, when they are of long ſtanding, ſeverely painful, the bones ſoftened and rendered carious, the cartilages ulcerated, the articulation filled with ſanious matter, and abſceſſes have formed, the openings of which continue fiſtulous, and emit a more or leſs abundant quantity of a thin fetid diſcharge, the diſeaſe is in general incurable. In this caſe, the violence of the pain, the hectic fever, the profuſe ſweats, and colliquative diarrhœa, plunge the patient into a ſtate of maraſmus, and ſoon carry him off, unleſs an attempt be made to ſave him by the timely performance of amputation. Yet, as Boyer obſerves, in ſome few caſes of this hopeleſs deſcription, nature, ſkilfully aſſiſted by art, has been known to ſubdue the diſeaſe. The ſuppuration then gradually diminiſhes and aſſumes a better quality, the ſlow fever, nocturnal perſpirations, and weakening diarrhœa, entirely ceaſe, the appetite returns, digeſtion is well performed, the ſtrength is reſtored, and the patient gets well with an anchyloſis. But ſuch fortunate caſes are extremely uncommon, and they do not juſtify us in leaving the diſeaſe to nature, inſtead of amputating the limb. Traité des Mal. Chir. t. iv. p. 505. 507.

Of all the diſeaſes which fall under the care of the ſurgeon, there is not one in which a greater variety of remedies has been propoſed than in white-ſwellings. Yet, notwithſtanding the numerous means which are occaſionally tried, the practitioner frequently has the mortification of finding, not only that he cannot accompliſh a radical cure, but that he cannot even palliate the complaint, moderate its violence, or retard its progreſs.

The ſurgeon, in order to be methodical, ſhould adapt the treatment to the particular form of the diſeaſe and its different ſtates. But, in every inſtance, perfect reſt of the limb is abſolutely indiſpenſable, as exerciſe always has the effect of keeping up pain and irritation, and doing harm, whatever may be the ſpecies of the diſeaſe.

Rheu-

Rheumatic white-ſwellings being invariably accompanied, at their commencement, with an inflammatory character, there can be no doubt, that, at this period of the complaint, the great indication is to take ſuch meaſures as are beſt calculated to leſſen and ſubdue inflammation; and bleeding is what ſhould firſt be practiſed. When the patient is ſtrong, robuſt, and much fever exiſts, he may be bled once or twice in the arm; but, in other caſes, we are to be content with drawing blood from the part affected with leeches, or by cupping. If leeches be uſed, they ſhould be applied to both ſides of the joint, and eight or ten ounces of blood ought to be thus taken away. The application of theſe animals ſhould alſo be repeated at proper intervals, more or leſs frequently, according to the violence of the ſymptoms, and the ſtrength of the patient. In caſes of this deſcription, drawing blood from the diſeaſed part itſelf is found to be much more efficacious than general blood-letting, which weakens the patient without proportionately leſſening the ſwelling of the joint.

Bliſters are another means, as efficacious as topical bleeding. Boyer recommends beginning with the application of a ſmall one to the front of the joint, where the leeches have not been put; and he ſays, that it ſhould be kept open, until the bites of the leeches are healed on one ſide of the articulation, where a ſecond bliſter is then to be applied. As ſoon as this is nearly healed, we are next adviſed to lay a third bliſter on the oppoſite ſide of the joint. By thus continually changing the ſituation of the bliſter from one ſide of the articulation to another, a permanent counter-irritation is kept up, which, ſays Boyer, in all deeply-ſeated inflammations, eſpecially thoſe which proceed from rheumatiſm, is much more effectual, than carefully maintaining a diſcharge from a ſingle bliſter.

In conjunction with the foregoing means, the limb ſhould be kept moderately and uniformly warm by covering it with flannel; a low diet is to be obſerved, cooling beverages preſcribed, and the action of the bowels regulated by clyſters. Thus, the ſeverity of the pain may generally be leſſened, and the inflammation diminiſhed. If the pain, however, ſhould ſtill continue to be violent, Boyer recommends the uſe of topical anodyne and narcotic applications. He ſtates, that, in this circumſtance, he has often employed with ſucceſs opiate and camphorated liniments; fomentations compoſed of a ſolution of the extract of opium in water; a ſtrong decoction of poppies, &c. He thinks, however, that ſuch applications ſhould never be uſed, unleſs the pain be very ſevere.

When the inflammatory ſtage is over, topical reſolvent remedies are to be employed, and their effect is to be promoted by exhibiting mild opening medicines at ſuitable intervals. The moſt effectual reſolvent applications, and thoſe which are moſt commonly tried in theſe caſes, are, dry frictions with a piece of flannel, impregnated with the vapour of benzoin, liniments containing ammonia and camphor, ammoniacal plaſters, ſoap-liniment, lotions of vinegar, ſpirit of wine, and the muriate of ammonia, &c. Mr. B. Bell had a very high opinion of the good effects of rubbing the joint with camphorated mercurial ointment; but Boyer affirms, that he has often tried the laſt application, and that his experience leads him to impute whatever benefit ariſes from its employment, chiefly to the frictions, which redden and promote the circulation in the ſkin.

By a perſeverance in the judicious uſe of the means above ſpecified, rheumatic white-ſwellings may ſometimes be cured; but it often happens, that, after the pain and ſwelling have ſubſided, the joint remains quite ſtiff and motionleſs, and every attempt to move it cauſes conſiderable ſuffering. In the majority of caſes, ſuch ſtiffneſs depends almoſt entirely upon the retraction of the muſcles, tendons, and ligaments, and demands the ſame treatment as a falſe anchyloſis. See Anchylosis.

When the diſeaſe reſiſts the foregoing treatment, and is of long ſtanding, the cure is more difficult, inaſmuch as the thickening of the ligaments, and the effuſion of a ſero-albuminous fluid into the cellular ſubſtance around them, are more conſiderable, and the bones and cartilages are likewiſe at the ſame time affected. In this circumſtance, if there be any hope of cure, the ſurgeon muſt have recourſe to more powerful means, which we ſhall mention in ſpeaking of the treatment of other deſcriptions of white-ſwelling.

In white-ſwellings, ariſing from an external cauſe, ſuch as blows, falls, &c. we muſt firſt leſſen the inflammation by general and local bleeding, low diet, cooling aperient beverages, fomentations, and emollient anodyne poultices. Afterwards, when the pain and tenſion have ſubſided, reſolvent applications are to be uſed, and the patient is not to be allowed to move the limb, as long as there is any danger of a renewal of the pain and irritation by exerciſe.

Scrofulous white-ſwellings in an early ſtage preſent different indications, according to the circumſtances with which they are accompanied. A fall, or blow upon a joint, being ſometimes the exciting cauſe of theſe tumours, any accident of this kind in a perſon evidently diſpoſed to ſcrofula demands the utmoſt attention and care. No means ſhould be neglected which are at all likely to leſſen the pain and irritation in the affected joint, and in particular the limb ought to be kept perfectly quiet for a long time. Scrofulous white-ſwellings frequently come on, as it were, ſpontaneouſly, without the concurrence of any external accident, and their attack is attended with a dull, ſometimes an acute pain in the very cavity of the joint, which at firſt is not affected with any manifeſt degree of ſwelling. In this circumſtance, the ſurgeon muſt endeavour to prevent the progreſs of the diſeaſe by enjoining the patient to refrain from moving the joint, and by directing the employment of ſoothing local applications, which are afterwards to be ſucceeded by bliſters, or an iſſue.

In the caſes of white-ſwelling, which appear from Mr. Brodie's account to depend principally upon inflammation of the ſynovial membrane, the acute ſtage of the diſeaſe is to be treated by general and local bleeding, aperient medicines, cold topical applications, or fomentations, and emollient poultices. When the affection has become chronic, this gentleman recommends perfect reſt, and leeches, or cupping, followed by the application of a large bliſter. Under this treatment, he ſays, "the pain is relieved, and, in a few days, the ſwelling, as far as it depends upon the fluid collected in the cavity of the joint, is much diminiſhed. Even where the tumour is ſolid, ariſing from the effuſion of coagulating lymph, it will in a great meaſure ſubſide, and ſometimes be entirely diſperſed, provided the lymph has not yet become organized. A ſingle bliſter often produces marked good effects; but, it is generally neceſſary to repeat both the bliſter and the blood-letting ſeveral times." Mr. Brodie conſiders the repeated application of bliſters more efficacious, than a ſingle bliſter kept open with the ſavine cerate. When the inflammation has been much ſubdued, he thinks moderate exerciſe of the joint rather beneficial, and commends the uſe of a ſtimulating liniment, compoſed of ℥iſs of olive oil, and ℥ſs of ſulphuric acid. This application, when too irritating, is to be weakened by an additional quantity of oil, and it is not to be uſed before in-

flammation

flammation is fubdued, left it aggravate the difeafe. Iffues and fetons, which are ufeful in ulceration of the cartilages, Mr. Brodie deems ufelefs in the prefent difeafe. Plafters of gum ammoniac, and others of a fimilar nature, are of little efficacy while inflammation exifts, but afterwards they are of ufe in guarding the joint from the influence of external cold, and preventing a relapfe. For the removal of a moderate degree of fwelling and ftiffnefs, left by the paft inflammation, Mr. Brodie entertains a favourable opinion of exercife of the limb, and friction with camphorated mercurial ointment, or by the hand with finely powdered ftarch. When the friction, however, produces inflammation again, it is to be difcontinued, and leeches applied. When the fwelling and ftiffnefs are confiderable, Mr. Brodie has never feen friction do much good, and, as it is in fuch cafes particularly apt to bring on inflammation again, it is to be employed with much caution. According to the fame author, friction is more efficacious, where the ftiffnefs of a joint depends on a contracted ftate of the mufcles, or tendons of the limb, or on thefe being glued to each other, or the furrounding parts, than where it is the confequence of difeafe of the joint itfelf. In fome cafes, the pumping of warm water on the part, from a height of feveral feet, as practifed at fome of the watering places, is beneficial; but in this plan, the fame cautions are neceffary, as in the employment of friction.

With regard to the cafes which Mr. Brodie defcribes as depending upon a total lofs of the natural ftructure of the fynovial membrane, which is converted into a pulpy fubftance, one-quarter, or one-half, of an inch in thicknefs, are, according to this gentleman, quite incurable, and they at length terminate in ulceration of the cartilages, abfceffes, &c. Hence, when the health begins to fuffer, he confiders amputation proper. See Medico-Chir. Tranf. vol. v.

When white-fwellings are accompanied with ulceration of the cartilages, all motion of the joint is extremely hurtful. Indeed, as Mr. Brodie well obferves, keeping the limb in a ftate of perfect quietude is a very important, if not the moft important circumftance to be attended to in the treatment. According to the fame writer, it is in thefe cafes, in which ulceration of the cartilage occurs as a primary difeafe, that cauftic iffues are ufually productive of fingular benefit; but he deems them of little ufe in any other difeafes of the joints. He thinks fetons, and blifters kept open with the favine cerate, may alfo be ufed with advantage in the fame defcription of cafes. Bleeding can only be proper, when, from the bad effects of exercife, the articular furfaces are inflamed, and pain and fever prevail. Mr. Brodie affures us, that the warm-bath relieves the fymptoms in the early ftage, if it does not ftop the progrefs of the difeafe; but he condemns plafters of gum ammoniac, embrocations, liniments, and frictions, as either ufelefs or hurtful. Op. Cit. vol. vi.

The pumping of warm water upon difeafed joints is a method which is at prefent very frequently adopted, as fome conceive, with decidedly beneficial effects. The plan is not altogether modern. Le Dran, and feveral other old practitioners, recommend throwing warm water upon difeafed joints, and they prove the advantages of this treatment by a relation of many fuccefsful cafes. In order to derive the greateft poffible good from the plan, the water fhould be as warm as the patient can bear it, and it ought to fall upon the part from a height of feven or eight feet. The fize of the ftream muft alfo vary according to the degree of fenfibility in the tumour. When the pain is acute, the end of the pipe muft be clofed with a piece of tin, perforated by many holes, like the fpout of a watering-pot. But when the pain is inconfiderable, the pipe may terminate in a fingle opening, the diameter of which fhould vary from half an inch to an inch, according to circumftances. The application is fometimes to be continued nearly an hour, and when it is finifhed, the patient ought to go to bed, and the joint be covered with bladders filled with water as hot as the patient can bear. Boyer recommends the application of the bladders to be perfevered in for the fpace of two hours, after which they are to be removed, and perfpiration from the part promoted by covering it with warm cloths, or flannels. In the evening, the bladders are to be repeated for fome hours. The dafhing of warm water againft the difeafed joint is to be practifed every day, or every other day, according as the patient can bear the plan, without too much fatigue or inconvenience. This treatment, fays baron Boyer, is proper in all kinds of white-fwellings, and in every ftage of the difeafe; but it is much the moft ufeful in thofe cafes in which the foft parts alone are affected, and at an early period, before the complaint has made great progrefs. Favourable effects may be expected from this method, when, after each application of the water, the part affected perfpires copioufly, when it grows gradually fofter, and when, after a certain number of trials, the fwelling begins to diminifh. Under thefe circumftances, the plan is to be continued and repeated very often, as a long perfeverance in it has frequently produced extraordinary cures. When none of the above-defcribed changes happen, little benefit can be hoped for from the method; but ftill the patient fhould not abandon it, before its inefficacy has been proved by adequate trials.

When there is no fuitable apparatus for applying the warm water, it may be injected againft the part with a large fyringe, which has a pipe about half an inch in diameter, made with four or five holes, for the difcharge of the fluid. The injections may be rendered more or lefs active, by propelling the water with more or lefs force.

Thefe affufions operate only by the heat and ftrength of the current of water. Boyer ftates, that their activity may be augmented by adding to the fluid a quantity of the muriate of foda or muriate of ammonia, or fome potaffa or foda; and he thinks it ftill better to employ a fulphuretted mineral water, either natural or factitious. The activity of the affufions may alfo be increafed by heating the water to a high temperature, letting it fall from a confiderable height, and making the ftream large. It is a plan, fays baron Boyer, adapted to thofe white-fwellings which are fituated in the foft parts on the outfide of the joints; and which are indolent, and unattended with much pain. When thefe active affufions are applied to white-fwellings which are painful, and which affect the bones, they often increafe the patient's fufferings, and accelerate the progrefs of the difeafe. See Traité des Mal. Chir. tom. iv. p. 512, &c.

Of late years, furgeons have frequently made trial of dry-rubbing, as it is termed, or friction of the joint, performed with the hand, for feveral hours a day, with the mere application of a little powdered ftarch, or hair-powder, in order to prevent the part from being chafed. It is a method which was firft practifed to a confiderable extent at Oxford, and with great fuccefs. Many poor women there earned a livelihood by rubbing difeafed joints at the rate of fixpence *per* hour. Indeed, there can be no doubt, that, in indolent rheumatic white-fwellings, fimple friction often removes the fwelling in an expeditious manner, as well as the ftiffnefs of the affected joint. The plan, however, will not effect a cure in fcrofulous cafes; nor can it be adopted without manifeft harm

harm in any examples, in which the difeafe is either in an inflamed or irritable ftate.

In chronic cafes, the fwelling may alfo be leffened, and the complaint fometimes much benefited by preffure, made either with ftrips of adhefive plafter, or with bandages. This method will not do much good in inftances where the bones are difeafed, nor is it applicable to cafes which are irritable, or attended with heat and inflammation.

For fcrofulous white-fwellings, furgery cannot yet be faid to have difcovered any effectual or certain means of relief; and thefe melancholy difeafes frequently compel the patient to fubmit to amputation, as the only thing by which a long train of fufferings can be arrefted, and the term of life extended. The common plan of treating fcrofulous white-fwellings is, by topical bleeding, fomentations, and cold applications, when they are attended with much pain, heat, and irritation; and by iffues, fetons, and blifters, in other periods of the difeafe. The cautery and moxa have alfo been much employed abroad; and, as every body knows, they were favourite and powerful remedies in the hands of the ancients. In this country, the ufe of actual fire in furgery is nearly, if not quite, exploded, on the ground that its employment is attended with an appearance of cruelty, and that iffues, made with cauftic, are equally efficacious. Pouteau, an eminent French furgeon, will ever be famous for having revived in his own country all the ancient partiality to burning irons. He recommended their ufe for all white-fwellings without difcrimination; and the accounts which he has left of the fuccefs of the practice are furprifing, if not incredible. In fact, they are in all probability great exaggerations; for we find that baron Boyer, one of the moft eminent furgeons at Paris at the prefent time, decidedly declares his opinion, that Pouteau's defcriptions of the efficacy of the actual cautery in the cure of white-fwellings do not correfpond with the refults of modern experience. Boyer himfelf gives a preference to the moxa, which is a cone of cotton, burnt upon the difeafed part, fo as to produce an efchar. We confefs, that to us this plan feems to have no material difference from the cautery; and, what is it but the application of actual fire in another form? Indeed, one cannot help thinking, that Boyer decries the cautery, only for the purpofe of afterwards recommending the moxa, which is now a more fafhionable means employed in French furgery. It is curious to find Boyer particularly forbidding the ufe of iffues, and the moxa in cafes of white-fwelling, where the bones and cartilages are difeafed; the very cafes in which Mr. Brodie, in common with the generality of furgeons in England, exprefsly recommends either iffues or perpetual blifters. Boyer has never feen much good arife from iffues in any cafes, although, as he affirms, he has made extenfive trial of them. The time alfo when he thinks the moxa ufeful, is in that ftage of the complaint which intervenes between the prevalence of inflammatory fymptoms, and the commencement of difeafe in the bones and cartilages. Sometimes, however, the diforder certainly has its very origin in the bones themfelves.

The late Mr. Crowther introduced the plan of keeping open blifters with the favine cerate, which is a method frequently attended with great fuccefs in chronic white-fwellings, and fometimes appears to check the progrefs of the fcrofulous form of the difeafe. Blifters may be kept open with this ointment a long time, and with lefs pain, than what proceeds from the ufe of the unguentum lyttæ, and other ftimulating dreffings. It alfo occafions no rifk of bringing on ftrangury, or inflammation of the bladder and urinary organs, like the ufe of ointments containing cantharides. In our opinion, Mr. Crowther had much merit in making known the eligible qualities of the favine cerate; and, we believe, no better application for keeping up a difcharge from blifters will ever be found out. Sometimes, however, the repeated application of blifters has more effect upon white-fwellings, than a fingle blifter kept open. This is a circumftance which the practical furgeon ought conftantly to remember.

We might enlarge this article with obfervations on iffues and fetons, which are frequently employed in thefe cafes; but it would be fuperfluous, as they have been already defcribed in other parts of the work. See Issue, and Seton.

It may be fuppofed, that fcrofulous white-fwellings will require the exhibition of the remedies ufually adminiftered in cafes of fcrofula. (See Scrofula.) Boyer, and fome other writers declare, that this is actually the cafe. We have never feen thefe remedies, however, do any good to difeafed joints, if we except fea-air, fea-bathing, and the ufe of fea-water lotions and poultices, which fometimes prove ufeful.

After all, we muft acknowledge that white-fwellings, we mean particularly the inftances accompanied with ulceration of the cartilages, and difeafe of the heads of the bones, are cafes which too generally baffle the utmoft fkill, and render a formidable operation unavoidable.

White *Tail.* See Motacilla *Œnanthe.*

White *Tartar.* See Tartar.

White *Thorn.* See Cratægus.

White *Thorn*, or *Hawthorn.* See Hedge, and Quickset-*Hedge.*

White *Thorn Layer*, a term applied to fuch plants of the white thorn kind as are laid down in hedges to grow, in the operation of plafhing. Alfo to the young roots of this thorn ufed in raifing this fort of hedges. See Plashing *Hedges.*

White-*Throat*, in *Ornithology*, the name of a fmall bird, very common in our gardens and hedges, and feeming to have been defcribed under the name of *fpipola* by Aldrovandus and fome others, though moft approaching to the *ficedula* clafs.

Its beak is black above, and whitifh below; its feet of a yellowifh-brown; its neck and back are of a brownifh-grey; its head more grey than either, and the upper part of the throat white, the reft reddifh; its breaft and belly are alfo a little reddifh; but in the female, the breaft is perfectly white. The edges of the long wing-feathers are fome whitifh and others brownifh, and the tail is variegated with black and white, and fome grey or afh-colour intermixed. It is extremely common in our gardens and orchards in fummer, and feeds on flies, fpiders, and other infects, but leaves us in winter. It builds in bufhes, at a fmall height from the ground, with ftubble and horfe-hair, and lays five brownifh-green eggs, with black fpots. Its note is continually repeated, and often attended with odd motions of the wings: it is harfh and difpleafing. This bird is fhy and wild, and feems of a pugnacious difpofition. Ray and Pennant. See Motacilla *Sylvia.*

White *Trefoil*, in *Agriculture*, is faid, in the third volume of the Effays of the Highland Society of Scotland, to be a humble but fweet plant, which delights in a dry found field, properly cleaned and limed; and is alone the delight of fheep. But that a mixture of it, and of the feeds of rye and rib grafs, conftitutes one of the beft fheep-paftures that can be formed by the induftry of man. That this fort of grafs is likewife perennial, and that it enriches inftead of impoverifhing the foil or land. This has generally been noticed

noticed to be the moſt abundant plant in ſuch rich improved paſtures; but that it has ſeldom been ſeen in lands remarkable for inducing the rot among ſheep. See Rot, Sheep, and White *Clover*.

White, *Troy*. See Troy-*White*.

White *Varniſh*, and *Vitriol*. See the ſubſtantives.

White *Vitriol*, in *Mineralogy*, a natural ſalt or ore of zinc. (See Zinc, and Zinc *Ores*.) This ore is a ſulphate of that metal, but is frequently combined with a ſmall portion of manganeſe. It is ſuppoſed to be formed naturally by the decompoſition of blende or ſulphuret of zinc.

White-*Waſhing*, *Roughcaſt*. See Wash *for*, &c.

White *Water*, a diſeaſe in *Sheep*, of the dangerous ſtomachic kind. It is ſaid to be cauſed by their feeding on rich ſucculent food in cold froſty ſeaſons, or at other times, and by many other ſuch cauſes; and is probably an affection of the inflammatory kind.

It is remarked in the Glouceſter Report on Agriculture, that the white water is a deſtructive diſorder on the Cotſwolds; uſually comes on with rapidity, and ſometimes terminates with death in three hours. It is ſuppoſed to be owing to their licking up the white froſt on their green food in ſpring and autumn. Folding at night on bare ground, giving them dry meat in the morning, and keeping them from the turnips till the froſt is gone, is the obvious mode of prevention, if the foregoing cauſe be well founded. If, however, the diſorder be owing to gorging themſelves with watery food, ſuch as turnips, it is probable that to keep them moving, without ſuffering them to reſt long, nor ſwell with what they have eaten, will carry off the beginning complaint; and even if the white froſt has been the occaſion, this is the beſt remedy that reaſoning ſuggeſts; and it is ſaid to be the practice of the ſhepherds in Northumberland, in the management of ſheep under this complaint.

It is probable that ſpeedy evacuation, both by bleeding and purging, may be found uſeful in this diſeaſe, and afterwards the uſe of ſtomachic remedies.

It is found to chiefly attack the young healthy ſheep. See Water, *Red and Black*.

White *Water-Lily*, in *Gardening*, a moſt beautiful plant of this country, which is capable of being propagated in artificial and ornamental pieces of water in gardens and pleaſure-grounds, merely by tranſplanting the bulbous roots of it in the winter ſeaſon. It is perennial in its nature.

White *Wax* is yellow wax blanched, and purified by the ſun and dew. See Wax.

White *upon White*, in the *Porcelain Manufactory*, a name given by the Engliſh merchants to a particular china-ware, which is formed of three different white ſubſtances, the body being of one, the flowers of another, and the varniſh which covers theſe of a third. See Hoache.

White *Wine* is that of a clear, bright, tranſparent colour, bordering on white. It is thus called to diſtinguiſh it from the red wines, or clarets.

The generality of white wines are made from white grapes; though there are ſome from black ones, only the ſkins are carefully kept from tinging them. See Wine.

Whites, the popular name of a diſorder incident to women. See Fluor *Albus*.

White, in *Geography*, a county of Weſt Tennaſſee, with 4028 inhabitants, including 283 ſlaves.

White *Bay*, a bay on the eaſt coaſt of Newfoundland. N. lat. 50° 10′. W. long. 56° 25′.—Alſo, a bay on the eaſt coaſt of Kerguelen's Land, ſouth of Point Pringle, ſo called from ſome white ſpots of land or rocks. In the bottom are ſeveral ſmaller bays or coves. S. lat. 47° 53′. E. long. 69° 15′.

White *Bear Lake*, a lake of North America, ſaid to be the moſt northerly of thoſe lakes which ſupply the Miſſiſſippi. It is about 60 miles in circumference. N. lat. 46° 50′. W. long. 95° 30′.

White *Cliff*, or *Culver Cliff*, a cape of the eaſt coaſt of the Iſle of Wight. North of it is a bay called White Cliff Bay. N. lat. 50° 39′. W. long. 0° 56′.

White *Deer*, a townſhip of Pennſylvania, in North Cumberland county, on the Suſquehanna, with 1132 inhabitants.

White *Flag Bay*, a bay on the weſt coaſt of the iſland of St. Chriſtopher; 2 miles N. of Sandy Point.

White *Head*, a cape of Ireland, on the coaſt of Antrim, at the entrance into Belfaſt Lough, a little to the ſouth of Black Head.

White *Hills*, a fiſhing-town of Scotland, in the county of Bamff, ſituated in a creek; 2 miles N. of Bamff.

White-*Horſe Vale*, a vale of Berkſhire, ſo called from the figure of a horſe in a galloping poſture, cut in the ſide of a chalky hill, as is ſuppoſed in memory of a great victory gained by Alfred over the Danes in the year 871. The ſcouring the horſe is an annual feſtival, and celebrated by rural games. On the top of the hill is a large Roman intrenchment, called Uffington caſtle, or Woolſton caſtle. There is likewiſe another camp in the neighbourhood, with the burial place of the Daniſh chief, incloſed by ſtones ſet on edge, a cromlech, and ſeveral barrows.

White *Horſes*, cliffs on the ſouth coaſt of Jamaica; 20 miles E.S.E. of Kingſton.

White-*Houſe Bay*, a bay on the weſt coaſt of the iſland of St. Chriſtopher, a little to the north of Guana Point.

White *Inlet*, or *Boca de Ratones*, an inlet on the eaſt coaſt of Eaſt Florida. N. lat. 26°. W. long. 80° 20′.

White *Iſland*, an iſland in the South Pacific ocean, near the eaſt coaſt of New Zealand, north of Cape Run-away. S. lat. 37° 31′. W. long. 182° 36′.—Alſo, a ſmall iſland in the Atlantic, near the S.E. coaſt of Nova Scotia. N. lat. 44° 55′. W. long. 61° 56′.

White *Iſland*, or *Burnt Iſland*, a ſmall iſland in the Arabian Gulf, near the coaſt of Adel. N. lat. 11° 8′. E. long. 64° 55′.

White, *Iſle of*. See *Iſle of* Wight.

White *Keys River*, a river of Africa, which runs into the Indian ſea, S. lat. 30° 35′.

White *Mountains*, mountains of New Hampſhire, peculiarly applied to the higheſt part of a ridge, which extends N.E. and S.W.: the whole circumference at leaſt fifty miles. The height of theſe mountains above an adjacent meadow is reckoned, from obſervations made by the Rev. Mr. Cutler, of Ipſwich, in 1784, to be about 5500 feet, and the meadow 3500 feet above the level of the ſea. The ſnow and ice cover them nine or ten months in the year, during which time they exhibit that bright appearance from which they are denominated the White Mountains. From this ſummit, in clear weather, is exhibited a view extending ſixty or ſeventy miles in every direction: although they are more than ſeventy miles within land, they are ſeen many leagues off at ſea, and appear like an exceedingly bright cloud in the horizon. Theſe immenſe heights, being copiouſly repleniſhed with water, afford a variety of caſcades. Three of the largeſt rivers in New England receive a great part of their waters from theſe mountains. Amanooſuck and Iſrael rivers, two principal branches of the Connecticut, fall from their weſtern ſides. Peabody river, a branch of the Amoriſcogen, falls from the north-eaſt ſide, and almoſt

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the whole of the Saco descends from the southern side. The highest summit of these mountains is in about 44° N. lat.

WHITE *Oak Creek*, a river of North Carolina, which runs into the Atlantic, N. lat. 34° 39′. W. long. 77° 26′.

WHITE *Oak Mountains*, mountains in the west part of North Carolina. N. lat. 36° 10′. W. long. 82° 30′.

WHITE *Point*, a cape on the coast of Cape Breton, near Louisburg.—Also, a cape on the south coast of Jamaica; 20 miles E. of Port Royal.—Also, a cape on the north coast of the island of Cumbava. S. lat. 8° 15′. E. long. 118° 51′.

WHITE *River*, a river of Louisiana, formerly thought to be a stream of inconsiderable magnitude, but now known to be one of the most considerable in the western country, and likely to become of still greater importance. It rises in the Black Mountains, which separate the waters of the Arkansas from those of the Missouri and Mississippi. Several of its branches interlock with those of the Osage river, the Maramak, and the St. Francis. It is navigable about 1200 miles, without any considerable interruption; 800 of which may be made with barges, and the rest with canoes or smaller boats. Its waters are clear and limpid, its current gentle, and even in the driest season, plentifully supplied from the numerous and excellent springs which are every where found. It also receives many considerable rivers in its course, the largest of which is Black river. The country which it waters is described by those who have traversed it as generally well wooded, and abounding in springs and rivulets: the soil is rich, though hilly; and it is said, that on the borders of this river a country may be chosen, at least 100 miles square, not surpassed by the best parts of Kentucky, and one of the best for settlements in the western world. This river is situated on the S.W. side of the Missouri, and is 300 miles wide at its mouth.

WHITE *River*, a river of Guadaloupe.—Also, a river of America, which runs into the Connecticut, 4 miles east of Norwich.—Also, a river of Jamaica, which runs into the sea, 4 miles W. of Morant bay.—Also, a river of Indiana, in the county of Koog, which rises about N. lat. 40° 45′, and W. long. 85° 5′, and runs into the Wabash, N. lat. 38° 19′, and W. long. 88° 20′.—Also, a river of America, which runs into lake Michigan, N. lat. 43° 40′. W. long. 85° 35′. —Also, a river of Vermont, which runs into the Connecticut, N. lat. 43° 38′. W. long. 72° 16′.

WHITE *Rock*, a rocky islet in the East Indian sea, near the south coast of Java.

WHITE *Rocks*, a range of buildings, accommodated for smelting-houses, about a mile from Swansea, in the county of Glamorgan, situated on the river.

WHITE'*s Bay*, a bay on the coast of Newfoundland. N. lat. 50° 17′. W. long. 56° 15′.

WHITEBURN, a town of Scotland, in the county of Linlithgow; 21 miles W. of Edinburgh.

WHITECLAY CREEK, a hundred of Delaware, in Newcastle county, with 1701 inhabitants.

WHITEFIELD, GEORGE, in *Biography*, one of the founders of Methodism, (see METHODISTS,) was the son of an innkeeper at Gloucester, where he was born in 1714, and where he received the rudiments of literature, so as to be sufficiently qualified for his father's business, for which he was designed. Accordingly he commenced it as drawer at the Bell-inn. At school he is said to have been distinguished by a retentive memory and good elocution. Of his early years, he gives a very unfavourable account, so that there was nothing about him but a fitness to be damned, with occasional gleams of grace that afforded some indication of his future destination. About the age of 18, he was admitted a servitor at Pembroke college, Oxford, and associated with those young persons whose dispositions and habits resembled his own, and whose conversation and manners contributed to cherish that religious enthusiasm to which he was strongly addicted. As soon as Dr. Benson, bishop of Gloucester, received information concerning the state of his mind and the course of his general conduct, he made him an offer of ordination, when he was about 21 years of age, and he was accordingly ordained a deacon in 1736. Upon his return to Oxford, after preaching his first sermon at Gloucester, he took the degree of bachelor, and diligently employed himself in communicating instruction to the poor and the prisoners. During the two following years, he acquired a great degree of popularity by his public services in London, Bath, Bristol, and other places; collecting large auditories, and interesting the attention of his hearers. His voice was strong and musical, his pronunciation clear and distinct, his imagination was lively, and his feelings were warm; and to these natural powers of eloquence we may add his selection of subjects, which were adapted to rouse the inconsiderate, and to comfort those that were awakened to a sense of their guilt and danger: so that we need not wonder that he should command a numerous audience. Upon receiving information that the province of Georgia was likely to open to him an extensive field of usefulness, he determined to visit it, and in May 1738, arrived at Savannah. Here he met with much greater success than his predecessor Wesley; and in order to supply the defect of education which he was concerned to observe in this province, he resolved to found an orphan-house, and in 1739 returned to England in order to collect money for this purpose. In England few of his clerical brethren were disposed to take much notice of him; nevertheless, his original patron, the bishop of Gloucester, gave him priest's orders: but upon afterwards visiting London, none of the churches into which he obtained admission were large enough to accommodate the crowds of people that assembled to hear him. It was about this time that he commenced his practice of preaching in the open fields, and the first scene of his exhibition in this way seems to have been Kingswood, near Bristol, where he collected thousands, chiefly of colliers, who without doubt derived benefit from his discourses. He also preached at Bristol in the open air, when he was refused access to the pulpits of the churches; and he likewise pursued the same practice in Moorfields and Kennington-common, near London, where, amidst the immense multitude that attended him, some persons occasionally treated him with rudeness, but the greater number were commanded by his peculiar power of address into respectful attention. Having succeeded beyond his expectations in soliciting contributions for his projected orphan-house in Georgia, he returned to America in August 1739; and in the following January laid the foundation of the building at Savannah. He then extended his tour as far as Boston, preaching to immense crowds, and collecting considerable sums for the completion of his design; and upon his return to Savannah he found his orphan family comfortably settled in their house; and in January 1741, he embarked for England. His absence had occasioned a declension among his followers; some other circumstances, besides the intermission of his personal labours amongst them, might probably have contributed to produce this effect. Whilst he was in America he had written, as he himself acknowledges, "two well-meant but injudicious letters against England's two great favourites, the Whole Duty of Man, and archbishop Tillotson, who, I said, knew no more of religion than Mahomet." His society had suffered from the influence of the Moravians. Mr. Wesley

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had preached and printed in favour of perfection and universal redemption, and against the doctrine of election. He had written a reply, but he acknowledges that he had used expressions that were too strong in reference to absolute reprobation, which had offended numbers of his spiritual children. His worldly circumstances were embarrassed, and he owed 1000*l.* for the orphan-house, and some of his bills were returned. He had some enemies who circulated reflections on his integrity in the contract of this business; but they were never justified, and his state of secular affairs at his death affords a strong presumption that they were groundless. Dr. Franklin, who lived upon the spot, bears testimony to his honesty. At this time, a separation had taken place between him and Wesley, and this had occasioned a decrease of his auditors. However, his zeal and perseverance overcame these difficulties. In order to counteract Wesley's popularity, he built a shed near his chapel in Moorfields, which he called the Tabernacle; and in process of time this rose from a mean beginning to be a spacious edifice; and he also renewed his field-preaching. At this time, he paid his first visit to Scotland; and though he was a clergyman of the church of England, which excited some prejudice against him, he was invited into the churches, and preached to large congregations, and made collections for his orphans. On his return by Wales, he married a Mrs. James, a widow lady of Abergavenny. His zeal for doing good, and for making proselytes, induced him, in the spring of 1742, to engage in a contest with the idle people who had booths in Moorfields, and where they frequented for their amusement on holidays. On Whitmonday he collected a party of his attendants, and resorted to the spot with a view of conducting a religious service. Although he was much disturbed in this effusion of his piety and zeal, the result, as he says, was so much in his favour, that he received 1000 notes from persons under conviction; and soon after more than 300 were admitted into the society in one day. In 1748 he returned from a third voyage to America; and then commenced his acquaintance with the countess of Huntingdon, who appointed him her chaplain, and excited the curiosity of some persons of rank to hear him: among these were the earl of Chesterfield and lord Bolingbroke. About this period, it is said, his sentiments became more rational; for on his third visit to Scotland, it was announced to a synod assembled at Glasgow to investigate certain charges against his opinions, that with regard to certain points which were considered as objectionable, his sentiments had been altered for upwards of two years; and that he now seldom preached a sermon without guarding his hearers against impressions, and admonishing them that a holy life is the best evidence of a state of grace. From this time, he was fully employed by a visit to Ireland, two more voyages to America, and his English circuits, till the year 1756, when his chapel in Tottenham-court-road was erected. His labours were incessant for many years; but at length, on a seventh visit to America, he was seized with an asthmatic complaint at Newbury-port, New England, which terminated his life in September 1770, near the completion of his fifty-sixth year.

With regard to his general character, we shall close this article with the reflections of a judicious and candid biographer. "That he had much enthusiasm and fanaticism in his composition is sufficiently evident from his own journal and letters; but whether these were accompanied, as they not unfrequently are, with craft and artifice, is a disputable point. There are, in his narratives, obvious marks of a disposition to represent himself as under the special protection of Providence, and to magnify trifling incidents into little less than miracles in his favour; and much of what is commonly called cant is apparent in his confessions and humiliations. Yet that he was a hypocrite acting a part will scarcely be believed by any one who looks at his course of life during 34 years. He has been charged with dishonesty and immorality; yet as it is certain that he obtained the esteem of many persons of worth, it may be concluded that such accusations were destitute of proof. His intellectual qualities were well suited to the task he undertook; and if in the pulpit he occasionally intermixed buffoonery with his vehemence, the latter was not less effectual on that account. His learning and literary talents were mean, and he is a writer only for his own sect." He published, at intervals, sermons, tracts, and letters, which, after his death, were collected in six vols. 8vo. Middleton's Biog. Evangel. Mosh. Eccl. Hist. Gen. Biog.

Whitefield, in *Geography*, a town of America, in the district of Maine, and county of Lincoln, having 995 inhabitants.—Also, a town of New Hampshire, in the county of Cowes, having 51 inhabitants.—Also, a town of North Carolina; 40 miles W. of Newbern.

Whitefield, or *Wheatfield*, a township of Pennsylvania; 156 miles W. of Philadelphia.

WHITEHALL, formerly called Skenesborough, a post-township of Washington county, in the state of New York, at the head of lake Champlain, about 65 miles N.E. from Albany: in medial length about 10 miles from N. to S., and 7 wide; first erected in 1788, with its present limits. The soil is a stiff clay, and adapted to grass. Wood-creek and Pawlet river unite in this town, and afford facility to navigation and trade, as well as mill-seats. Marble, limestone, and iron-ore, and also a mineral spring, are found in this township. It has 1 Congregational, 1 Presbyterian, 1 Baptist, and 1 Methodist congregation, and a competent number of common schools; 2 grist-mills, 2 saw-mills, a fulling-mill, and carding-machine.—Also, an incorporated post-village at the N. end, with considerable trade, situated principally on the W. bank of Wood-creek, at its entrance into lake Champlain; 71 miles N.E. from Albany. About a quarter of a mile from the village is a handsome Presbyterian church, founded by the donation of John Williams, esq. of Salem, who endowed it with a parsonage of 60 acres of land. The whole population, by the census of 1810, was 2119, with 178 electors.—Also, a township of Pennsylvania, in Northampton county, with 2551 inhabitants; 61 miles N. of Philadelphia.

WHITEHAVEN, a sea-port and market-town in Allerdale ward, in the county of Cumberland, England, is situated between two hills at the northern extremity of a narrow vale, at the distance of 40 miles S.W. from Carlisle, and 305 miles N.W. from London. The rise, progress, and increasing importance of this now rich and flourishing town, strikingly display the effects of trade, industry, and enterprise. From an obscure hamlet, it has advanced, within less than two centuries, to considerable magnitude and commercial importance; and, both in extent and population, by far exceeds the capital of the county. In the year 1566, it consisted only of six fishermen's cabins; in 1633, of nine or ten thatched cottages; but in 1693, its buildings were sufficiently numerous for 2222 inhabitants, and have been progressively increasing; till, in the year 1811, the population was returned to parliament as 10,106, occupying 1940 houses. The increase of shipping has been proportionate: in 1685, the whole number of vessels belonging to this port was 46, carrying 1871 tons; they have since gradually increased to 230; the quantity of tonnage is nearly 74,000 tons. The honour of raising this town to its present importance must be attributed to the Lowther family.

family. Sir John Lowther, about the beginning of the reign of Charles I., purchafed the lands of the diffolved monaftery of St. Bees for his fecond fon, fir Chriftopher, who, as coals about that period came into general ufe, conceived the idea of improving his poffeffions by opening fome collieries. No effectual progrefs was, however, made till after the Reftoration, when another fir John Lowther, who had fucceeded to the eftate, formed a plan for working the mines on a very extenfive fcale. To obviate all oppofition to his operations, he procured a gift of all the ungranted lands within the diftrict, and alfo of the whole fea-coaft for two miles northward, between high and low water mark. He then directed his attention to the port, which was fmall and inconvenient; and, by his judicious fchemes, laid the foundation of the prefent haven. Subfequent improvements have been made, particularly during the reign of George II., when an act was paffed to perfect and keep it in repair, by a tonnage on fhipping. The mines are faid to be the deepeft in England, and extend a confiderable way under the fea: one has been carried 1000 yards out from the fhore, at the depth of 112 fathoms under the water. Moft of the coal exported from this haven is conveyed to Ireland; the quantity raifed annually, on the average, is about 90,000 chaldrons. (See COAL.) The creek on which Whitehaven is built is fo deeply feated, that the adjacent lands overlook it on every fide. The approach from the north is fingular, as the heights are fo much above the town, that only the roofs of the houfes can be feen till near the entrance, which, on this point, is through an archway of red free-ftone. The town itfelf is one of the moft refpectable in all the northern counties; the ftreets being regular and fpacious, and croffing each other at right angles; the houfes in general are well built, and even the tradefmen's fhops exhibit a degree of elegance. Here are three chapels, plain convenient ftructures: they were all erected by fubfcription of the inhabitants, aided by the benevolence of the Lowther family. St. Nicholas's chapel was built in 1693; Trinity, in 1715; St. James's, in 1752. The latter is neatly fitted up; the roof and galleries are fupported by ranges of pillars. Befides the eftablifhed chapels, here are three meeting-houfes for Methodifts, two for Prefbyterians, and one for each of the following fects, Anabaptifts, Roman Catholics, Glaffites, and Sandemanians. The principal manufactures are thofe of cordage and fail-cloth; the latter was only eftablifhed in 1786, but already gives employment to feveral hundred workmen, though much of the bufinefs is executed by machinery of great power. A fair is held annually, and there are three weekly markets. The caftle, as it is called, adjoining the eaft fide of the town, one of the feats of the earl of Lonfdale, is a large quadrangular building, chiefly erected by the late earl, and containing fome good paintings.

St. Bees, in which parifh Whitehaven is fituated, derives its origin from a religious houfe founded here by Bega, an Irifh faint, about the year 650. On her death, a church was erected to her honour; but both thefe eftablifhments having been deftroyed by the Danes, they were replaced, in the reign of Henry I., by a new foundation for Benedictine monks. The church built at this period had the form of a crofs, and great part of it yet remains. The eaft end is unroofed, and in ruins; the nave is fitted up as the parifh church; and the crofs-aifle is ufed as a burial-place. The whole is of a red free-ftone. In this village a free-fchool was founded by a bequeft of archbifhop Grindall, in the year 1587, under a charter of queen Elizabeth. The endowments were increafed by James I., and have been fince further augmented by various benefactions.—Beauties of England and Wales, vol. iii. Cumberland, by J. Britton and E. W. Brayley, 1802. Magna Britannia, Cumberland, by Meffrs. Lyfons, 4to. 1816.

WHITEHEAD, WILLIAM, in *Biography*, an Englifh poet, was born at Cambridge in 1714–5, educated at Winchefter fchool, where from his talent in writing verfe he acquired the notice of Pope; and upon his return to Cambridge, obtained a fcholarfhip of Clare-hall. As a poet, Whitehead's higheft ambition was to refemble the manner of Pope; and of his proficiency he gave a fpecimen in his "Epiftle on the Danger of writing Verfe," 1741. In the following year he was elected fellow of Clare-hall, and purfued his ftudies with a view to the church; but his poetical talents produced a change in his circumftances and in his purpofe. Being recommended to the earl of Jerfey as a proper tutor for his eldeft fon, he removed in 1745 to the earl's houfe in London, where his treatment was in the higheft degree liberal. Having leifure for indulging his tafte for literary purfuits, he turned his attention to dramatic compofition, and produced a tragedy, entitled "The Roman Father," which was exhibited with applaufe upon the ftage in Drury-lane in 1750. In 1754 he publifhed another, the title of which was "Creufa," which was alfo favourably received. With the profits arifing from thefe two performances he very honourably difcharged the debts of his father, who had died infolvent. In this year he accompanied his pupil, vifcount Villiers, and vifcount Nuneham, fon of earl Harcourt, on their travels, which continued more than two years; and on his return he publifhed an "Ode to the Tiber," and fix elegiac epiftles, which were much applauded. Lady Jerfey, during his abfence, had procured for him the appointment of fecretary and regifter to the order of the Bath; and in 1757, on the death of Cibber, he fucceeded to the laureat, which he rendered refpectable; though in the difcharge of the cuftomary duties of the office, he did not efcape abufe, and efpecially that of Churchill, whofe popular fatire almoft overwhelmed the reputation of the laureat. Lady Jerfey, in confideration of his fervices as governor to her fon, invited him to take up his refidence in her houfe, where he paffed fourteen years, frequently vifiting lord Harcourt, much refpected by his noble hofts and his former pupils. He ftill amufed himfelf by prefenting to the public occafional productions, one of which was a comedy of the moral or fentimental clafs, entitled "The School for Lovers." After paffing through life tranquilly and pleafantly, and maintaining an eftimable character, he died fuddenly, April 1785, in his 70th year. Of his works two volumes were publifhed by himfelf, and to thefe a third was added by Mr. Mafon, who prefixed memoirs of his life and writings, to which we refer. Gen. Biog.

WHITEHEAD, GEORGE, an eminent perfon among the Quakers, was born in 1636 at Sunbigg, in Weftmoreland. Attaching himfelf early in life to this fociety, and engaging in the propagation of its doctrine, he partook of the fufferings which, in that age, were the ordinary lot of its active members; and was once, fimply for having preached at Nayland, in Suffolk, feverely whipped by order of two juftices as a vagabond; a proceeding which ferved, as might have been expected, to increafe the difpofition of the people to hear him. Soon after the Reftoration of the monarchy, the Quakers were made the exprefs fubjects of a law, the precurfor of others of like nature, which impofed on their profeffion and worfhip penalties extending to banifhment. In the progrefs of the bill through the houfe of commons, Whitehead, with three other Quakers, was admitted to the bar of the houfe, and heard in defence of the fociety. They pleaded its caufe with the freedom of confcious innocence,

cence, and the meeknefs of men prepared to fuffer, but pleaded in vain :—the bill paffed, and two out of the four, who had thus advocated the rights of confcience, prefently fell victims to the force by which confcience was deliberately oppreffed, dying in a crowded unhealthy prifon, to which they were dragged from their peaceable religious meetings. Whitehead, who was imprifoned with them, furvived to be liberated.

In the year 1672, when Charles II. iffued his declaration for fufpending the penal ftatutes againft non-conformifts, Whitehead folicited and obtained an order under the great feal for the difcharge of about four hundred Quakers, many of whom had been for years under clofe confinement. He records, with expreffions of satisfaction, the circumftance that fome other diffenters alfo partook at this time of the benefit of his exertions. On feveral other occafions he was concerned in applications on the Quakers' behalf to Charles II. and James II. And after the Revolution, when the Toleration Bill was before parliament, he was particularly ferviceable to his friends in that matter; as likewife in taking a part in thofe reprefentations, which procured the acceptance of their affirmation in lieu of an oath. A profeffion of faith being propofed for infertion in the above act, in terms which to the Quakers would not have been quite fatisfactory, Whitehead and his coadjutors propofed the following, as their own belief on the points to which it relates, and which was adopted as a teft for the fociety accordingly, *viz.* "I profefs faith in God the Father, and in Jefus Chrift his Eternal Son the true God, and in the Holy Spirit, one God, bleffed for evermore; and do acknowledge the holy fcriptures of the Old and New Teftament to be given by divine infpiration."

Whitehead lived the greater part of his time in or near London, which accounts for his being one of thofe Quakers ufually concerned in applications to the government. He was well efteemed by his brethren, whom he continued to edify by his miniftry and example to the end, dying, after a fhort confinement, by infirmity, at the age of 86. Befides feveral writings chiefly controverfial, heleft fome memoirs of his life, which were printed in one volume, 8vo. in 1725.

Whitehead, in *Geography*, an ifland in the Atlantic, near the coaft of Maine. N. lat. 44° 43′. W. long. 67° 40′.—Alfo, a cape of Ireland, at the north-eaft of the bay of Carrickfergus, in the county of Antrim.

WHITEHORN, a royal borough and market-town in the diftrict of Machers, and fhire of Wigtown, Scotland, is fituated on the weftern fide of the bay of Wigtown, at the diftance of 116 miles S.S.W. from Edinburgh. It is a place of great antiquity, having been the Roman ftation Leucophibia, or Candida-Cafa of Bede, and the capital of the Novantes, who poffeffed all Galloway beyond the river Dee; and it was fo early the feat of religion, that, according to Pinkerton, the bifhopric of Galloway, or Whitehorn, is the oldeft in Scotland. The cathedral, of which there are now fcarcely any remains, was founded in the fourth century by St. Ninian. A priory of the Premonftratenfian order was alfo early founded here, and richly endowed by Fergus, lord of Galloway. The borough now confifts chiefly of one large well-built ftreet, extending from north to fouth, interfected by feveral fmaller. A rivulet, over which is a neat bridge, runs acrofs the main ftreet. Near the centre of the town is a refpectable hall for public meetings, adorned with turrets and a fpire, and furnifhed with a fet of bells. Whitehorn is governed by a provoft, two baillies, and fifteen counfellors; and unites with the boroughs of New Galloway, Wigtown, and Stranraer, in fending a reprefentative to the imperial parliament. A weekly market is well fupplied. The tanning of leather has been carried on feveral years to a confiderable extent, and fome cotton manufactures have been commenced. The parifh of Whitehorn extends eight miles in length and four in breadth, and occupies that extremity of the peninfula of the fhire of Wigtown which is formed by the bays of Wigtown and Luce. The foil is in general fertile, and the farms well cultivated. Here are many extenfive plantations in a flourifhing condition; confiderable quarries of variegated marble and ftrong flate; and promifing appearances of lead and copper mines, but none have as yet been worked. The extent of fea-coaft is about nine miles. The ifle of Whitehorn, included in the parifh, has a fafe harbour, and a village containing 350 inhabitants. According to the return of the year 1811, the population of the whole parifh was 1935.—Beauties of Scotland, vol. ii. Wigtownfhire. Carlifle's Topographical Dictionary of Scotland, vol. ii. 1813.

Whitehorn, a fmall ifland of Scotland, near the fouth-eaft coaft of the county of Wigtown. N. lat. 54° 46′. W. long. 4° 27′.

WHITEHURST, John, in *Biography*, was born at Congleton, in Chefhire, in 1713, and brought up to the trade of his father, who was a watch-maker. At the age of 21 years he vifited Dublin, in order to acquaint himfelf with the conftructioo of a curious clock; but being difappointed, he engaged in bufinefs for himfelf at Derby, about two or three years after his return, where he diftinguifhed himfelf by a variety of ingenious pieces of mechanifm; and he thus eftablifhed a reputation, which caufed him to be confulted by all perfons who wifhed to avail themfelves of fuperior fkill in mechanics, pneumatics, and hydraulics. In 1775 he was appointed, without any folicitation on his own part, ftamper of the money weights; which office required his removal to London, where he fpent the remainder of his days, and where his houfe was the refort of fcientific men of various defcriptions. In 1778 he publifhed his "Inquiry into the original State and Formation of the Earth," of which an enlarged and improved edition appeared in 1786, and a third in 1792. In May 1779 he was elected a fellow of the Royal Society. In 1783 he vifited Ireland, to examine the Giant's Caufeway, and the northern parts of the ifland; and the refult of his inquiries was annexed to his work above-mentioned. In the courfe of his journey he erected an engine for raifing water from a well to the fummit of a hill, in a bleaching-ground at Tullidoi, in the county of Tyrone. It is worked by a current of water, and is of very curious conftruction. In 1787 he publifhed "An Attempt towards obtaining invariable Meafures of Length, Capacity, and Weight, from the Menfuration of Time." (See Standard.) Mr. Whitehurft, having been for fome time fubject to the gout, was at length carried off by a paroxyfm of it in the ftomach, in February 1788, in the 75th year of his age, at his houfe in Bolt-court, Fleet-ftreet. As a man of fcience, he was much refpected by all who knew him; but he was ftill more eftimable on account of his moral qualities. In his drefs he was plain, temperate in his diet, and in his general intercourfe with mankind eafy of accefs, benevolent in his difpofition, and obliging in his manners. His papers on Chimneys, Ventilation, and Garden-ftoves, were collected and publifhed in 1794 by Dr. Willan. His papers in the Philofophical Tranfactions, printed afterwards in the collection of his works in 1792, were the following: *viz.* "Thermometrical Obfervations at Derby," in vol. lvii.; "An Account of a Machine for raifing Water at Oulton in Chefhire," vol. lxv.; and "Experiments

periments on ignited Subſtances," vol. lxvi. Hutton's Math. Dict.

WHITEKIRK, in *Geography*, a pariſh and village of Scotland, in the county of Haddington; 4 miles S.E. of North Berwick.

WHITELAND, West. See West *Whiteland*.

WHITELICK, a town of the ſtate of Kentucky; 13 miles S. of Stamford.

WHITELOCK, Bulstrode, in *Biography*, a lawyer and ſtateſman, was born in London in the year 1605, and finiſhed his education as a gentleman-commoner of St. John's college, Oxford. Being deſtined for the profeſſion of the law, he purſued the ſtudy of it under the direction of his father, ſir James Whitelock, who was one of the juſtices of the King's Bench. As he had a taſte for the fine arts, he was nominated as one of the chief managers of the royal maſque preſented by the inns of court to Charles I. and his queen in 1633, of which he has given a florid deſcription. He became ſoon diſtinguiſhed in his profeſſion at the bar, and was frequently conſulted by Hampden, when he was under proſecution for reſiſting the impoſition of ſhip-money. In 1640 he was elected as a repreſentative for Marlow in the Long parliament; and though his principles were favourable to the meaſures which then engaged the public attention, he concurred with Selden and others in deprecating a reſort to arms; but when the houſe had determined for war, he accepted the poſt of deputy-lieutenant for the counties of Oxford and Buckingham, and appeared at the head of a gallant company of horſe raiſed among his neighbours. Neverthelefs he was always averſe from a civil conteſt; and in January 1642–3, he was one of the commiſſioners appointed to treat of peace with the king at Oxford; and in 1644 he was one of thoſe who preſented to the king propoſitions of peace agreed upon in parliament; and the king's anſwer was, at his majeſty's requeſt, drawn up by him and Holles, for which they were accuſed of high treaſon by parliament, but extricated themſelves with honour. As a member of the aſſembly at Weſtminſter for ſettling the form of church government, he avowed himſelf in oppoſition to the divine right of preſbytery. He alſo oppoſed the power of excommunication aſſumed by the Preſbyterians; being always, like Selden, an enemy to violent exertions of church power by any party; and he was an invariable advocate of legal rights, and an oppoſer of arbitrary power, aſſumed or exerciſed in either houſe of parliament. When he became ſuſpected by the parliamentary leaders, he joined the army-party, and oppoſed the meaſure of diſbanding the troops, which was propoſed by ſome of his former aſſociates. When it was determined to bring the king to trial, he was nominated as one of the committee for drawing up the charge; but this was a buſineſs in which he did not chooſe to engage. However, he had no objection againſt taking an active part under the new government, and he was nominated in February 1648–9 one of the council of ſtate. In ſome other inſtances he incurred the charge of inconſiſtency, as he complied with meaſures which he did not approve. To Cromwell he was ſo agreeable, that he was one of the four members of parliament appointed to meet him after his famous victory at Worceſter in 1651. Whitelock avowed himſelf ſteadily attached to monarchy, as a part of the ſtate which could not be diſpenſed with, and as interwoven with the laws of the country; and he therefore ſuggeſted, that the late king's eldeſt or ſecond ſon ſhould be ſent for, and enter into terms for ſecuring the liberties of the nation. Upon the diſſolution of parliament by Cromwell, though he had previouſly reſiſted the attempts of the army to govern without the parliament, he obſequiouſly performed the functions of his office under the new eſtabliſhment. The uſurper, however, regarded him with diſtruſt, and would not admit him into his firſt or little parliament. His commiſſion of the ſeals was ſuperſeded by the ſuppreſſion of the court of chancery; and he was therefore glad to be occupied in a ſtation which would not require his interference in party conteſts, which was that of ambaſſador from England to queen Chriſtina of Sweden. Upon his departure, Cromwell aſſumed the title and authority of lord protector, and iſſued his inſtrument of government, which Mr. Whitelock had concurred in preparing, and which was afterwards found by Cromwell incompatible with his uſurpation. Having concluded an advantageous treaty with queen Chriſtina, who received him in November 1653 with diſtinction, he returned to his own country, and reſumed the office of commiſſioner of the great ſeal, upon the reſtoration of the court of chancery; and he was returned as a repreſentative for three counties in Cromwell's ſecond parliament. Upon Cromwell's regulation and limitation of the court of chancery, he again reſigned the cuſtody of the ſeal; and as ſome compenſation for his loſs, he was appointed a commiſſioner of the treaſury. He was free and faithful in giving ſalutary advice to the Protector, and nevertheleſs retained his confidence. Declining the office of ambaſſador to Sweden, which was offered him, he acted as one of the commiſſioners to treat with the Swediſh ambaſſador in England. He was returned for Buckinghamſhire in Cromwell's third parliament, and officiated for ſome time as ſpeaker. Although he would not preſent to parliament the "Humble Petition and Advice," which was intended to empower Cromwell to aſſume a higher title than that of Protector, he was chairman of the committee for conferring with him about it; and he concurred in the requeſt that he would adopt the royal title. Whitelock contracted ſo decidedly in Cromwell's intereſt, that he was one of thoſe who were called by him to the upper houſe; but he declined being governor of Dunkirk, and alſo the honour of being created a viſcount. During the ſhort protectorate of Richard, Whitelock acted as one of the keepers of the great ſeal; and when the army ſet up a republican government, he was nominated one of the council of ſtate; and as its preſident, he joined in all the meaſures that were adopted for upholding the tottering frame of government, on the principle that if no legal authority was acknowledged, the ſword alone would probably govern. When Monk propoſed to reſtore the remains of the Long parliament, Whitelock took a commiſſion from the committee of ſafety for raiſing a regiment of horſe, and urged Lambert to march againſt that leader. But the deſign failing, and the parliament meeting, he juſt appeared in purſuance of the ſpeaker's ſummons; and as he had reaſon for ſuſpecting a deſign to apprehend him, he returned to a friend's houſe in the country, and ſent the great ſeal by his wife to the ſpeaker;—and thus terminated his public life. Upon the Reſtoration, he had the good fortune to eſcape a bill of pains and penalties in the houſe of commons, only by the negative of a ſmall majority. After having paſſed fifteen years in retirement, chiefly at Chilton-park in Wiltſhire, he there died in January 1676; leaving a numerous family, after having been twice married.

Poſſeſſed of conſiderable abilities, and of diſtinguiſhed talents for buſineſs, he would have claimed a more general and cordial reſpect, if he had not been a temporizer in his public conduct. His principles of government appear, however, to have been good, and in his temper he was averſe from every kind of violence and injuſtice. He was a well-wiſher to the law and conſtitution, and ſupported them as far as it was conſiſtent with his intereſt and ſafety. In all private

private concerns he maintained an estimable character for probity and honour. After his death an anonymous editor, in 1682, published his "Memorials of the English Affairs; or, an historical Account of what passed from the Beginning of the Reign of King Charles I. to King Charles II. his happy Restoration," fol.; an improved edition of which appeared in 1732. From his MSS. were published in 1709, "Memorials of the English Affairs from the supposed Expedition of Brute to this Island, to the End of the Reign of King James I.," a chronological epitome of history for his own use. In 1766 Dr. Charles Morton, secretary to the Royal Society, published "Whitelock's Notes upon the King's Writ for choosing Members of Parliament, 13 Car. II. being Disquisitions on the Government of England by King, Lords, and Commons," 2 vols. 4to. The same editor also published in 1772, "A Journal of the Swedish Embassy in the Years 1653 and 1654, from the Commonwealth of England, Scotland, and Ireland; written by the Ambassador the Lord Commissioner Whitelock; with an Appendix of original Papers," 2 vols. 4to. Biog. Brit. Gen. Biog.

The commissioner, amid all his grave affairs, found leisure to cultivate music, of which he was very fond; and seems to have interested himself in all the remarkable performances of his time. During the happy days of Charles I., masques were so frequent at court and elsewhere, that in 1633 no less than five masques were performed at different places before the king and queen. See Masque.

A very circumstantial account of one of these, "The Triumphs of Peace," has been left to his family by the commissioner himself, which was in the possession of the late Dr. Morton of the British Museum. The musical part of this performance seems to have been wholly assigned by the benchers at the Temple to commissioner Whitelock. For in his narrative he says, "I made choice of Mr. Symon Ives, an honest and able musician, of excellent skill in the art, and of Mr. Lawes, to compose all the aiers, lessons, and songs for the masque, and to be masters of all the musicke under me." See Ives, and Lawes, William.

The commissioner, besides being a performer, was a bit of a composer; as he says with great triumph at the latter end of his narrative: "I was so conversant with the musitians, and so willing to gaine their favour, especially at this time, that I composed an aier myselfe, with the assistance of Mr. Ives, and called it 'Whitelocke's Coranto;' which being cried up, was first played publiquely, by the Blackefryar's musicke, who were then esteemed the best of common musitians in London. Whenever I came to that house (as I did sometimes in those dayes), though not often, to see a play, the musitians would presently play 'Whitelocke's Coranto;' and it was so often called for, that they would have it played twice or thrice in an afternoon. The queen hearing it, would not be persuaded that it was made by an Englishman, bicause she said it was fuller of life and spirit than the English aiers use to be; butt she honoured the 'Coranto' and the maker of it with her majestyes royall commendation. It grew to that request, that all the common musitians in this towne, and all over the kingdome, gott the composition of it, and played it publiquely in all places, for above thirtie years after."

Among other moral reflections, addressed to his family, on such vanities as he had been describing, lord commissioner Whitelock adds: "Yet I am farre from discommending the knowledge of this art (music), and exercise of this recreation for a diversion, and so as you spend not too much of your time in it, that I advise you in this as in other accomplishments, that you indeavour to gett to some perfection, as I did, and it will be the more ornament aud delight to you."

The lord commissioner inserts his aier, in order to preserve it for the use of his family, if any of them should delight in it. This "Coranto" may be seen in Burney's Hist. Mus. vol. iii.; and the whole narrative of the masque, entitled "The Triumph of Peace," from "Whitelock's Labours remembered in the Annales of his Life, written for the Use of his Children," MS.

WHITEMARSH, in *Geography*, a township of Pennsylvania, in the county of Montgomery, with 1328 inhabitants; 15 miles N.W. of Philadelphia.

WHITEN Head, a cape on the north coast of Scotland. N. lat. 58° 37′. W. long. 4° 22′.

WHITENESS, a town of the island of Shetland; 6 miles N.W. of Lerwick.

WHITENING *of Bones*, for a skeleton. See Bone.

Whitening *of Cloth*. See Bleaching.

Whitening *of Hair*. See Hair.

Whitening *of Wax*. See Wax.

WHITEPAINE, in *Geography*, a town of Pennsylvania, in the county of Montgomery, with 955 inhabitants; 20 miles N.W. of Philadelphia.

WHITE-PLAINS, a post-township and half-shire town of West Chester county, in New York; 30 miles from New York, and 140 S. of Albany. The whole area of this town is about $8\frac{1}{2}$ square miles; and its population, in 1810, was 693, with 68 electors, and 109 taxable inhabitants. The village of White-plains is pleasantly situated on a fine plain, three-quarters of a mile E. of Bronx creek, and contains a court-house, prison, and a handsome collection of houses. The American troops were defeated in this place, by the British under general Howe, in the year 1776.

WHITESAND Bay, a bay on the W. coast of England, in the county of Cornwall, a little to the N. of the Land's End. N. lat. 50° 6′. W. long. 5° 34′.—Also, a bay on the W. coast of Wales; 1 mile N.W. of St. David's.

WHITESEA, a large gulf of the North Frozen sea, on the N. coast of Russia, bounded on the N.E. and S. by the government of Olonetz, in the vicinity of Archangel, extending from N. to S. within the land, from 69° to 63° of N. lat., and containing a number of small islands.

WHITESTOWN, the principal town and half shire of the county of Oneida, in the state of New York, situated on the Mohawk river, 95 miles N.W. of Albany; including Utica, and having three post-offices. Its form is irregular, and area about 40 square miles. In January, 1785, Mr. Hugh White, from Connecticut, with a young family, became the first settler. In 1788 the town of German Flats was divided, and a new town erected, and named Whitestown, in honour of Mr. White. In 1798 the county of Oneida was established, by a subdivision of Herkimer, and Whitestown included within this county. By subsequent divisions, Whitestown was reduced to a medial measure of 9 miles by 8. It is situated immediately on the great thoroughfare between Albany and the Western lakes; between Canada and the principal commercial sea-ports of the American states on the Atlantic ocean. This town contains three large post-villages, Utica incorporated, Whitesborough, and New Hartford. Whitestown, including these villages, is unrivalled, in the United States, with regard to wealth, population, trade, and improvements, among inland towns of such recent settlement; and none in this state, of the same area, affords so great a population. It has seven principal churches; one Episcopal, three Presbyterian, two Baptist, in one of which the service is performed

formed in the Welſh language, and one of Welſh Independents, beſides ſome ſmaller houſes dedicated to the ſame purpoſe. Here are three grammar-ſchools, one in each village, and many common ſchools. It has alſo a cotton manufactory. This town has been gradually enlarged and embelliſhed. Its population, by the cenſus of 1810, is 4912, with 533 ſenatorial electors.

WHITEWATER, a townſhip of Ohio, in Henieton county, with 910 inhabitants.—Alſo, a river of Scotland, which runs into the Eſk, in the county of Forfar.

WHITGIFT, John, in *Biography*, an Engliſh prelate, was born at Great Grimſby, Lincolnſhire, in 1530, and in 1548 entered at Queen's college, Cambridge, from which he removed to Pembroke-hall, where he enjoyed the tuition of John Bradford, afterwards one of the Proteſtant martyrs. In 1555 he became a fellow of Peter-houſe, and in 1557 commenced M.A. Upon the viſitation of the univerſity by cardinal Pole, about this time, for the purpoſe of purging it of reputed heretics, Whitgift dreaded the ſearch; but by favour of the vice-chancellor eſcaped, and remained in the univerſity. Upon the acceſſion of queen Elizabeth, he entered into orders in 1560, and obtained preferment from Dr. Cox, biſhop of Ely. In 1563 he was appointed Margaret profeſſor of divinity, and chaplain to the queen in 1565. Continuing in the univerſity, and maintaining the character of a good preacher and vigorous diſciplinarian, his ſalary as profeſſor was advanced, and a licence was granted him to preach in any part of the realm. In 1567 he was made maſter of Pembroke-hall, and ſoon after regius profeſſor of divinity. He next became maſter of Trinity college, and graduated D.D.; and on his appointment to keep the commencement-act, he choſe for his theſis "The Pope is the Antichriſt." In 1570 he formed a body of ſtatutes for the univerſity; in conſequence of which the heads of houſes gained new powers, by the exerciſe of which he deprived Cartwright, an eminent Calviniſtic divine, of his Margaret profeſſorſhip. In 1571 he was vice-chancellor of the univerſity, in the exerciſe of which office he manifeſted ſo much zeal for the eſtabliſhed church, that the queen conferred upon him the deanery of Lincoln, beſides other dignities and honours. He alſo expelled Cartwright from his fellowſhip, and carried on a controverſy with that divine and other Puritans in general. In 1577 he was advanced to the ſee of Worceſter, and the office of vice-preſident of the council for the marches of Wales. Upon his advancement to the prelacy, he reſigned his maſterſhip of Trinity college, and devoted himſelf to the duties of his new office, taking care to improve its revenues; and in the exerciſe of a power, which he obtained from the crown by the intereſt of lord Burleigh, to beſtow the prebends of his church on his own friends according to his own ſelection. His zeal, however, againſt popiſh recuſants, which was thus recompenſed, and which he exerciſed without due diſcrimination in the execution of his office as vice-preſident of Wales, involved him in diſputes with the other judges, and offended the preſident, ſir Henry Sydney, ſo that on his return from Ireland, where he was lord-deputy, he diſcharged Whitgift from his poſt. As he occupied new ſtations, his reputation as a man of buſineſs increaſed; and in 1582 he was nominated by the archbiſhop of Canterbury, Grindal, chief commiſſioner for ſettling diſputes in the dioceſes of Lichfield and of Hereford. Grindal's remiſſneſs in executing the laws againſt the non-conforming clergy diſpleaſed the queen, and cauſed her to ſuſpend him from his functions; and on his death in 1583, Whitgift, who had ſecured her favour by his zeal for the church and hoſtility to the Puritans, was appointed to ſucceed him. He did not diſappoint her expectations; but engaged her to iſſue a new eccleſiaſtical commiſſion, more arbitrary and poſſeſſing more extenſive authority than any former one. Its juriſdiction extended over the whole kingdom, and comprehended all orders of men; and as Hume deſcribes it, "every circumſtance of its authority, and all its methods of proceeding, were contrary to the cleareſt principles of law and natural equity." "In a word," ſays he, "this court was a real *inquiſition*, attended with all the iniquities, as well as cruelties, inſeparable from that tribunal." The meaſures of Whitgift were in uniſon with the conſtitution and ſpirit of this commiſſion; and the council itſelf interpoſed to moderate them. In reply to the remonſtrance of the council in favour of ſome miniſters of Ely, who had been ſuſpended for refuſing to anſwer interrogatories, he ſaid, "Rather than grant them liberty to preach, he would chooſe to die, or live in priſon all the days of his life." To the queen he recommended "ſuppreſſing" the diſcipline propoſed by the Puritans, "rather than confuting it by writing;" and he adviſed that a reſtraint ſhould be laid upon the liberty of the preſs at Cambridge. It is no wonder that by ſuch conduct he ſhould become the object of great averſion to the puritanical party. Accordingly he was very acrimoniouſly attacked in a pamphlet, entitled "Martyn Marprelate," in which he was compared to the moſt ambitious and tyrannical churchmen of former times. Whitgift, however, blended with the violence of his temper ſome degree of kindneſs and good humour. This was manifeſted in his conduct towards Cartwright. In his charities he was munificent, and in his mode of living hoſpitable, as well as ſplendid and oſtentatious. In 1595 he laid the foundation of a hoſpital at Croydon, on which very large ſums were expended. He maintained ſeveral ſtudents at the univerſity, and entertained for many years at his palace ſeveral refugee divines, that had been recommended to him by Beza and others. His houſe, it is ſaid, was as much an academy for martial exerciſes as a ſchool for letters. "On his progreſſes he was attended by a numerous and ſplendid train; and at his firſt journey into Kent he rode into Dover with one hundred of his own ſervants in livery, of whom forty were gentlemen wearing gold chains. On feſtival days he was ſerved with great ſolemnity, ſometimes on the knee; and public worſhip in his chapels was performed with every circumſtance of religious pomp. This external grandeur exalted the church of England in the eyes of foreigners, who had been led to imagine that the Reformation in this country had degraded the eccleſiaſtical eſtabliſhment as much as it had done in ſome others."

Upon the acceſſion of king James, Whitgift felt ſome alarm under the apprehenſion of ſome changes in the liturgy; and it has been ſuppoſed that his agitated ſtate of mind concurred with the debility of age, and the operation of ſome other cauſes, in producing the paralytic attack which terminated his life in February 1603–4. A monument was erected to his memory at Croydon, where he was interred. Whitgift was neither a man of learning, the Latin language bounding his claſſical literature, nor a profound theologian. He was principally diſtinguiſhed by his vigour and activity as a man of buſineſs. As a preacher he was popular; and this talent in which he excelled laid the foundation of his advancement. Biog. Brit. Hume's Hiſt. Gen. Biog.

WHITING, in *Ichthyology*, the Engliſh name of a common fiſh of the aſellus kind, commonly diſtinguiſhed by the writers in ichthyology by the name of *aſellus mollis*, though by ſome called *aſellus albus* and *merlangus*.

The whiting, or gadus merlangus of Linnæus, is a fiſh of an elegant form; the upper jaw is the longeſt; the eyes are large, the noſe ſharp, and the teeth of the upper jaw long,

long, appearing above the lower when closed: the first dorsal fin has fifteen rays, the second eighteen, and the last twenty. The colour of the head and back is a pale brown; the lateral line white and crooked; the belly and sides silvery; the last streaked lengthways with yellow.

Whitings appear in large shoals in our seas in the spring, keeping at the distance of about half a mile to that of three miles from the shore. They are the most delicate and wholesome of any of the genus; and seldom grow to more than ten or twelve inches in length. Pennant.

No whiting is to be taken in the Thames or Medway of less size than six inches from the eye to the end of the tail, or at any time except from Michaelmas-day to Ember week. (30 Geo. II. cap. 21.) Nor under six inches any where else. 1 Geo. I. stat. 2. cap. 18.

Whiting-*Pollack*. See Gadus *Pollachius*, and Pollack.

Whiting-*Pout*. See Pouting, and Gadus *Barbatus*.

Whiting, in *Geography*, a township of Vermont, in the county of Addison, with 565 inhabitants; 25 miles N. of Rutland.

Whiting *Bay*, a small bay of the county of Waterford, Ireland, a little E. of Youghal bay.

WHITLEY, a township of Pennsylvania, in Greene county, with 1264 inhabitants.

WHITLOW, in *Surgery*, called also by surgeons *paronychia*, *panaritium*, *onychia*, &c. is an inflammation affecting one or more of the phalanges of the fingers, and generally terminating in an abscess. These are the parts which are the usual situation of the complaint; but sometimes a disease, which is precisely similar, makes its attack upon the toes. It is likewise to be understood, that in severe cases, the disorder extends itself to many other parts besides the finger, the matter making its way upward higher than the wrist. Thus, as Callisen justly observes, the skin, cellular substance, sheath of the flexor tendons, and less commonly that of the extensors, the tendons themselves, the annular and capsular ligaments, the periosteum, the very texture of the finger-bones, and the pulpy substance underneath the nail, are all parts to which a whitlow may extend its mischievous consequences.

From what has been already observed, it must be plain that whitlows differ very much in their degree of violence, and in their depth and extent. Hence, surgical authors usually describe four or five varieties of the complaint. The division adopted by Callisen comprehends five cases; namely, the *cutaneous* or *superficial paronychia*, the *subcutaneous paronychia*, the *paronychia of the tendons*, or *theca*, the *paronychia of the periosteum*, and the *subungual paronychia*, or *that situated underneath the nail*.

The *cutaneous paronychia* begins with a superficial inflammatory redness of the finger, and, as early as the second or third day from the commencement of the attack, the cuticle of the part affected becomes raised in the form of vesicles, which contain a limpid serum, but sometimes a bloody fluid. (Callisen, vol. i. p. 294.) Mr. Pearson describes the cutaneous paronychia as being seated at the end of the finger, immediately below the cuticle, and as sometimes surrounding the finger and root of the nail. The skin, he says, is very little discoloured. The case speedily advances to suppuration; and when this process is completed, the cuticle appears almost transparent. After the contents of this little abscess are evacuated, the ulcer seldom demands any particular attention. Principles of Surgery, p. 88. edit. 2.

The *subcutaneous paronychia* makes its appearance in the form of an inflammatory tumour, attended with a great deal of acute pain. The symptoms, however, are not alarming, nor do they generally extend beyond the inflamed finger. In severe examples, the whole hand is more or less affected with pain and tension, and uneasiness is felt all up the arm. The severity of the pain, in such cases, frequently prevents sleep, and the whole system is thrown into some disorder. The attack of this kind of whitlow is attended with a more acute and throbbing pain than that of the cutaneous paronychia, suppuration proceeds more slowly, and matter is frequently formed under the nail. The disease is particularly situated in the cellular membrane under the cutis.

The *more deeply-seated kinds of whitlow* are those affecting the sheath of the flexor tendons and the periosteum, which parts, indeed, by reason of their vicinity to each other, are often both attacked together. The disease commences with an intense, burning, shooting, throbbing pain in the finger, accompanied with severe febrile symptoms. At first, no swelling whatsoever can be perceived in the part affected; but afterwards a slight œdematous tumour follows, which gradually assumes an inflammatory appearance, and the tumefaction spreads from the finger to the hand, and forearm, and even to the axilla. On the inner side of the arm, red hard streaks may also frequently be observed, which are inflamed absorbent vessels tending to the axillary glands, which are themselves sometimes enlarged and very painful. The pain of the whitlow is particularly felt shooting up from the affected finger to the inner condyle of the humerus, and thence to the arm-pit. Delirium, and other alarming symptoms, occasionally attend these worst descriptions of whitlows, which are alleged to have proved sometimes fatal. The matter, which is small in quantity, is either collected within the sheath of one of the tendons, or it is under the periosteum in contact with the bone, which is generally found in a carious state; and sometimes the superincumbent integuments suffer sphacelation. See Pearson's Principles, p. 90.

The *subungual paronychia*, or that which especially occurs under the nail, commences with inflammatory symptoms, which are, however, much less urgent and dangerous than those of the preceding case; and the situation of the disease renders its nature quite obvious.

The usual exciting causes of whitlows are various external injuries, as pricks, contusions, &c. The lodgement of a thorn or splinter in the part, is another frequent cause of these abscesses. They are, however, much more common in young healthy persons than in others; and they appear in many instances to occur spontaneously, that is to say, without our being able to assign any manifest cause for them. There is one particular sort of whitlow, which Mr. Pearson has thought proper to call *venereal*, as will be presently noticed.

With regard to the prognosis in ordinary examples of the complaint, it may be laid down that the cutaneous and subcutaneous paronychiæ are in general unattended with danger. But those whitlows which are formed within the theca of the flexor tendon, if they be not relieved by the timely interference of surgery, very often produce abscesses, extending up the hand and arm, in the course of the corresponding tendon and muscle, which parts become so altered and diseased, that their functions are permanently injured, and the bones of the finger destroyed by necrosis. When also the periosteum is affected, the matter lying underneath, or closely upon it, the neighbouring phalanx of the finger generally perishes. Whitlows beneath the nail frequently occasion a loss and separation of the part.

The indications in the treatment of whitlows are;

1. To endeavour to produce an early resolution of the inflammation; but as this attempt seldom succeeds, and the case almost proceeds to suppuration,

2. The

2. The great defideratum is to difcharge the matter as foon after its formation as poffible.

3. The laft thing is to heal the wound.

With refpect to the firft indication, experience proves, that the inflammation, in a very early ftage of the complaint, may fometimes be difperfed by the adoption of ordinary antiphlogiftic treatment. Here topical bleeding, efpecially the prompt and repeated application of leeches to the painful part feveral times in the day, is highly commendable; and the inflamed finger and hand may be covered with a cold, difcutient, faturnine lotion, together with which means fome writers advife the whole limb to be bound with a circular roller. Others fpeak highly of the good effects of an early immerfion of the affected finger in very warm water, or in lotions made of alcohol, vinegar, oil of turpentine, &c. and ufed as hot as can be borne. Callifen ftates, that he has alfo frequently obferved great benefit arife from the affufion of fuch lotions on the part. He even afferts, that the pain and more deeply-feated inflammation of the finger may be fometimes checked by applying cauftic or a blifter to the integuments. When the patient's fufferings are very great, the exhibition of opium is indifpenfable after bleeding has been duly practifed. The fame writer alfo affirms, that electricity has been found ufeful at the very commencement of a whitlow.

When two days elapfe without any probability of refolution taking place, fuppuration ought to be promoted by the immediate and continued ufe of emollient poultices and fomentations. Nor fhould the furgeon wait for the abfcefs to point, but make an opening with lefs lofs of time, in proportion as the cafe becomes worfe. In examples where the pain is exceedingly violent, the incifion fhould not be deferred beyond the fourth day from the beginning of the pain. The opening ought alfo to be made at the part which was firft painful, and thence the cut fhould be continued longitudinally, and as deeply as the fituation of the matter. The lancet, indeed, if requifite, muft be introduced down to the bone, by which means a fmall quantity of deeply-feated confined matter may frequently be voided, and the pain and progrefs of the difeafe at once ftopped. Even when no matter is difcharged from the opening, an early incifion fometimes fpeedily relieves very fevere cafes of whitlow; probably (as Callifen obferves) on the principle of removing tenfion, and occafioning hemorrhage from the part. In thofe inftances, in which an incifion has not been practifed in due time, and the matter under the tendinous theca has fpread extenfively up the hand and arm, it is fometimes neceffary to make the opening free and ample, without injuring, however, the annular ligament. The difcharge of the abfcefs, and the evacuation of blood from the incifion, are followed by almoft immediate relief. When the matter is lodged under the periofteum, the bone is moftly found affected with necrofis. In cafes of this defcription, there are fome practitioners who prefer the removal of the difeafed phalanx, to awaiting a tedious and uncertain cure by the proceffes of nature. Callifen, however, informs us, that he has often feen the dead portion of the bone exfoliate, leaving the reft in a ftate of prefervation.

When a whitlow under the nail cannot be difperfed, the matter fhould be let out by an opening, practifed through the tranfparent part of the nail, or by the fide of it. Some furgeons adopt the plan of fcraping the nail, fo as to render it as thin as poffible, before they cut through it, which is an ingenious and commendable method. See Callifen's Syft. Chir. Hod. t. i. p. 293. 295.

In the fifth volume of the Medico-Chirurgical Tranfactions, Mr. Wardrop has defcribed a very inveterate and troublefome fpecies of whitlow, which, from its malignant character, he has called the *onychia maligna.* "The commencement of this difeafe is marked by a degree of fwelling, of a deep red colour, in the foft parts at the root of the nail. An oozing of a thin ichor afterwards takes place at the cleft, formed between the root of the nail and foft parts, and at laft the foft parts begin to ulcerate. The ulcer appears on the circular edge of the foft parts at the root of the nail; it is accompanied with a good deal of fwelling, and the fkin, particularly that adjacent to the ulcer, has a deep purple colour. The appearance of the ulcer is very unhealthy, the edges being thin and acute, and its furface covered with a dull yellow, or brown-coloured lymph, and attended with an ichorous and very fetid difcharge. The growth of the nail is interrupted, it lofes its natural colour, and at fome places appears to have but little connection with the foft parts. In this ftate (fays Mr. Wardrop), I have feen the difeafe continue for feveral years, fo that the toe or finger became a deformed bulbous mafs. The pain is fometimes very acute; but the difeafe is more commonly indolent, and accompanied with little uneafinefs. This difeafe affects both the toes and the fingers. I have only obferved it on the great toe, and more frequently on the thumb, than any of the fingers. It occurs, too, chiefly in young people; but I have alfo feen adults affected with it."

With regard to the treatment of the fpecies of whitlow named by Mr. Wardrop *onychia maligna*, all local applications have in many inftances proved quite ineffectual, and the part been amputated. The only local treatment which Mr. Wardrop has ever feen relieve this complaint has been the evulfion of the nail, and afterwards the occafional application of efcharotics to the ulcerated furface. We have feen a fimilar plan occafionally fucceed, and the applications which appeared to anfwer beft were, arfenical lotions, Plunket's cauftic, or a very ftrong folution of the nitrate of filver. Nothing, however, will avail till the nail is removed, and its total feparation fometimes takes up a good deal of time, unlefs the patient fubmit to the great pain of having it cut away.

Mr. Wardrop tried with fuccefs the exhibition of mercury in four cafes of the onychia maligna. The medicine was given in fmall dofes at firft, and afterwards increafed, fo as to affect the gums in about twelve or fourteen days. The fores in general foon affumed a healing appearance when the fyftem was in this ftate, and the bulbous fwelling gradually difappeared. Wardrop in Medico-Chir. Tranf. vol. v. p. 135, &c.

Mr. Pearfon has publifhed an account of a peculiar fort of whitlow, to which he affixes the epithet *venereal.* He obferves, that it generally appears in the form of a fmooth, foft, unrefifting tumour, of a dark red colour, and is fituated in the cellular membrane about the root of the nail. It is attended with an inconfiderable degree of pain in the incipient ftate; but as fuppuration advances, the pain increafes in feverity. The progrefs of the abfcefs to maturation is generally flow, and is feldom completed.

When the matter is evacuated, the nail is generally found to be loofe, and a very foul but exquifitely fenfible ulcer is expofed; and confiderable floughs of cellular membrane, &c. come away, fo as to render the fore fometimes very deep. The difcoloured and tumid ftate of the fkin commonly extends along the finger, confiderably beyond the margin of the ulcer. In fuch cafes, the integuments of the finger become remarkably thickened, and the cellular membrane is fo firmly condenfed, as not to permit the fkin to glide over the fubjacent parts. The bone is not ufually found in a carious ftate.

According to the fame author, this fpecies of whitlow is more frequently feen among the lower clafs of people, when they labour under lues venerea, than in the higher ranks of life. It does not appear to be connected with any particular ftate of the difeafe, nor is it confined to one fex more than the other. In the Lock Hofpital, it is faid to occur in the proportion of one patient in five hundred.

In adopting the name of *venereal paronychia*, Mr. Pearfon informs us, that it is not with the defign of implying that the cafe is a true venereal abfcefs, the matter of which is capable of communicating fyphilis to a found perfon. Its progrefs and cure, he obferves, feem to be unconnected with the increafed or diminifhed action of the venereal poifon in the conftitution, and to be alfo uninfluenced by the operation of mercury. Mr. Pearfon confiders the venereal difeafe as a remote caufe, which gives occafion to the appearance of this as well as of feveral other difeafes, which are widely different from its own fpecific nature.

In the incipient ftate of the venereal whitlow, when no fevere fymptoms are prefent, Mr. Pearfon thinks it beft to ufe no external applications, and merely cover the part with a bit of fine rag. The difeafe will then often gradually difappear of itfelf, without coming to fuppuration. When matter is formed, Mr. Pearfon fays, the abfcefs may be permitted to burft fpontaneoufly. Every fpecies of dreffing will frequently be found to give great pain, and difagree with the fore. The fame writer, however, ftates, that one application, compofed of equal parts of the balfam of copaiva and tinctura thebaica, may fometimes be ufed with a good effect. The principal object is to keep the patient as eafy as poffible, by the internal ufe of opium, until the floughs are feparated, and the ulcer becomes clean. It may then be treated as a common fore: Peruvian bark will alfo be generally proper. In the thickened difeafed ftate of the integuments, Mr. Pearfon condemns amputation, as being likely to produce a ftump, which will change into a fore, refembling that for which the operation was performed. See Pearfon's Principles of Surgery, edit. 2.

It is not at all clear to us, that Mr. Wardrop's cafe, which he terms the onychia maligna, is not actually the fame difeafe as what Mr. Pearfon has named the venereal whitlow. The only doubt arifes from the former gentleman's recommending the exhibition of mercury as a means of cure; while the latter declares, that the complaint is quite uninfluenced by the operation of this medicine. We confefs, that although fome hundreds of cafes of very bad whitlows have fallen under our obfervation, we have never met with any inftance in which the cure feemed to require mercury.

Whitlow *in the Feet of Sheep*, in *Rural Economy*, a difeafe that takes place in the latter end of fummer, and which is more frequent among the long than the fhort fort of fheep. It but feldom happens in clean fheep-walks, though it is very troublefome on foft, dirty, pafture-lands. It is frequently occafioned in the milking feafon, by the boughts or folds being dirty, and by the fheep being confined in the old houfes. It is of the inflammatory nature, and commonly affects the fore-feet, but fometimes all four. The outer part of the hoof is the ufual feat of the difeafe, and from the cleft a fharp fetid humour exudes, fometimes engendering maggots, and corroding the flefh, nay even the bone. All around the hoof there is an inflammation, which turns black, and this part fometimes drops off. It is a very painful affection, fo much fo, that the animal often crawls. As the weather gets more cold, it commonly becomes better, but it ftill walks in a lame manner.

On the appearance of the difeafe the foot is to be examined, and the difeafed part opened to let out the acrid matter. It is then to be wafhed well, and dreffed with mercurial ointment and fulphur in mixture, or tar with red precipitate, binding it up with a flannel bandage, to preferve it warm and clean. In cafe it does not take on fuppuration, but degenerates into a foul and tedious ulcer, fuch applications as fpirit of turpentine and fulphuric acid may be proper. And in all cafes the fheep fhould be kept in a clean, eafy, dry pafture, until it becomes well. See Foot-*Rot*.

Whitlow-*Grafs*, or *Mountain Knot-Grafs*, in *Botany*. See Paronychia, or Illecebrum.

Whitlow-*Grafs* is alfo a name given to fome fpecies of draba.

Whitlow-*Grafs*, *Rue-leaved*, a fpecies of faxifrage.

WHITSTABLE, in *Geography*, a village and fea-port of England, in Kent, near the mouth of the Swale. Here is a confiderable oyfter-fifhery, which employs upwards of 70 boats. Some colliers likewife bring hither coals for Canterbury and the neighbourhood; 7 miles N. of Canterbury. N. lat. 51° 22'. E. long. 1° 2'.

WHITSUN Island, an ifland in the South Pacific ocean, difcovered by captain Wallis on Whitfun-eve, in the year 1767, about four miles long and three wide, furrounded by a reef. The boat's crew got fome cocoa-nuts, and fome fcurvy-grafs: they met with none of the inhabitants, but fome huts and feveral canoes building. No anchoring place for the fhip could be difcovered. S. lat. 19° 26'. W. long. 137° 56'.

Whitsun, or *Whitfunday Ifland*, or *Pentecoft*, one of the New Hebrides, in the South Pacific ocean, about thirty miles in length, and eight in breadth. S. lat. 15° 44'. E. long. 168° 20'. See *New* Hebrides.

Whitsun *Farthings*. See Pentecostals.

WHITSUNDAY'S Passage, in *Geography*, a ftrait fo called by captain Cook, from the day on which he failed through it, in 1770; between Cumberland ifland and the coaft of New Holland.

WHITSUNTIDE, the fiftieth day after Eafter.

The feafon properly called *Pentecoft*, is popularly called *Whitfuntide*; fome fay, becaufe in the primitive church, thofe who were newly baptized came to church between Eafter and Pentecoft, in *white* garments.

Whitsuntide *Bay*, in *Geography*, a bay on the north coaft of the ifland of Kodiack, weft of Cape Whitfunday.

WHIT-TAWER, in *Rural Economy*, a provincial term applied to a collar-maker for team-horfes.

WHITTINGHAM, in *Geography*, a town of Vermont, in the county of Windham, with 1248 inhabitants; 16 miles E. of Bennington.

WHITTLE, a provincial name applied to a fort of pocket or fheathed knife.

WHITTLEBURY Forest, in *Geography*, a royal foreft of England, in Northamptonfhire.

WHITTLESEA Mere, a lake of England, in the county of Huntingdon, formed by a branch of the river Nen, fituated to the S.E. of Peterborough.

WHITTLESEY, or Whittlesea, a town in the north part of the hundred of Witchford, Ifle of Ely, and county of Cambridge, England, is fituated on the confines of Northamptonfhire and Lincolnfhire, at the diftance of 10 miles W.S.W. from the town of March, and 5 miles E. by N. from Peterborough. It contains two parifhes, St. Mary's and St. Andrew's; but their boundaries cannot be diftinctly diſtinctly aſcertained, and they are ſo far conſolidated, that, though in ſeparate patronage, the two livings are generally held by the ſame perſon ; and only one regiſter of births and burials is kept for both. Whittleſey formerly had a market ; but when or by whom granted, there are no exiſting records. The market-day was Friday ; but it has long been gradually falling into diſuſe, and ſince the year 1788 has been wholly diſcontinued. An annual fair for horſes is ſtill held. Each pariſh has a church, in which are various ſepulchral memorials of ancient families. St. Andrew's church was given to the monks of Ely in the twelfth century, by Nigellus, ſecond biſhop of that ſee, for the purpoſe of augmenting their library, or, as it is expreſſed by an hiſtorian of that time, "making books for the library." At the weſt end of St. Mary's church is a very handſome tower, ſurmounted by a tall and elegant ſpire, which from its height conſtitutes a very conſpicuous object from diſtant parts of this flat country. The tower is much ornamented with niches, pinnacles, and quaterfoils ; and each angle of the octangular ſpire, which connects with the angular pinnacles of the tower by flying buttreſſes, is adorned with foliated crockets. There is in the town a charity-ſchool for the inſtruction of twenty-ſeven children, and ſeveral almshouſes.

Whittleſey, excluſive of the town, is divided into five diſtricts, named Eltry, Cotes, Eldernal, Willow-hall, and Glaſſmoor. At Eldernal was a chapel, conſecrated in 1525, but long ſince dilapidated. At Glaſſmoor were found, about the year 1742, ſeveral Roman lamps made of the red ware. The population of the whole, in the return of the year 1811, is ſtated to be 4248, occupying 729 houſes. Lyſons's Magna Britannia, vol. ii. Cambridgeſhire, 1808.

WHITTON, a town of England, in Lincolnſhire, on the ſide of the Humber ; 15 miles N.N.W. of Glamford Briggs.

WHOLAGUNGE, a town of Hindooſtan, in Oude ; 12 miles N.E. of Fyzabad.

WHOLDYACHUCK, a lake of North America. N. lat. 60° 20′. W. long. 109° 30′.

WHOLE, Totum, in *Arithmetic*, &c. See Part, Division, Partition, &c.

Whole, in *Logic*, is diſtinguiſhed into four kinds ; *viz.* a *metaphyſical*, when the eſſence of a thing is ſaid to conſiſt of two parts, the genus and the difference ; *mathematical* or *integral*, when the ſeveral parts which go to make up the whole are really diſtinct from one another, and each of them may ſubſiſt apart ; *phyſical* or *eſſential*, uſually denoting and including the two eſſential parts of man, body and ſoul, but more properly including all the eſſential modes, attributes, or properties, contained in the comprehenſion of any idea ; and *logical*, called alſo *univerſal*, the parts of which are all the particular ideas to which this univerſal nature extends. Watts's Logic, p. 117.

Whole *Blood*, *Meaſure*, *Number*, and *Sine*. See the ſubſtantives.

Whole *Milk-Cheeſe*, in *Rural Economy*, a term uſed to ſignify ſuch cheeſes as are made from the whole meal of milk, in contradiſtinction to thoſe which are made from a part of it only. It is obſerved in the Glouceſter Report on Agriculture, that coward-cheeſe ought to be made of the whole meal of milk ; but in a dairy of twenty cows, it is not unuſual to ſet by a pan, of about ſeven or eight gallons, till the next milking, which is then ſkimmed, and added to the new meal, from which a ſimilar quantity is taken as before. The cream thus laid by is made into milk-butter. Coward-cheeſes are either thin, about eight to the hundred ; or thick, generally called double Glouceſter, about four to the hundred, or even larger. The latter are made in May, June, and July, principally, and even as long as graſs continues good in ſome dairies.

It is noticed, too, in the ſame ſort of report for the county of Peebles, in Scotland, that in the ſheep-farms there, where ſheep's-milk cheeſe is made, the whole of that ſort of milk is ſeldom employed ; but that the whole of the cow's milk upon the farm is mixed with the ſheep's milk. That the butter, during this period, being ill-taſted, is kept for mixing with the tar for ſmearing the ſheep ; and the milk is afterwards made into cheeſe. There are, in conſequence, very few farms where cheeſe is made of entire ſheep's milk ; and that, from the various proportions of the admixture of cow's milk, there are few articles in commerce paſſing under one common denomination, of which the qualities are ſo various as thoſe of ſheep's-milk cheeſe. See Dairying, and Cheese.

Whole-*Moulding*. The impropriety of continuing whole-moulding in the conſtruction of ſhips, has been pointed out in the article Ship-building : but as it is at preſent continued in the formation of boats ; therefore, how far whole-moulding may be uſed in the conſtruction of boats, we ſhall endeavour to explain by introducing a boat, which might be whole-moulded from the ſtem to the ſtern-poſt, if part of the midſhip-bend was approved of for the ſhape of the tranſom ; but as there can be no neceſſity that it ſhould be ſo far whole-moulded, we ſhall omit it to the ſtern-poſt, but extend it quite forward to the ſtem.

The length, ſtem, and ſtern-poſt, being determined on in *Plate Ship*, *fig.* 1, the next thing is the ſtation of the midſhip-frame, which is not of material conſequence, only let it be before the middle of the boat. Then ſet off all the ſtations of the timbers afore and abaft the midſhip-bend.

The height in the midſhips being given, draw the ſheer-line, or top of the gunwale, ſo that it may have an agreeable appearance. The line below it ſhews the breadth of the ſheer-ſtrake, and the ticked line above it ſhews the upper edge of the waſh-board.

The next thing is the riſing-line, which requires ſome experience to determine at once, ſo as to anſwer every purpoſe ; for not only the form of the midſhip-bend, but likewiſe the deſign of the boat muſt be kept in mind, to know how far we may venture to lift the riſing-line afore and abaft, without occaſioning any hindrance to her ſtowage.

Having determined the height of the riſing-line, diſpoſe of the main height of breadth-line at the midſhip-bend, at ſuch height as will beſt ſuit the intended form of the midſhip-bend, and continue it from thence forward and aft, parallel to the riſing-line ; for ſo far as the boat is to be whole-moulded, the main height-of-breadth and riſing-line muſt be parallel to each other in the direction of the ſquare timbers.

In the half-breadth plan, *fig.* 2, ſquare down from the ſheer-plan, *fig.* 1, when the height-of-breadth line croſſes the fore part of the rabbet of the ſtem, and the aft part of the rabbet of the ſtern-poſt, or aft-ſide of the tranſom. But as this line riſes above the tranſom abaft, obſerve where the top of the ſide croſſes the aft part of the tranſom, and draw it parallel down from any of the ſtations of the timbers. Alſo ſquare down the ſtation of the midſhip-bend.

Set off from the middle-line, A B, *fig.* 2, the half-thickneſs of the ſtem, and from thence ſweep an arch to the

thickneſs

thickneſs of the board uſed for the bottom, the back of which arch will give the ending of the fore part of the main-half-breadth line. Then ſet off the half-breadth to the outſide of the timber at the midſhip-bend, and draw C D parallel to A B. Determine the breadth of the tranſom at the top of the ſide, and ſet off the half-breadth on the line for the aft-ſide of the tranſom.

Thus we have three ſpots, one at the aft-ſide of the tranſom, one at the midſhip-bend, and one at the ſtem, through which draw an unlimited curve; obſerving to make it faint about half the length of the boat in midſhips, and to form the bow by part of a circle.

To form the Midſhip-bend.—Draw the horizontal line A B (*fig.* 3.), and erect a perpendicular in the middle; then take the half-breadth of the boat at the midſhip-bend, in *fig.* 2, and ſet it off on each ſide the middle-line, and erect the perpendicular C D. Take the height from the line A B, *fig.* 1. (which is the upper edge of the rabbet of the keel) to the riſing-line, and to the height-of-breadth line at the midſhip-bend; and ſet off above the line A B on the perpendicular C D, *fig.* 2, and draw the lines marked M B, and "Riſing."

The diſtance from the riſing-line to the height-of-breadth line, is the radius of the circle intended for the midſhip-bend; which diſtance, ſet off from the point where the half-breadth line interſects the ſide perpendicular, *c*, on the height-of-breadth line, will give the centre for the ſweep of the midſhip-bend; then ſweep an arch from the interſection of the perpendicular *c* to the interſection of the riſing-line.

From the middle-line ſet off the half-breadth of the keel on the line A B, and draw a ſtraight line from the ſide of the keel to the back of the arch of the midſhip-bend: let the top of the ſide above the height-of-breadth line be perpendicular, complete the other ſide of the middle-line the ſame from perpendicular D.

To form the ſquare Timbers of the Fore-Body.—Take the diſtance from the line A B, *fig.* 1. to the riſing-line at timber A B, &c. as far forward as timber I, and ſet them off, and draw lines parallel to the line A B, *fig.* 3, from the middle-line towards the line *c*.

Then take the diſtance from the line A B, *fig.* 1, to the height-of-breadth line at each ſeparate timber, and draw them as before in *fig.* 3. parallel to A B.

Then take the half-breadth of each timber, A B, &c. in *fig.* 2, and apply each ſeparate diſtance from the middle-line in *fig.* 3, on the lines of their correſponding names for the height-of-breadth, and there make a ſpot.

Make a mould agreeable to the ſhape of the midſhip-bend, the lower part to agree with the riſing-line of the midſhip-bend, and extend as far beyond the middle-line as is neceſſary.

Croſs the height-of-breadth on the mould, and the middle-line, when it lies well with the midſhip-bend.

Take the diſtance from the line C D, *fig.* 2. to the main-breadth line at timber A B, &c. and ſet them off from the middle-line on the lower ſide of the mould, towards perpendicular *c*, which ſhews the narrowing of each timber more than the midſhip-bend.

From the height-of-breadth line in *fig.* 1. take the diſtance to the top of the ſheer-ſtrake at each of the above timbers, and ſet them off above the main-breadth, on the mould, which gives the heads of all the timbers in the fore-body.

The lower edge of the mould is ſuppoſed to be the height of the riſing-line from the timbers.

Then apply the lower edge of the mould on each riſing-line, *fig.* 3, and move it till each letter on the lower edge of the mould agrees with the middle-line, and the main-breadth on the mould agrees with its correſponding height-of-breadth line. Then draw the form of the mould from the head of the timber to the middle-line, as ticked in *fig.* 3, and draw a ſtraight line from the ſide of the keel, at the upper edge of the rabbet, to touch the outſide of the curve formed by the mould, except where the rabbet of the keel and ſtem riſes, as at F, G, H, I.

Set off the half-thickneſs of the keel from the middle-line, *fig.* 3, and take the height from the line A B, *fig.* 1. to the lower edge of the rabbet at each timber, and ſet it from the line A B, *fig.* 3, on the line for the half-thickneſs of the keel or ſtem; then with compaſſes ſet to the thickneſs of the bottom plank, ſweep an arch; from the upper ſide of which draw a ſtraight line to the back of each curve of the mould, which will finiſh completely the heels of the timbers.

The ſame method muſt be obſerved in the after-body towards perpendicular D, *fig.* 3, applying the midſhip-bend mould in the ſame manner as directed in the fore-body, making uſe of the mould as far aft as timber 12.

The after-ſquare timber is 9; therefore, to 9 may be finiſhed the heels of the timbers, by drawing a ſtraight line from the back of the whole-moulding curve to the back of the ſweep at the rabbet of the keel.

In whole-moulding, but few moulds are neceſſary to be made to mould all the timbers. Thus the floor-mould is to be made to the midſhip-bend in *fig.* 3, a little above the diagonal line, *a b* or *a c*, which is to be the heads of the floors, and let the lower part of the mould correſpond well with the riſing of the midſhip-bend, as is ſhewn in *fig.* 4.

When the mould lies well, as in *fig.* 3, mark the middle-line on the lower edge of the mould, and the head of the floor on the outer edge. Make the inſide of the mould to its proper ſcantling, and let the upper edge correſpond well with the cutting-down of the inſide of the midſhip-floors; which cutting-down is ſo marked in *fig.* 1.

Then in *fig.* 2. take the diſtance of each timber from the line C D to the main-half-breadth line, and ſet them off on the lower edge of the mould, from the middle-line of the midſhip-bend towards the outer end of the mould, which is the middle-line for each floor.

Now fix the lower edge of the mould in *fig.* 3. on each riſing-height, in the ſame manner as the timbers were got in by whole-moulding; and when each mark on the mould is well with the middle-line, and on its proper riſing, deſcribe on the outer edge of the mould the heads of the floors, or the diagonal line *a b*, or *a c*.

Or, as in *fig.* 4, ſquare the middle-lines of each timber, and then take the half-breadths of each floor from *fig.* 3. and ſet them off ſquare from each middle-line in *fig.* 4, to interſect the edge of the mould.

The lower Futtock-Mould, fig. 5, is made to the riſing-height of the midſhip-bend, and from thence to the top of the ſheer; but need not be made ſo long at the heel as the floor-mould. The inſide is made to the ſcantling, and the croſſing of the middle-line and the floor-head, on the lower futtock-mould, is done in the ſame manner as on the floor-mould; or the beſt way is to lay the floor-mould on the lower futtock-mould, and croſs it by the floor-mould. When the lower futtock-mould is laid in its place to the midſhip-bend in *fig.* 3, then mark the main-breadth on the mould, which is the main-breadth for all the timbers. Then take the diſtance in *fig.* 1. from the main-breadth line to the top of the ſheer at each timber, and ſet it off on the mould, from the main-breadth

breadth upward, which is the heads of all the timbers; and then the crofling of the lower futtock-mould is finifhed.

To crofs the rifing Square.—When the boat is whole-moulded, the floors and lower futtocks are generally moulded by the ufe of the rifing-fquare; which is fo called, becaufe when the fquare is properly placed to mould any timber, one fide of the fquare correfponds with the rifing of that timber. When the timbers are moulded by the outfide of the mould, and the heels by the rifing-fquare, (which gives the upper edge of the rabbet of the keel, or bearding-line,) then there is a batton, called a cutting-down batton, with the heights of all the floors, from the upper edge of the rabbet of the keel to the cutting-down line; which gives the cutting-down or infide of all the floors.

To make the rifing-fquare, let one fide of the fquare be of fufficient breadth to receive the rifing and the cutting-down, as may be feen by the fquare E.

When moulding the floors, or lower futtocks, the lower fide of the mould is the rifing of the timber; and confequently the edge of the fquare, which is to be applied to the under fide of the mould, is alfo the fame.

Then to mark or crofs the fquare, take the diftance from the rifing-line in *fig.* 1. to the upper edge of the rabbet of the keel, or bearding-line, at each timber; and fet them off from that edge of the fquare which is to be applied to the mould, on the other edge of the fquare, and clofe to the edge, drawing a margin to put the letters or figures under them. Then take the diftance in *fig.* 1. from the rifing-line to the cutting-down line, at the timbers, where the cutting-down is below the rifing, and fet them off from the edge of the fquare that is to be applied to the mould on the other edge of the fquare, but within the rifings, as may be feen on the fquare. The other timbers, from 3 to B, where the cutting-down is above the rifing, may be marked on the moulds.

From the edge of the fquare where the rifings are placed, fet off on the other edge of the fquare the half-thicknefs of the keel, which call the middle-line; and then the fquare is ready for moulding.

To mould the Floors.—The beft way for moulding the floors for a whole-moulded boat, is to make two moulds, agreeable to the former directions, made and croffed both alike, but the fides reverfed. Then lay one on the other, the fame as in *fig.* 4, keeping the lower edges in a ftraight line, and mooring them till the correfponding middle-lines on the moulds agree. The moulds in *fig.* 4. are fixed at 9, but the middle-lines on the lower mould cannot be feen; therefore, before the moulds are put together, it is beft to mark (in chalk) on the edges of the mould the middle-lines of the timber. When the moulds are placed, fix the middle-line, marked on the edge of the fquare, to the middle-line on the mould of the timber, and the other edge of the fquare will reprefent the fide of the keel.

Then apply a ftraight batton to the rifing of 9, on the edge of the fquare, and alfo to the outfide of the floor-mould. This will give the moulding of the outfide of the floors, except timber 9, which is fomewhat hollow. Then fquare the cutting-down for 9, acrofs to the edge of the fquare, and draw a ftraight line to touch the infide of the mould.

In the fame manner mould the other arm of the floor, by canting the fquare. But the rifing and cutting-down fhould be marked on both fides.

Before the moulds are moved, mark the heads and firmarks, if any, as a guide to fix the lower futtock when put in its place, if it fhould not run down to the fide of the keel.

To mould the lower Futtocks.—The lower futtock-mould is *fig.* 5, which is made in the fame manner as the floor-mould, but continued as high as the top of the fheer. The upper part being ftraight and perpendicular, and the mould made to the fcantling, there is no difference between moulding one fide of the floors and moulding the lower futtocks.

The fame method of fixing the fquare for the moulding of the floors will ferve to mould the lower futtocks, as on the fquare in the plate, where the middle-line on the fquare is put to the middle-line on the lower futtock-mould for G. A ftraight batton applied to the rifing for G, on the fquare, and to the back of the lower futtock-mould, gives the moulding of the outfide of the lower futtock; and the cutting-down for G on the fquare brought to the edge of the fquare, a ftraight batton from thence to the infide of the mould will alfo be the infide of the lower futtock.

Mark the firmark, or floor-head, in the fame manner as the floors, in order to place the lower futtock to its proper height at the fide of the floors, in cafe they fhould not be required to run down to the fide of the keel.

Likewife mark the main-breadth, and the head for G, before the mould is moved.

That there is no difference between the floors and the lower futtocks in ufing the rifing-fquare, may be feen more clearly in *fig.* 4, where the floor-mould is continued up to the top of the fide, which makes the lower futtock-mould; fo that the form of the lower futtock is feen, as well as the floor.

The two floor-moulds may be made to ferve for all the floors, by putting the fore-body on one fide of the mould, and the after-body on the other; but obferve to crofs one mould oppofite to the other, fo that when it is canted over, it fhall then be proper to mould with.

Two rifing-fquares are fometimes ufed; one for the fore-body, and the other for the after-body; becaufe the fquares muft be croffed alike on both fides, to mould the arms of the floors, and likewife to mould the lower futtock for both fides of the boat. Or, inftead of this, the fore-body may be put on one fide of the fquare, and the after-body on the other. When the fquare is wanted on the oppofite fide, chalk on the edge of the fquare the rifing and the cutting-down for the timber to be moulded, and then cant the fquare.

Two lower futtock-moulds may alfo be made, or crofs the fore-body on one fide of the mould, and the after-body on the other. In order to mould a timber for that fide of the fhip where the firmarks are at the under fide of the mould, chalk the firmarks for the timber wanted on the edge of the mould; or make two margins on the edge of the mould, referving one for the fore-body, and the other for the after-body, and reverfed on the oppofite fide.

The lower futtocks for boats generally run about half way between the floor-head and the fide of the keel; but if it were a hoy, or fmall veffel that was whole-moulded, the lower futtocks might then be required to run to the fide of the keel, or dead-wood; wherefore, it is proper to fhew the moulding of them down to the fide of the keel.

Various are the methods ufed by different artificers in moulding the lower futtocks; and it is evident that the method which has been practifed moft will appear the beft.

Some will make no ufe of the fquare, but mark the heels of the lower futtocks on the mould, and provide a batton, marked the fame as the fquare; the lower end of the batton being long enough to mould the outfide of the foremoft and aftermoft timbers; and the upper end of the batton being long enough to mould the infide of the midfhip-timber.

Mark a firmark acrofs the batton, fuppofed to reprefent the fide of the fquare, which muft always be fitted well to the lower edge of the mould; from which firmark, fuppofed to be the rifing for all the timbers, fet off clofe to the edge of the batton the heels of all the timbers in the fore-body, or the diftance in *fig.* 1. from the rifing-line to the upper edge of the rabbet of the keel, or bearding-line.

Then draw a margin for the cutting-down of the timbers, and take the diftance in *fig.* 1. from the rifing-line of each timber to the cutting-down, and fet them off on the batton for the cutting-down, as much above or below the firmark on the batton as the cutting-down is above or below the rifing at each timber.

On the other fide of the batton may be put the after-body.

In fome boats or veffels, where the rifing and cutting-down are farther afunder at the midfhip-bend, then the batton will be as ufeful as the fquare; but inftead of the middle-lines being marked on the lower futtock-mould, it will be better to mark the fide of the keel, or where the keels of the lower futtocks are intended to be, for the better applying the batton.

If the heels of the lower futtocks do not run down to the fide of the keel, it will alter the rifings on the batton; the heels being marked on the mould fhort of the fide of the keel.

The proper heels of the lower futtocks fhould be marked on the mould, though moulded by the fquare; for then the edge of the fquare might be put to the proper mark on the mould for the heels of the timbers.

The middle-lines marked on the lower futtock-mould in the *Plate*, were intended only to fhew that the method of moulding the floors and lower futtocks were alike. The fquare is the beft to mould the floors, becaufe the middle-lines are the propereft to be marked on the floor-mould.

What has been faid may fuffice to fhew that whole-moulding may, in fome meafure, be ufed, and yet form a pleafing draught, much more fo than that of the boat in *fig.* 1, if lefs ftowage were fufficient to anfwer the purpofe for which fhe is defigned.

WHOLESOME Ship, in the *Sea Language*, one that will try, hull, and ride well, without rolling or labouring in the fea. A long fhip that draws much water may try, hull, and ride well; but if fhe draws little water, fhe may try and ride well, but never hull well; and a fhort fhip that draws much water may hull well, but neither ride nor try well; and fuch is called an *unwholefome* fhip.

WHORE. See Courtesan, Harlot, Concubine, &c.

WHORL, in *Botany*. See Verticillus.

WHORLBAT, or Hurlbat, a kind of gauntlet, or leathern ftrap, loaden with plumbets; ufed by the ancient Romans in their folemn games and exercifes; and by them called *ceftus*.

WHORLED Plants. See Verticillatæ.

WHORLES *of Flowers*, among *Herbalifts*, are rows of leffer flowers, fet at certain diftances about the main ftalk or fpike, as in penny-royal, &c.

WHORTLE-Berry, Bilberry, or *Cranberry*, in *Botany*. See Vaccinium.

The whortle-berry, with one flower upon each footftalk, oval-fawed leaves, which fall off in winter, and an angular ftalk, called *black whorts*, or *bilberries*, grows very common upon large wild heaths, in many parts of England, but is never cultivated in gardens, it being with great difficulty tranfplanted; nor will it thrive long when moved thither. The fruit is gathered by the poor inhabitants of thofe villages which are fituated in the neighbourhood of their growth, and carried to the market-towns. Thefe are by fome eaten with cream or milk; they are alfo put into tarts, and much efteemed by people in the North, but they are feldom brought to London.

The fhrub on which thefe grow rifes about two feet high, having many ftems, which are garnifhed with oblong leaves, fhaped like thofe of the box-tree, but fomewhat longer, and a little fawed on their edges. The flowers are fhaped like thofe of the arbutus, or ftrawberry-tree, of a greenifh-white colour, changing to a dark red toward the top. The fruit is about the fize of large juniper-berries, and of a deep purple colour, having a flue upon it when untouched, like the blue plums, which is rubbed off with handling.

The whortle-berry with nodding bunches of flowers terminating the branches, and oval leaves which are entire, turned back and punctured on their under fide, called *vitis idæa*, and *red whorts*, is an ever-green fhrub, feldom rifing above fix or eight inches high, with leaves like thofe of the dwarf-box, which grows upon moors in feveral parts of the North, but is not capable of being eafily tranfplanted: the berries are red, and have a more agreeable acid flavour than thofe of the firft fort.

The whortle-berries with oval, entire, reflexed leaves, and naked, flender, creeping ftalks, called *mofs-berries*, *moor-berries*, and *cran-berries*, produce branches fmall as thread, and trailing upon the moffy bogs, which are garnifhed with leaves refembling thofe of thyme, with the upper furface of a fhining green, and white underneath. The berries, which grow upon long flender foot-ftalks, fucceeding the flowers, are round, red, and fpotted, of a fharp acid flavour, and much efteemed for tarts, or eaten with milk or cream. This is a native of bogs, and cannot be propagated upon dry land.

There are feveral other fpecies of this genus, fome of which are natives of Spain and Portugal, others of Germany and Hungary, and feveral of the northern parts of America; from whence thofe large fruits are brought to England which are ufed by the paftry-cooks of London, during the winter feafon, for tarts. But as all thefe forts grow naturally in fwamps and bogs, they are not eafily tranfplanted into gardens in their native country, fo as to thrive or produce fruit; therefore, there can be little hope of cultivating them to advantage. Miller.

Whortle-*Berry*, *African*, a fpecies of Royena.

Whortle-*Berry*, *Bear's*. See Uva *Urfi*.

WHUR, in *Falconry*, denotes the fluttering of partridges or pheafants as they rife.

WHY-EA-TEA, in *Geography*, a bay on the eaft coaft of Owhyhee. N. lat. 19° 44′. E. long. 204° 54′.

WHYMEA Bay, a bay on the north coaft of the ifland of Woahoo. N. lat. 21° 38′. E. long. 202° 51′.

Whymea *Road*, a road on the fouth-weft coaft of the ifland of Attowai. Captain Vancouver fays, this bay is much confined in refpect to fafe anchorage.

WHYTE, Robert, in *Biography*, an excellent compofer of church-fervices in the ftyle of Paleftrina, which, however, he could not imitate, as he was anterior to him, and a great mafter of harmony before the productions of this chief of the Roman fchool were publifhed, or at leaft circulated, in other parts of Europe. Whyte was dead in 1581, when his Latin Full Anthems and Services were beautifully tranfcribed in a fet of books, ftill preferved at Oxford;

Oxford; as we find by a diftich at the end of a prayer, in five parts, upon a plain fong: "Precamur Sancte Domine."

Maxima mufarum noftrarum gloria Whyte
Tu peris; æternum fed tua mufa manet.

Whyte preceded Tallis and Bird, and died before their fame was well eftablifhed. His works feem never to have been printed; but in the library of Chrift-church, Oxford, a fufficient number of them has been preferved in the Aldrich collection, to excite not only wonder, but indignation, at the little notice that has been taken of them by mufical writers. Morley, indeed, has given him a place in the lift of compofers at the end of his Introduction, and ranks him, with Orlando di Laffo, among *excellent men*, who had ventured to begin a compofition with a fourth and fixth; he likewife places him with Fairfax, Taverner, Shepherd, Mundy, Parfons, and Bird, "famous Englifhmen who have been nothing inferior to the beft compofers on the continent." And no mufician had then appeared who better deferved to be celebrated for knowledge of harmony, and clearnefs of ftyle, than Robert Whyte, as is manifefted in Burney's Hift. of Muf. vol. iii. by an anthem for five voices.

But befides this mafterly compofition, and a great number of others, to Latin words, which we fcored from the Chrift-church books, and which were probably produced at the latter end of Henry VIII.'s reign, or during the time of queen Mary, when the Romifh religion was ftill in ufe, we are in poffeffion of a fmall MS., which, by the writing and orthography, feems of the 16th century, entitled "Mr. Robert Whyte, his Bitts, of three Parte Songes, in Partition: with Ditties, 11; withoute Ditties, 16." Thefe are fhort fugues or intonations in moft of the eight ecclefiaftical modes, in which the harmony is extremely pure, and the anfwer to each fubject of fugue brought in with great fcience and regularity. Burney.

WHYTHORNE, Thomas, gentleman, in *Mufical Hiftory*, author of a book of fongs, printed by John Daye, in 1571, under the following title: "Songes of three, fower, and five voyces, compofed and made by Thomas Whythorne, gentleman, the which fonges be of fundrie fortes, that is to fay, fome long, fome fhort, fome hard, fome eafie to be fonge, and fome between both; alfo fome folemne, and fome pleafaunt or mery: fo that according to the fkil of the fingers (not being mufitians), and difpofition or delite of the hearers, they may here find fonges to their contentation and liking."

Our fecular vocal mufic, during the firft years of Elizabeth's reign, feems to have been much inferior to that of the church, if any judgment can be fairly formed of it from this book, publifhed before the fongs of Bird had appeared, and of which both the words and the mufic are alike truly barbarous. But we have, in our own time, mufic-books publifhed in England every day without genius or fcience to recommend them. And it is not certain that Whythorne's fongs were ever in much public favour. Now, if it fhould happen that one of thefe, by efcaping the broom of Time, fhould reach pofterity, and fall into the hands of fome future antiquary, critic, or hiftorian, who fhould condemn *all* the compofitions of the prefent age by *one*, that had, perhaps, been never performed or heard of by contemporary judges and lovers of good mufic, the fentence would furely be very unjuft.

WHYTT, Robert, F.R.S. in *Biography*, a diftinguifhed phyfician, was born at Edinburgh in 1714, educated at St. Andrew's, and ftudied phyfic firft at Edinburgh, and afterwards at London, Paris, and Leyden. He fettled in his profeffion at Edinburgh, where he became a fellow, then prefident of the college of phyficians, and in 1746 chairman of the inftitutions of medicine in the univerfity. As a medical practitioner and teacher, and alfo as a writer, he acquired celebrity. The firft of his publications was an "Effay on the Vital and other Involuntary Motions of Animals," 1751, in which he advances a theory different from that of Stahl, as he attributes thefe motions not to the foul, acting to a forefeen end, but to the power of ftimulus. In 1755 he publifhed "Phyfiological Effays, containing an Inquiry into the Caufes which promote the Circulation of the Fluids in the very fmall Veffels of Animals; with Obfervations on the Senfibility and Irritability of the Parts of Man and other Animals." Here he fuppofes that the action of the heart is not fufficient to propel the blood through the minuteft veffels, but that it is affifted by an ofcillatory motion of the veffels themfelves. Of this work, an enlarged edition appeared in 1761. His other works are, "An Effay on the Virtues of Lime-water in the Cure of the Stone," 1752; "Obfervations on the Nature, Caufe, and Cure of thofe Diforders which are commonly called Nervous, Hypochondriac, and Hyfteric," 1764; and fome papers in the Edinburgh "Effays and Obfervations, Phyfical and Literary." A pofthumous work appeared, entitled "Obfervations on the Dropfy of the Brain." Having long laboured under a complication of chronic complaints, he died in 1766. His fon publifhed an edition of all his works in 1768, 4to. under the infpection of fir John Pringle. Haller Bib. Anat. Gen. Biog.

WIA, in *Geography*, one of the fmall weftern iflands of Scotland, a little to the fouth of Benbecula. N. lat. 57° 22′. W. long. 7° 11′.—Alfo, one of the fmall Weftern iflands, near the eaft coaft of Barray. N. lat. 56° 58′. W. long. 7° 22′.—Alfo, a fmall ifland near the weft coaft of Skye. N. lat. 57° 21′. W. long. 6° 27′.

WIAMPA, or Winita, or *Sinpa*, a town of Africa, on the Gold Coaft, in the diftrict of Agonna.

WIANDOTS. See Wyandots.

WIAPOCO, or Little Wia, one of the navigable mouths of the Oroonoko.

WIBALDUS, in *Biography*, a perfon of note in the 12th century, defcended from a noble family in the bifhopric of Liege, completed his ftudies at Liege, and became a teacher firft at Vaffo, and afterwards at Stablo. In 1130 he was elected abbot; and in 1136 he accompanied the emperor Lotharius on his expedition to Italy, by whom he was employed in feveral important departments, and fixed as abbot in the monaftery of mount Caffino. But he quitted this monaftery in the following year, and returned to Germany. In 1146 he became abbot of the monaftery of Corvei on the Wefer, in which he was confirmed by king Conrad, to whom he was no lefs an object of confidence than he had been to Lotharius. He was no lefs a favourite with Frederic I., who had fent him twice as ambaffador to Conftantinople; but on his return from his laft miffion thither, he terminated his life at Buleltia, in Paphlagonia, in confequence, as it is faid, of poifon, which had been given to him in the month of July, 1158. His Letters, mixed with fome other works, one volume of which only remains, throw confiderable light on the ftate of fociety at that time, and on the ecclefiaftical hiftory of Germany. Gen. Biog.

WIBLINGEN, in *Geography*, a town of Bavaria, with a Benedictine abbey, near the conflux of the Iler with the Danube; 3 miles S.S.W. of Ulm.

WIBORGIA, in *Botany*. See Viborgia.

WIBURG, in *Geography*. See VIBORG.

WIBY, a town of Sweden, in the province of Nericia; 18 miles S.W. of Orebro.

WIC, denotes a place on the fea-fhore, or on the bank of a river. Though in the original Saxon, it more properly fignifies a *ftreet*, *village*, or *dwelling-place*; as alfo a *caftle*. See WYKE.

We often meet with *wic* in the Saxon writers, as a termination of the name of a town which had a complete name without it: as, *Lunden-wic*, that is, London-town; which fignifies no more than *London*. In the Saxon Annals, it is mentioned, that king Ethelbert made Melitus bifhop of *Lunden-wic*.

So, Ipfwich is written in fome old charters, *vill de Gippo*, and fometimes *villa de Gippo wico*; which is no variation, but the fame thing; for *Gipps* is the complete name, and the *Gipp-wic* is Gipps-town.

WICCAKAW, in *Geography*, a town of the ftate of Georgia; 22 miles N.N.W. of Oakfufkee.

WICHRA, a river of Saxony, which rifes three miles N. of Waldenburg, and runs into the Pleifs, 2 miles N. of Borna.

WICHTIS, a town of Sweden, in the province of Nyland; 27 miles N.N.W. of Helfingfors.

WICHTRACH, a town of Switzerland, in the canton of Berne; 12 miles S.S.E. of Berne.

WICK, a royal borough, market-town, and the county-town of the fhire of Caithnefs, Scotland, is fituated at the entrance of the fmall river Wick, the eftuary of which forms a good harbour, at the diftance of 279 miles N. from Edinburgh. The town is fmall, and the ftreets narrow and confined; but there are feveral refpectable buildings to ornament the place. The church is an old, dark, and ill-conftructed edifice. A weekly market is held on Fridays, and is well fupplied. The chief fources of commerce and induftry are the fifheries, which are profecuted with great attention and fuccefs. The town and borough-lands of Wick were anciently part of the earldom of Caithnefs: on the petition of George, then earl, a charter was granted by James VI. of Scotland, Sept. 24, 1589, erecting the town of Wick into a royal borough, under the fuperiority of that nobleman. In 1672 the whole earldom of Caithnefs was difpofed of to John Campbell, afterwards created earl Breadalbane, by whofe fucceffors it was fold to the family of Sinclair, in whom the fuperiority is ftill vefted. In 1716 the convention of royal boroughs fixed the fett or government of the borough of Wick. By this fett, the old magiftrates nominate two perfons, out of whom a provoft and two baillies are to be chofen by the free burgeffes: the provoft and two baillies fo elected have the right of choofing feven counfellors, a treafurer, and a dean of guild. Wick, in conjunction with the boroughs of Dingwall, Dornock, Kirkwall, and Tain, fends one member to parliament. The parifh of Wick is twenty miles long and ten broad; and in the population return of the year 1811 is ftated to contain 5080 inhabitants. Carlifle's Topographical Dictionary of Scotland, 4to. 2 vols. 1813. Gazetteer of Scotland, 1806. Beauties of Scotland, vol. v. Caithnefsfhire.

WICK, a river of Scotland, which runs into the Northern ocean, at Wick, in the county of Caithnefs.

WICKER, a twig of the ofier fhrub, fingle or wrought.

WICKER-*Bafket*, in *Rural Economy*, any fort of bafket which is made of wicker-work, or the plaited or twifted twigs of the willow, or other fuch kinds of young fhoots. See BASKET.

A fort of wicker-bafket or braid, too, is made ufe of in grafting in field, orchard, or fruit grounds. It is obferved in the Gloucefterfhire Report on Agriculture, that the grafts are fecured immediately after the compoft is put on, with "braids." Thefe are open wicker-bafkets in the form of an inverted cone, fitting the ftock below the place to which the compoft extends, and rifing about two feet high, and expanding at the top to nearly the fame diameter. This contrivance ferves not only to guard the grafts in their early ftate, but alfo to keep the fhoots to a proper compact form of growth. The practice chiefly prevails on the banks of the Severn, where the ofier (*falix viminalis*) is grown in great abundance.

In hop-grounds likewife large wicker-bafkets are employed for picking the hops into. See HOP.

And wicker-work of the bafket kind is made ufe of for many other purpofes of different forts.

WICKER-*Tree*, a name given by the Englifh to a tree, common in China, and defcribed by Kircher and others. It is, as it were, a rope twifted by nature, about an inch thick, and creeps along the earth often for above a hundred paces together, much embarraffing the way, but ferving for cables of fhips, feats, hurdles, beds, mats, and various other neceffary ufes It endures no vermin, and is much valued for being cool and refrefhing in the hot feafons.

WICKER-*Work*, in *Agriculture*, a fort of bafket-work on a large fcale, ufed for defending land from water of the fea or other kinds. It is obferved by Mr. Loudon, in his work on "Country Refidences," that in fome very fandy fhores, defences of the embankment kind may be made of wicker-work; and that three or four rows of paling may be made of different heights, and the intervals between them be filled with furze, brufhwood, ftraw, or any other fuch materials. It is thought that thefe materials would retain the fand as the tide paffed through among them; and that in a very fhort time a defence or fort of embankment would be formed of the fhelving kind, which fhould then be planted with the upright fea lime-grafs, in order to bind it. See EMBANKMENT, and WATER, *Sea*, *Defending Land from*. Alfo UPRIGHT *Sea Lyme-Grafs*, and ELYMUS *Arenarius*.

WICKERAD, in *Geography*, a town of France, in the department of the Roer. It gave name to a lordfhip, furrounded by the duchy of Juliers; 3 miles N.E. of Erkelens.

WICKET, of the French *guichet*, a little door within a gate; or a hole in a door, through which to view what paffes without.

WICKFORD, in *Geography*, a town of Rhode ifland, with a poft-office; 10 miles N.W. of Newport.

WICKHAM, commonly called *Market-Wickham*, to diftinguifh it from two other places of the fame name in the county, is a village and parifh in the hundred of Wilford, and county of Suffolk, England. It has been a place of much greater confequence than it is at prefent, and had a weekly market and town-hall, where the quarter-feffions were held. The fpiritual courts for the archdeaconry of Suffolk are ftill held here. The parifh-church, being built on a hill, conftitutes a land-mark for veffels failing by the coaft. From the tower, a fpectator may fee nearly fifty other churches. An aifle, or chapel, on the fouth fide of the church, was built by Walter Fulburn, of this parifh, who died, and was buried within its walls, in 1489. The rectories of Wickham, Pettiftree, and Bing, all in the hundred of Wilford, were bequeathed in 1718 by Mr. John Pemberton for charitable ufes. According to the population report of 1811, this parifh contained 133 houfes, and 906 inhabitants. It is 12½ miles N.E. of Ipfwich, and

and 81 in the ſame direction from London. The market, which was formerly held on Saturdays, has long been diſcontinued.—Beauties of England and Wales, vol. xiv. Suffolk, by F. Shoberl.

Wickham *Breaux*, and Wickham *Streyth*, the names of two other pariſhes in Suffolk, England.

WICKLIFFISTS, or Wickliffites, in *Eccleſiaſtical Hiſtory*, a religious ſect, who had their riſe in England in the 14th century, and their name from their leader *John Wickliffe*.

Wickliffe, of whoſe opinions we give ſome account in his biographical article, (ſee Wicliff,) denied that biſhops were of a different order from prieſts, and that by virtue of their office they had any power to do what prieſts have not; and that in the apoſtolic times the two orders ſubſiſting in the church were thoſe of prieſt and deacon. With regard to tithes, he obſerves, that we do not read in the Goſpel where Chriſt paid tithes, or commanded any man ſo to do; and that if they were due by God's commandment, there ſhould be every where in Chriſtendom one manner of tithing; and that thoſe things which are due to prieſts ſhould be given freely, without exaction or conſtraining. In oppoſition to the papal claims of ſupremacy and dominion, he maintained that the grants of emperors may be reſumed; that St. Peter and his ſucceſſors have no rights conferred upon them of civil or political dominion; that the perſons of the clergy and the goods of the church are not exempted from the civil powers; and that bulls of abſolution or excommunication are conditional and not abſolute, and depend for their effects on the diſpoſition and character of thoſe to whom they pertain.

Wickliffe defines hereſy to be error maintained againſt holy writ, and that in life and converſation, as well as in opinion. He ventured to affirm, that children who die without baptiſm may be ſaved; that this rite does not confer grace, but only ſignify that which was before given; and he denied that all ſins are aboliſhed by baptiſm. But in theſe and ſome other points, occurring in his various works, which were publiſhed at different times, he is not always perfectly conſiſtent; but in all matters of principal importance he is uniform.

He left many followers in England and other countries, who were called Wickliffites and Lollards, and who held their opinions in private without making any public profeſſion of them; though they were generally known by their diſparaging the ſuperſtitious clergy, whoſe corruptions were ſo notorious, and their cruelty ſo enraged, that it was no wonder the people were much prejudiced againſt them. Wherever they could be found, they were terribly perſecuted by the inquiſitors, and other inſtruments of papal vengeance.—Lewis's Hiſtory, &c. 8vo. paſſim. Moſh. Eccl. Hiſt. vol. iii. 8vo. Burnet's Hiſt. Reform. vol. i. p. 23.

WICKLOW, in *Geography*, a maritime county of Ireland, on the eaſt coaſt, having the county of Dublin on the north, the Iriſh ſea on the eaſt, the counties of Kildare, Dublin, and Carlow, on the weſt, and that of Wexford on the ſouth. Its extent from north to ſouth is 32 Iriſh ($40\frac{1}{2}$ Engliſh) miles; from eaſt to weſt, 26 Iriſh (33 Engliſh) miles; and the ſuperficial contents are 311,600 acres, or 486 ſquare miles, equal to 500,600 acres, or 780 ſquare miles Engliſh. Mr. Radcliffe, according to the county map, ſtates the ſuperficial contents at 305,404 Iriſh acres. There are 58 pariſhes, which have 20 churches, moſtly in the archbiſhopric of Dublin. Dr. Beaufort ſtates the population at 58,000. "A great part of Wicklow is rendered unfit for habitation, and incapable of culture, by mountains intermixed with rocks and bogs. However, though the heart of the county be a cheerleſs waſte, the hills on the eaſt and weſt ſides, and eſpecially along the coaſt, are from ſix to eight miles in breadth, being many of them well wooded, and intermixed with profitable and ſmiling valleys, form a delightful and various ſcenery. They are crowded with gentlemen's ſeats, and are not without ſmall towns and villages." This was Dr. Beaufort's account in 1792. In 1801, captain Frazer publiſhed a ſtatiſtical account for the Dublin Society. This gentleman laments, that "the Wicklow farmers foul the land by repeated corn-crops, and ſeldom or never lay it down to graſs with ſeeds." He deplores "the total neglect of the improvement of the breed of animals for ſtock and labour;" and under the head of ploughs he remarks, "the common plough in uſe in this diſtrict is the ſwing-plough; it is ſeldom, however, formed on any ſcientific principles, and is generally very clumſy, and ill-adapted for making clean or regular work." In 1812, however, when the Rev. Thomas Radcliffe publiſhed a Report of the Agriculture and Live-Stock of the County of Wicklow, a very great change had taken place. A few extracts from this intereſting publication will furniſh the reader with the moſt authentic information on the ſtate of this county, and of what has been effected by the exertions of the Farming Society of Ireland, its own local Farming Society, and the encouragement as well as example of good landlords.

The climate of the county is, in general, mild; but on the eaſtern ſide, along the ſea-coaſt, is peculiarly warm, and favourable to vegetation; inſomuch that there is almoſt a perpetual ſpring; and land of an apparently light quality is known to produce crops equal, if not ſuperior, to thoſe on the richeſt ſoils in other parts of Ireland. The crops commonly cultivated are, potatoes, wheat, barley, and oats. With reſpect to potatoes, the valuable ſyſtem of drilling is almoſt univerſally adopted. The quantity of wheat is inconſiderable: it is generally taken after the potatoe-crop, ſometimes after another white crop, or upon the lea; but the periodical fallow for wheat is fortunately unheard of. The barley-crop is taken after potatoes or turnips, and, like the wheat, is ſown under the plough. The oat-crop, by the common practice, is taken upon the lea; but if upon ſtubble-ground, it is ſown under the plough. The crops are not exceeded in quantity or quality in any part of Ireland. Green crops are not in much uſe among the tenantry. The manure in this county, beſides dung, conſiſts of brown, blue, and white marl, lime and lime-ſtone gravel. In the greateſt part of this county, the implements of the beſt conſtruction are in very general uſe; ſuch as the Scotch plough, as recommended and ſupplied by the Farming Society, the Scotch harrow, the Scotch cart, drill-machines, and even the threſhing-machine. Moſt of the improved breeds of cattle have been introduced into this county; but Wicklow cannot be conſidered as a breeding county. The dairies are numerous; but, on a contracted ſcale, averaging from eight to ſixteen cows, and almoſt uniformly engaged in the feeding of veal for the Dublin market. In the northern part of the county, much of the milk is conſumed in fattening early lamb. The county of Wicklow, though not to be claſſed as a breeding county with reſpect to cattle, is very extenſively ſo with reſpect to ſheep, its vaſt tracts of mountain ſupplying a wholeſome, though not an exuberant, paſture to that animal. The breed of this county is the mountain kind; and the number of breeding ewes may be ſtated at 20,000. The South Down are the favourites with the gentlemen; and many flocks of the native mountain have been croſſed with South Down. The Merino ſheep have alſo been ſucceſsfully introduced. The cotton manufacture is carried on with spirit at Stratford-upon-Slaney. The woollen manufacture is chiefly limited to the flannel-trade. This, however, is carried on largely, and is a source of fair profit and industrious occupation. It prevails on the property of earl Fitzwilliam, and the Flannel-hall at Rathdrum was built at his lordship's expence. The average annual sale is about 5000 pieces of 120 yards each.

The romantic beauties of this county have been often described. The vicinity to Dublin makes them easily accessible, and few travellers omit to visit them. The antiquities of Glendalough have been noticed in the proper place, under that name. The mineralogy of Wicklow has been noticed in Dr. Fetton's valuable Notes on the Mineralogy of the Neighbourhood of Dublin; and on this head Mr. Griffith's Report on the Mountain District of Wicklow should also be consulted. This uncultivated district has many peculiarities, which consist chiefly in the facility of access by means of roads; the vicinity of highly improved lands and industrious inhabitants; the frequent occurrence of beds of lime-stone, gravel, and marl; the best manure for the amelioration of mountain soils; and the uncommon mildness of the climate. These uncultivated lands occupy about 200,000 Irish acres, of which about 60,000 consist of black bog; the remainder is moory soil, generally covered by coarse sedgy grass, or grass intermixed with heath. In this district, many rivers have their sources. The Liffey, with its tributary streams, takes a circular course through the county of Kildare, and falls into the bay of Dublin; the Slaney runs southward to the county of Wicklow; the Fartrey disembogues itself at Wicklow; and the Ovoca at Arklow. (For an account of the Cronebane mines, see CRONEBANE.) At Croghan Kinshela, in the southern part of the county, a quantity of native gold has been extracted by washing from the alluvial soil, of which an account, by Messrs. Mills and Weaver, may be found in the Transactions of the Dublin Society. Near 600 ounces of gold, worth above 2000*l*., were extracted; but the vein could not be discovered, and the search for it was given up. Oxyd of tin was found in the same stream. The county of Wicklow has no large town, and has only the two members for the county to represent it in parliament. — Frazer's Survey. Beaufort's Memoir. Radcliffe's Report. Griffith's Report, &c.

WICKLOW, the assize-town of the preceding county, which is also a post-town. It is pleasantly situated on a small harbour, and near a beautiful strand abounding in fine pebbles, which is called the Murrough. The ale of Wicklow has been long celebrated in Dublin. It is 24 miles S.S.E. from Dublin.

WICKWA, a small lake of Canada, at the eastern extremity of Lake St. John.

WICKWAR, anciently WICKEN, a market-town in the hundred of Grombald's Ash, in the county of Gloucester, England, is situated 19 miles S.W. from Gloucester, and 108 miles W. from London, and consists of one long street. The town is incorporated and governed by a mayor and twelve aldermen. It has a weekly market on Monday, and two yearly fairs. In it two courts are held; one for the borough, and another for the tything, or foreign, which have separate constables. The clothing manufacture, which once flourished here, has long been on the decline; but the lower classes are still employed in spinning for the clothiers of other places. Wickwar contains a well-endowed free grammar-school, which was founded in 1684. The church, a handsome building on an eminence, consists of a nave and north aisle. The rectory is valued in the king's books at 18*l*. The resident population in 1801 was 764; in 1811 it had increased to 805.—Hist. of the County of Gloucester, by the Rev. Thomas Rudge, B.D. Gloucester, 1803, 2 vols. 8vo.

WICLIFF, DE WYCLIF, WICLEF, or WICKLIFFE, JOHN, in *Biography*, the earliest reformer of religion from Popery, was born about the year 1324 in Yorkshire, near the river Tees, in a parish whence he takes his name. He was educated at Oxford, first as a commoner of Queen's college, and then at Merton college, peculiarly celebrated at that period for its learned members. His industry and talents soon raised him to distinction; and he is said to have committed to memory the most abstruse parts of Aristotle, and to have excelled in his acquaintance with the subtleties of the school divinity. He was also eminently skilled in civil and canon law, and in the law of the land. But the study which led to his future fame was that of the Scriptures; to which he added a diligent perusal of the Latin fathers, and of the writings of the English divines, Robert Grosthead and Richard Fitz-Ralph. In his treatise "Of the Last Age of the Church," at the early period of the year 1356, he remonstrated against some Popish corruptions; and in 1360 he was active in opposing the encroachments of the Mendicant Friars, who interfered with the jurisdiction and statutes of the university, and took all opportunities of enticing the students from the colleges into their convents. In the following year, such was the credit he had acquired by his conduct and writings, he was appointed master of Baliol college, and was presented to a living in Lincolnshire. At this time he was held in such esteem by archbishop Simon Islip, that in 1365 he constituted him warden of Canterbury college, which he had just founded; but on occasion of a dispute between the regular and secular priests, Wickliffe and the three secular fellows were rejected; and on an appeal to Rome, the sentence against Wickliffe was confirmed in 1370. His reputation in the university was not at all diminished by his exclusion. In 1372 he took the degree of D.D., and read lectures, which gained him such applause, that whatever he said was regarded as an oracle. The impostures of the monks were the objects to which his first attacks were particularly directed; and the circumstances of the times favoured his design. The court of Rome was now enforcing by menaces its demands on king Edward III. of the homage and tribute to the see of Rome, which had been ingloriously stipulated by king John; and the parliament had determined to support the king in his refusal. A monk appeared as an advocate on behalf of the claims of Rome; and Wickliffe's reply caused him to be favourably regarded at court, and procured for him the patronage of the king's son, John of Gaunt, duke of Lancaster. In 1374 Wickliffe was joined in an embassy to Bruges, the object of which was to confer with the papal nuncios concerning the liberties of the English church, on which the usurpations of Rome had made unwarrantable encroachments. In the same year the king presented him to the valuable rectory of Lutterworth, in Leicestershire; and in the following year he was installed in a prebend of the collegiate church of Westbury, in Gloucestershire. Wickliffe, by his foreign mission, had an opportunity of acquainting himself with the corruption and tyranny of the court of Rome; and both his lectures and conversations were amplified with invectives against the pope. Whilst he defended the authority of the crown and the privileges of the nobles against all ecclesiastical encroachments, he censured vice and corruption in all ranks of society. This conduct, though it raised his reputation among the people, excited a host of enemies, who selected from his writings nineteen articles, which they deemed heretical, and which, as ſuch, they tranſmitted to Gregory XI. In 1377 this pontiff returned three bulls addreſſed to the archbiſhop of Canterbury and the biſhop of London, ordering the ſeizure and impriſonment of Wickliffe; or, if this meaſure failed, his citation to the court of Rome; and alſo a requiſition to the king and government to aſſiſt in extirpating the errors which he had propagated. Edward died before the bulls arrived; and the duke of Lancaſter, uncle to the young king, had great influence in the adminiſtration. When Wickliffe, therefore, was cited to appear at St. Paul's church before the two prelates, poſſeſſing plenitude of power, he thought it neceſſary to ſecure himſelf by the protection of that powerful patron. On the appointed day he appeared at St. Paul's, in the midſt of a vaſt concourſe of people, and accompanied by the duke of Lancaſter, and lord Henry Percy, earl-marſhal. The biſhop of London was very indignant, and angry words paſſed between him and the two lords; ſo that the whole aſſembly was tumultuous, and nothing was done. Wickliffe afterwards appeared before the two prelates in Lambeth palace, and delivered an explanation of the articles objected againſt him. The Londoners, who were apprehenſive that he might be ſeverely treated, flocked in crowds to the palace; and a meſſenger from the queen forbade the delegates to proceed to a definitive ſentence. Gregory ſoon after died, and his commiſſion expiring with him, Wickliffe eſcaped, but not without a ſevere illneſs, which was the conſequence of his anxiety and fatigue. His ſpirits, however, were unbroken, and he was firm in maintaining opinions which the friars, by all the efforts of intimidation, urged him to renounce.

Upon his recovery, he preſented to the parliament, in 1379, a paper againſt the tyranny and uſurpations of Rome; and he alſo drew up ſome free remarks on the papal ſupremacy and infallibility. But his moſt effectual attack on the corruption of religion was his tranſlation of the Bible into Engliſh. This occupied many of the laſt years of his life, and remains a valuable relic of the age in which it was performed, and a permanent memorial of the talents and induſtry of the perſon by whom it was accompliſhed. (See *Engliſh* BIBLES.) By way of preparation for his Bible, he publiſhed a treatiſe "Of the Truth of the Scripture," in which, as well as in a prologue or preface to his tranſlation, he held, long before any of our other reformers or advocates for the ſufficiency of Scripture, that this is the law of Chriſt, and the faith of the church; that all truth is contained in it; and that every diſputation which has not its origin thence is profane. "The truth of the faith," ſays he, "ſhines the more by how much the more it is known—nor are thoſe heretics to be heard who fancy that ſeculars ought not to know the law of God, but that it is ſufficient for them to know what prieſts and prelates tell them by word of mouth; for the Scripture is the faith of the church, and the more it is known in an orthodox ſenſe the better; therefore, as ſecular men ought to know the faith, ſo it is to be taught men in whatſoever language is beſt known to them. Beſides, ſince the truth of the faith is clearer and more exact in the Scripture than the prieſts know how to expreſs it—it ſeems uſeful that the faithful ſhould themſelves ſearch out and diſcover the ſenſe of the faith, by having the Scriptures in a language which they underſtand.—The laws which the prelates make are not to be received as matters of faith; nor are we to believe their words or diſcourſes any farther or otherwiſe than they are founded on the Scripture;"—with much more to the ſame purpoſe, and in the ſame admirable ſtrain. In this preface, and ſeveral other publications and treatiſes ſtill in manuſcript, he reflected ſeverely on the corruptions of the clergy, condemned the worſhip of ſaints and images, the doctrine of indulgences, pilgrimages to particular ſhrines, and confeſſion; and alſo denied the corporal preſence of Chriſt in the ſacrament, inveighed againſt the wanton exerciſe of the papal power, and oppoſed the making of the belief of the pope's being head of the church an article of faith and ſalvation, cenſured the celibacy of the clergy, forced vows of chaſtity, expoſed various errors and irregularities in the hierarchy and diſcipline of the church, and earneſtly exhorted all people to the ſtudy of the Scriptures.

In his lectures of 1381, he attacked the Popiſh doctrine of tranſubſtantiation, concerning which he laid down this fundamental propoſition; *viz.* that the ſubſtance of bread and wine ſtill remained in the ſacramental elements after their conſecration, and that the hoſt is only typically to be regarded as the body of Chriſt; and he deduced from it ſixteen concluſions. This attack alarmed the church, which regarded tranſubſtantiation as the moſt ſacred tenet of the Romiſh religion, and the chancellor of Oxford pronounced a condemnation of theſe concluſions. Wickliffe appealed from this ſentence to the king; but he found himſelf deſerted by his protector, the duke of Lancaſter, who had no further occaſion for his ſervices, or who could not avail himſelf for any political purpoſe of his theological diſcuſſions. Thus circumſtanced, he found himſelf in danger; his reſolution failed him, and he humbled himſelf by making a confeſſion at Oxford, before the archbiſhop and ſix biſhops, with other clergy, who had already condemned ſome of his tenets as erroneous and heretical. In this confeſſion, he admitted the real preſence of Chriſt's body in the ſacrament, with ſome explanations and reaſons which were not ſatisfactory to his perſecutors. It has been ſaid that he made a public recantation of the opinions with which he was charged; but of this no ſufficient evidence appears. The next ſtep in their proceedings againſt him was a royal letter, procured by the archbiſhop, addreſſed to the chancellor and proctors, and directing them to expel from the univerſity and town of Oxford all who ſhould harbour Wickliffe or his followers, or hold any communication with them. Theſe proceedings obliged him to withdraw, and to retire to his rectory at Lutterworth, where he continued to preach reformation in religion, and finiſhed his tranſlation of the Scriptures. Some have ſaid that king Richard baniſhed him out of England; but if that were the caſe, it was only a temporary exile, and he returned in ſafety to Lutterworth. In 1383 he had a paralytic ſtroke, which furniſhed him with an apology for not appearing to a citation of pope Urban VI.; and this was ſucceeded by a ſecond attack, which terminated his life on the laſt day of December 1384. His remains, however, did not eſcape the vengeance of his enemies many years after his death; for the council of Conſtance in 1415, not content with condemning many propoſitions in his works, and declaring that he died an obſtinate heretic, with impotent malignity ordered his bones to be dug up and thrown upon a dunghill. This ſentence was executed in 1428, in conſequence of a mandate from the pope, by Flemming, biſhop of Lincoln, who cauſed his remains to be diſinterred and burnt, and the aſhes to be thrown into a brook. "Thus," ſays Fuller, the church hiſtorian, in a figurative ſtrain juſtified by fact, "this brook hath conveyed his aſhes into Avon, Avon into Severn, Severn into the narrow ſeas, they into the main ocean; and thus the aſhes of Wickliffe are the emblem of his doctrine, which now is diſperſed all the world over." His doctrine not only ſurvived theſe impotent attempts to extinguiſh it, but was perpetuated and diffuſed by his followers, who were called Lollards; and "this germ of reformation," as one of his biographers ſays, "broke forth into complete expanſion, when the ſeaſon for that great change was fully come." Of his general character, it will be ſufficient to ſay, "that he was confeſſedly learned for his age, and was an acute reaſoner. In ſhort, notwithſtanding certain errors and imperfections, he may be regarded as a perſon of extraordinary merit and qualifications, who is entitled to honourable remembrance from every foe to eccleſiaſtical tyranny and impoſture;" and we may add that he advanced principles which have not yet produced their full effect.

The number of tracts he wrote and publiſhed, both in Latin and Engliſh, is very conſiderable. From two large volumes of his works, entitled "Aletheia, *i. e.* Truth," and a third under the title of "Trialogus," John Huſs is ſaid to have derived moſt of his doctrines. We have a full and complete "Hiſtory of the Life and Sufferings, and various Writings of Wickliffe," both printed and MS., publiſhed in 8vo., at London, in the year 1720, by Mr. John Lewis; who alſo publiſhed, in 1731, "Wickliffe's Engliſh Tranſlation of the New Teſtament from the Latin Verſion, called the Vulgate." This tranſlation is enriched with a learned preface by the editor, in which he enlarges upon the life, actions, and ſufferings of this eminent reformer. Biog. Brit. Moſh. Eccl. Hiſt. Neal's Hiſt. of the Puritans. Gen. Biog. For an account of his diſtinguiſhing tenets, and thoſe of his followers, ſee WICKLIFFISTS and LOLLARDS.

WICOMICO, in *Geography*, a river which riſes in the ſtate of Delaware, enters the ſtate of Maryland, and paſſes into Fiſhing bay, on the eaſt ſide of the Cheſapeak, N. lat. 38° 16′. W. long. 75° 57′.

WICOMOCO, a river of Virginia, which runs into the Cheſapeak, N. lat. 37° 55′. W. long. 76° 25′.

WICQUEFORT, ABRAHAM, in *Biography*, was born at Amſterdam in 1598, and having left his own country for France at an early age, he was nominated reſident for the elector of Brandenburg at the French court, and held the office for thirty-two years. But being ſuſpected by cardinal Mazarin of communicating ſecrets to his correſpondents in Holland with regard to the amours of Lewis XIV., he was ordered, in 1658, to leave the kingdom; but in the mean time he was arreſted, and confined in the Baſtille. At length, in 1659, he was releaſed and diſmiſſed. However, in three months the cardinal recalled him, and ſettled on him a penſion. On occaſion of the war between France and Holland in 1672, he returned to his own country, and was protected by John de Witt, who employed him in writing a hiſtory of Holland to his own time. In 1676 he was arreſted and condemned to perpetual impriſonment, under an accuſation of carrying on a ſecret correſpondence with the enemies of the ſtate; and after having been confined for three years, he made his eſcape by the contrivance of one of his daughters. He then ſought refuge at the court of Zell, from which he returned to Holland in 1681, where he lived without moleſtation, but without recovering the places of which he had been deprived. In the following year, 1682, he died. The work on account of which Wicquefort is beſt known, is entitled "L'Ambaſſadeur et ſes Fonctions," firſt printed at the Hague in 2 vols. 4to. 1681, and often reprinted. He holds in high eſtimation the privileges of the order to which he belonged, as we may infer from his cenſure of Cromwell's ſpirited act of juſtice in executing the brother of the Portugueſe ambaſſador for a murder: nevertheleſs he inculcates ſound morality with regard to the conduct of diplomatiſts in the countries to which they are ſent. His other works are, "Memoires touchant les Ambaſſadeurs et les Miniſtres;" one volume of his "Hiſtory of the Dutch Republic," which appeared in French at the Hague in 1719, fol.; and tranſlations into French of the accounts of different embaſſies, and alſo of voyages and travels. Moreri. Gen. Biog.

WICRANGLE, in *Ornithology*, an Engliſh name for the mattageſs, or greater butcher-bird, the *lanius cinereus major* of authors.

WICRANTUM, in *Natural Hiſtory*, a name given by the people of the Eaſt Indies to certain foſſile bodies, of the nature of the pyrites, of the ſize of peas, and formed into variouſly angular figures.

They look black and gloſſy, and much of the nature of blende, or mock-lead; but when put into the fire, they ſhew us by their ſmell that they contain ſulphur. They are found in the diamond-mines.

The natives firſt powder them; and then mixing them with the juices of certain plants, they dry them, and then calcine them again. Theſe proceſſes they repeat at leaſt ſixty times; but the firſt calcinations are made with a mixture of divers urines, as that of the horſe, the camel, the cow, and the like.

After this tedious preparation, they are given in coughs and colds, and are ſaid to be a remedy even in conſumptions.

WICZENIECZ, in *Geography*, a town of Poland, in Podolia; 6 miles N.W. of Kaminiec.

WIDAWA, a town of the duchy of Warſaw; 22 miles S.W. of Siradia.

WIDDAU, a river of Germany, which joins the Rodau at Rotenburg, in the county of Verden.

WIDDY, in *Agriculture*. See WITHY.

WIDE, is uſed in ſome places to denote a ſmall vale, and alſo a wide piece of water, or pond.

WIDE-*Eared*, in the *Manege*, is applied to a horſe, when the root, or lower part of his ear is placed too low, and the ear itſelf is too large. The French uſe the term *oreillard* for ſuch a horſe.

WIDE *Bay*, in *Geography*, a bay on the eaſt coaſt of New Holland, between Double Iſland Point and Indian Head.

WIDE *Mouth Bay*, a bay of England, on the N.W. coaſt of Cornwall. N. lat. 50° 46′. W. long. 5° 19′.

WIDEKINDI, or WIDICHINDI, JOHN, in *Biography*, a Swediſh hiſtorian, was born in the province of Weſtmanland, about the year 1620, and ſtudied at Upſal, where he delivered an oration in 1654, on occaſion of queen Chriſtina's acceſſion to the throne; and by her recommendation he was appointed hiſtoriographer of the kingdom. In 1676 he propoſed printing his "Hiſtory of Guſtavus Adolphus," and meaſures were taken for this purpoſe; but he died at Stockholm in 1678, before the work was executed. The firſt part of this hiſtory was publiſhed in 1691, fol.; but as it much offended both the Danes and Ruſſians, it was ſuppreſſed by the king's command. It is not known whether he completed the work in MS.; but the part publiſhed is written in a dull, heavy ſtyle, and it has been careleſsly printed. The author, however, was a man of learning, well acquainted with hiſtory, and reckoned a good Latin poet. He poſſeſſed an excellent library, and was much reſpected by king Charles Guſtavus, who called him his philoſopher. The moſt important of his works, a catalogue of which is given in "Schefferi Svecia Litterata," is the "Hiſtory of the Ruſſian War," written both in Latin and Swediſh, 1672, 4to. Gen. Biog.

WIDERDRIESS, in *Geography*, a town of the duchy of Stiria; 2 miles S. of Windiſch Gratz.

WIDJITZE, a town of Bohemia, in the circle of Czaflau; 8 miles W. of Czaflau.

WIDMINNEN, a town of Pruffia; 14 miles N.W. of Lick.

WIDOW, Vidua, a woman that has loft her hufband. Some alfo ufe the term *widower*, for a man who has loft his wife. Marriage with a widow is a kind of bigamy in the eye of the canon law.

The widow of a freeman of London may ufe her hufband's trade as long as fhe continues a widow.

Mr. Kerfeboom has given us a table, fhewing how long four hundred and thirty-two widows lived, and finds, that at a medium, each lived fourteen years. Phil. Tranf. N° 468, fect. 3.

It appears that, in Germany, the number of widows dying annually is four times the number of widowers: thus, in Drefden alone, the number of widows who died in four years was 584; the number of widowers 149: *i. e.* 4 to 1. At Wittenberg, during 11 years, 98 widowers died, and 376 widows. At Gotha, during 20 years, 210 widowers died, and 760 widows. And as widows are certainly, one with another, feveral years younger than widowers, it may be concluded that the number of the former in life together could not be lefs than five times the latter.

Thus alfo, in 1770, the number of widows in life, derived from the whole body of profeffors and minifters in Scotland, was 380; but the number of widowers among them has, one year with another, been fcarcely 90; *i. e.* not fo much as a quarter of the number of widows. Price's Obferv. on Rev. Paym. eff. 4.

Thefe facts cannot be accounted for without admitting the greater mortality of males. See Marriage, and Mortality.

There have been many fchemes eftablifhed for providing annuities for widows, for an account of feveral of which, fee Price's Obferv. &c. chap. ii. fect. 1, 2, 3.

Among the ancient Greeks, widows had the care of the eternal fire of Vefta committed to them; which charge among the Romans could be performed by virgins only, who from their office were called veftals. See Vestal.

Widow *of the King*, was fhe, who, after her hufband's death, being the king's tenant in capite, was driven to recover her dower by the writ *De dote affignanda;* and could not marry again without the king's confent.

Widow *Bench*, in the county of Suffex, is that fhare which a widow is allowed of her hufband's eftate, befides her jointure.

Widow'*s Chamber*, a name given in London to the apparel and furniture of the bed-chamber of the widow of a freeman, to which fhe is entitled.

Widow-*Wail*, in *Botany*. See Cneorum.

WIDURIS, in *Natural Hiftory*, the name of a ftone found in Java, Malabar, and fome other places, and defcribed by Rumphius. Some fpecies of this are all over of a fine white; others are of a dufky colour, with ftreaks of white; the fimply white ones are femi-pellucid, and look very like the white of an egg. Some alfo have called this the *hyalops*, or *achates vitreæ perfpicuitatis*.

WIECK. See Week.

WIED, in *Geography*, a county of Germany, fituated to the north of Treves, in the year 1560, divided into two parts: the Lower County, or New Wied, or Wied New Wied; and the Upper County, or Wied Runkel. Both had feats in the college of Weftphalia counts.

Wied, *New*. See Neuwied.

Wied, or *Old Wied*, a town of Germany, in the county of New Wied; 9 miles N. of Coblentz.

WIEDENBRUCK, a town of Weftphalia, in the bifhopric of Ofnabruck; 32 miles S.S.E. of Ofnabruck. N. lat. 51° 45′. E. long. 8° 18′.

WIEDERAU, a town of Saxony; 5 miles N. of Liebenwerda.

WIEDERSBERG, a town of Saxony, in the Vogtland; 8 miles W.S.W. of Oelfnitz.

WIEDERSPACH, a town of Germany, in the margravate of Anfpach; 6 miles W. of Anfpach.

WIEGANDSTHAL, or Wiegenthal, a town of Upper Lufatia; 11 miles S. of Lauban.

WIEHE, a town of Thuringia; 26 miles N.N.E. of Erfurt. N. lat. 51° 18′. E. long. 11° 35′.

WIELAND, Christopher Martin, in *Biography*, was the fon of a Proteftant clergyman at Biberach, in Swabia, where he was born in September 1733. Educated by his father, he began at the early age of thirteen to diftinguifh himfelf by his Latin and German poems; and he purfued his education at Magdeburg and at Erfurt. Upon his return home he became affectionately attached to Sophia de Guterman, afterwards known by her works under the name of Mad. de la Roche. In the year 1750 he ftudied jurifprudence at Tubingen; but his time was chiefly devoted to the writing of verfes, fo that in 1752 he publifhed a didactic poem in fix cantos, entitled "The Nature of Things;" "Ante-Ovid, or the Art of Love;" and "Moral Letters and Tales." He alfo began an epic poem, on the fubject of Arminius, the firft five cantos of which he fent to the famous Swifs poet Bodmer; and he was thus led to vifit Switzerland, and to cultivate a friendfhip with this celebrated poet, and to refide for fome time in his houfe at Zurich. In this retired and tranquil fituation, he applied with great diligence to the ftudy of the belles lettres, and acquainted himfelf with the principal modern languages, fuch as Englifh, French, and Italian, to which he afterwards added the Spanifh and Portuguefe. He alfo read Plato with great attention, and wrote feveral works, among which were the "Trial of Abraham," and "Letters of the Dead." After a refidence of feven or eight years in Switzerland, he quitted this country, having formed his tafte on the models of Euripides, Xenophon, and Shaftfbury, whofe writings he had diligently ftudied; and in 1758 he publifhed his "Arafpes and Panthea," a work which manifefts the afcendency which judgment and moral fentiment had acquired over his imagination. Upon his return in 1760 to his native city, he was appointed a director of the chancery, which office he held till the year 1769, referving, however, fome leifure moments for the compofition of his philofophical romance, entitled "Agathon," and his beautiful didactic poem "Mufarion." About this time he became intimately acquainted with count Stadion, a nobleman who lived with fplendour near Biberach, who had cultivated a tafte for literature, and who poffeffed an excellent library. He afterwards received from the elector of Mentz an invitation to be profeffor of philofophy and the belles lettres at Erfurt, and during his refidence in this place he became acquainted with Anna Amelia, duchefs dowager of Weimar, a patronefs of polite literature, and in 1772 fhe appointed him tutor to the two princes, Charles Auguftus and his brother Conftantine, of whom fhe was guardian. In this fituation he occupied himfelf in preparing a variety of works, both in profe and verfe, which have done honour to German literature. He was at this time aulic counfellor to the duke of Saxe Weimar, with a penfion, and a counfellor of government to the elector of Mentz. Wieland married his favourite daughter Charlotte to a bookfeller at Zurich, who was a fon of the celebrated poet Solomon Gefner. In 1797 he vifited visited his children at Zurich, and resided with his family in a romantic situation on the border of the lake, where he was visited by the most eminent literati of Switzerland. Conceiving a fond attachment to a rural retreat, he sold his house at Weimar, and purchased a small estate in the neighbourhood, where he fixed his abode. Although his fortune was small, his disposition was liberal; and he assisted many distressed young poets and authors for their contributions to the German Mercury, which he commenced in the year 1783. To the ex-monk Reinhold, who had escaped from Vienna, he was a generous patron, and gave to him one of his daughters in marriage. This monk was afterwards professor of philosophy at Kiel. He also supported another monk, who had fled to him from a Cistertian monastery in Swabia, during his residence at Jena, where he studied philosophy. Wieland had married in 1765 a person of good family at Augsburg, of whom he expresses himself in the highest terms of respect and affection, and by whom he had thirteen children; "sound," he says, "in body and mind; with their mother, they form the happiness of my life." In 1807 this venerable poet was elected a member of the floral order at Nuremberg; and in 1808, Buonaparte sent him the cross of the legion of honour. After the battle of Jena, he was protected by a special order of that conqueror. He died in January 1813, in his 80th year. For the delineation of his talents and character by Küttner and others, and an account of his works, which were very numerous, we must refer to his article in the General Biography, observing that his original works have been published in thirty-six large 4to. volumes, and six supplementary volumes. Leipsic, 1794—1802.

WIELAS, in *Geography*, a town on the east coast of the island of Gilolo. N. lat. 1° 9′. E. long. 128° 30′.

WIELCZYNY, a town of Lithuania, in the palatinate of Novogrodek; 40 miles S.E. of Slonim.

WIELDEMAN. See WILDEMAN.

WIELEN, a town of the duchy of Warsaw; 46 miles N.W. of Posen.

WIELICHOW, a town of the duchy of Warsaw; 25 miles S.S.W. of Posen.

WIELICZA, a town of Austrian Poland, celebrated for its salt-mines, which produce a great revenue to the emperor, to whose lot it fell in the year 1773. The inhabitants reside chiefly in the mines, and the church is underground; 8 miles S. of Cracow. These salt-mines, with the territory belonging to them, were assigned to the emperor of Austria by the treaty at Vienna in 1815.

WIELONA, a town of Samogitia; 20 miles S. of Rosienne.

WIELUN, a town of Poland, in the palatinate of Siradia; 16 miles S. of Siradia.

WIEN, a river of Austria, which runs into the Danube at Vienna.

WIENNERHORBEG, a town of Austria; 12 miles W. of Brugg.

WIENNERWALD, or *The Forest of Vienna*, the south part of the arch-duchy of Austria, bordering on Hungary.

WIEPERZ, or WIPRZ, a river of Poland, which runs into the Vistula, near Stericza, in the palatinate of Sandomirz.

WIER, JOHN, in *Biography*, a physician, was born in 1515, at Grave on the Meuse; and being domesticated with the famous Cornelius Agrippa, adopted his opinions with regard to the occult sciences. After having studied at Paris and Orleans, he took the degree of M.D. about the year 1534. In the course of his travels, he visited the court of the duke of Cleves, and was appointed his physician. He died at Tecklenburg, in Westphalia, in 1586. He was a man of considerable learning; and though participating in a great degree the credulity of the age, he incurred the enmity of the monks by ascribing to deception and imposture the sorcery, witchcraft, and magical practices, which they supported, to the operation of natural causes. The turn of his mind is discernible in his book "De Dæmonum Prestigiis et Incantationibus." In his treatise of medical observations he has given an account of the putrid sore throat, under the name of "Angina pestilentialis." Among his other writings are enumerated "De Iræ Morbo, et ejus Curatione Philosophica, Medica, et Philosophica;" "Tractatus de Commentitiis Jejuniis;" "De Tussi Epidemica, Anno 1580;" "De Varenis, Morbo endemio Westphalorum." Haller. Eloy.

WIERINGEN, in *Geography*. See VIERINGEN.

WIERNITZ, a town of Austria; 8 miles N. of Korn-Neuburg.

WIESE, a town of Silesia, in the principality of Grotkau; 2 miles N.E. of Weydenau.

WIESEN, a river of Germany, which rises in the Black Forest, and runs into the Rhine a little below Bâle.

WIESENBACHE, a river of Saxony, which runs into the Weissnitz, 4 miles N. of Dippoldiswalda.

WIESENBRUN, a town of the county of Castell; 14 miles E. of Wurzburg.

WIESENBURG, a citadel of Saxony, in the circle of Erzgebirg; 5 miles S. of Zwickau.—Also, a town of Saxony; 15 miles N.N.W. of Wittenberg.

WIESENFELD, a town of the duchy of Wurzburg; 5 miles S.S.E. of Gemunden.

WIESENSTEIG, a lordship of Bavaria, situated between the territories of Ulm and Wurtemberg, about eight miles long, and nearly as much in breadth. It descended from the dukes of Teck to the counts of Helfenstein, and gave name to a peculiar line. On the failure of the counts of this house, in the year 1627, in the person of count Rudolph, one-third of this lordship devolved to the house of Furstenberg, but the other two-thirds were purchased by the elector of Bavaria, of the two elder daughters of the last count; to this the dukes of Wurtemberg indeed would not give their consent, and in the year 1704 took possession of the lordship, but by virtue of the peace of Baden, concluded in the year 1714, were obliged to restore it to the elector of Bavaria.—Also, a town of Bavaria, and capital of a lordship of the same name; 25 miles S.E. of Stuttgart.

WIESENT, a town of Bavaria, in the bishopric of Bamberg; 3 miles E. of Forcheim.

WIESENTHAL, BOHMISCH, a town of Bohemia, in the circle of Saatz; 25 miles N.W. of Saatz. N. lat. 50° 23′. E. long. 12° 57′.

WIESENTHAL, *Ober*, a town of Saxony, in the circle of Erzgebirg; 11 miles S.E. of Schwartzenberg.

WIESENTHAL, *Unter*, a town of Saxony, in the circle of Erzgebirg. All these towns are very near together, a small brook only separates the Bohemian town from the two German ones; 10 miles S.E. of Schwartzenberg.

WIESENTHEID, a lordship situated between the duchy of Wurzburg, the county of Castell, and the margravate of Anspach. It takes its name from a citadel belonging to the counts of Schonburg.

WIESPINCAN, a river of Louisiana, which runs into the Mississippi, N. lat. 41° 22′. W. long. 91° 36′.

WIESSEN,

WIESSEN, a town of Germany, in the county of Rieneck; 10 miles N.W. of Löhr.

WIESTERBURG, a town of Weſtphalia, in the principality of Halberſtadt; 7 miles N.E. of Oſterwick.

WIETHEN, a lake of North America. N. lat. 62° 30'. W. long. 99° 50'.

WIETLISBACH, a town of Switzerland, in the canton of Berne; 20 miles N. of Berne.

WIETMARSEN, or WITTMARSCHEN, a town of Germany, in the county of Bentheim, with an abbey, which formerly belonged to the Benedictines, and was in the 12th century ſecularized for noble ladies; 4 miles N. of Northorn.

WIFE, UXOR, a married woman; or one joined with, and under the protection of, a huſband. See MARRIAGE.

A wife, in our Engliſh law, is termed *feme covert; fœmina viro co-operta;* her condition during marriage is called her *coverture;* and, in the judgment of the law, is reputed to have no will, as being ſuppoſed entirely under, and ſubject to, that of her huſband: *uxor fulget radiis mariti.*

A man cannot grant any thing to his wife, or enter into covenant with her; for the grant would ſuppoſe her ſeparate exiſtence, and to covenant with her would be only to covenant with himſelf; and, therefore, it is generally true, that all compacts made between huſband and wife, when ſingle, are void by the intermarriage. A woman, however, may be attorney for her huſband; and a huſband may bequeath any thing to his wife by will, for that cannot take effect till the coverture is determined by his death.

From the unity of perſon that ſubſiſts between the huſband and wife, in conſequence of marriage, it follows, that whatever perſonal property belonged to the wife before marriage, is by marriage abſolutely veſted in the huſband. In a real eſtate, he only gains a title to the rents and profits during coverture; for that, depending upon feodal principles, remains entire to the wife, after the death of her huſband, or to her heirs, if ſhe dies before him; unleſs by the birth of a child, he becomes tenant for life by the curteſy. But in chattel intereſts, the ſole and abſolute property veſts in the huſband, to be diſpoſed of at his pleaſure, if he chooſes to take poſſeſſion of them: for, unleſs he reduces them to poſſeſſion, by exerciſing ſome act of ownerſhip upon them, no property veſts in him, but they ſhall remain to the wife, or to her repreſentatives, after the coverture is determined.

There is, however, a conſiderable difference in the acquiſition of this ſpecies of property by the huſband, according to the ſubject-matter; *viz.* whether it be a *chattel real* or *perſonal;* and of chattels perſonal, whether it be in *poſſeſſion*, or in *action* only.

A *chattel real* veſts in the huſband, not abſolutely, but *ſub modo.* As, in caſe of a leaſe for years; the huſband ſhall receive all the rents and profits of it, and may, if he pleaſes, ſell, ſurrender, or diſpoſe of it during the coverture: if he be outlawed or attainted, it ſhall be forfeited to the king; it is liable to execution for his debts; and if he ſurvives his wife, it is to all intents and purpoſes his own. Yet if he has made no diſpoſition thereof in his life-time, and dies before his wife, he cannot diſpoſe of it by will; for, having never been transferred from the wife, after his death ſhe ſhall remain in her ancient poſſeſſion, and it ſhall not go to his executors.

Thus alſo with regard to chattels perſonal (or *choſes in action*), as debts upon bond, contracts, and the like; theſe the huſband may have if he pleaſes; that is, if he reduces them into poſſeſſion by receiving or recovering them at law: in which caſe, they are abſolutely and entirely his own: and ſhall go to his executors or adminiſtrators, or as he ſhall bequeath them by will, and ſhall not reveſt in the wife. But if he dies before he has reduced them into poſſeſſion, ſo that at his death they ſtill continue *choſes in action*, they ſhall ſurvive to the wife.

Thus in both the ſpecies of property the law is the ſame, in caſe the wife ſurvives the huſband; but, in caſe the huſband ſurvives the wife, the law is very different with reſpect to *chattels real* and *choſes in action;* for he ſhall have the *chattel real* by ſurvivorſhip, but not the *choſe in action;* except in the caſe of arrears of rent, due to the wife before her coverture, which in caſe of her death are given to the huſband by the ſtatute 32 Hen. VIII. cap. 37.

As to *chattels perſonal* (or *choſes in poſſeſſion*), which the wife hath in her own right, as ready money, jewels, houſehold goods, and the like, the huſband hath therein an immediate and abſolute property, devolved to him by the marriage, which can never again reveſt in the wife or her repreſentatives.

The wife alſo, by marriage, acquires a property in ſome of her huſband's goods, called her *paraphernalia*, which ſhall remain to her after his death, and ſhall not go to his executors. Theſe, ſignifying the apparel and ornaments of the wife, ſuitable to her rank and degree, the huſband cannot deviſe by his will; though during his life perhaps he hath the power (if unkindly inclined to exert it) to ſell them or give them away. But if ſhe continues in the uſe of them till his death, ſhe ſhall afterwards retain them againſt his executors and adminiſtrators, and all other perſons, except creditors where there is a deficiency of aſſets. And her neceſſary apparel is protected even againſt the claim of creditors.

The wife can make no contract without her huſband's conſent; and, in all law-matters, *ſine viro reſpondere non poteſt.*

The huſband is bound to provide his wife with neceſſaries by law, as much as himſelf; and if ſhe contracts debts for them, he is obliged to pay them; but for any thing beſides neceſſaries, he is not chargeable. Alſo if a wife elopes, and lives with another man, the huſband is not chargeable even for neceſſaries, at leaſt if the perſon who furniſhes them is ſufficiently apprized of her elopement.

If the wife be indebted before marriage, the huſband is bound afterwards to pay the debt. If the wife be injured in her perſon or property, ſhe can bring no action for redreſs without her huſband's concurrence, and in his name as well as her own; neither can ſhe be ſued, without making the huſband a defendant. There is indeed one caſe where the wife ſhall ſue and be ſued as a *feme ſole*, *viz.* where the huſband has abjured the realm, or is baniſhed; for he is then dead in law. See CUSTOM *of London.*

In criminal proſecutions, the wife may be indicted and puniſhed ſeparately; for the union is only a civil union. But in trials of any ſort, they are not allowed to be evidence for or againſt each other. However, where the offence is directly againſt the perſon of the wife, this rule has been uſually diſpenſed with; and, therefore, by ſtat. 3 Hen. VII. cap. 2. in caſe a woman be forcibly taken away and married, ſhe may be witneſs againſt ſuch her huſband, in order to convict him of felony. See FORCIBLE *Abduction.*

In the civil law, the huſband and wife are conſidered as two diſtinct perſons; and may have ſeparate eſtates, contracts, debts, and injuries; and, therefore, in our eccleſiaſtical courts, a woman may ſue and be ſued without her huſband.

But, though our law in general conſiders man and wife as as one perſon, yet there are ſome inſtances in which ſhe is ſeparately conſidered; as inferior to him, and acting by his compulſion. And, therefore, all deeds executed, and acts done by her during her coverture, are void; except it be a fine or the like matter of record, in which caſe ſhe muſt be ſolely and ſecretly examined, to learn if her acts be voluntary. She cannot by will deviſe lands to her huſband, unleſs under ſpecial circumſtances; for at the time of making it ſhe is ſuppoſed to be under his coercion. And in ſome felonies, and other inferior crimes, committed by her through conſtraint of her huſband, the law excuſes her; but this extends not to treaſon and murder. See FEME-*Covert*.

The huſband alſo, by the old law, might give his wife moderate correction; but this power of correction was confined within reaſonable bounds, and the huſband was prohibited from uſing any violence to his wife. The civil law gave the huſband the ſame, or a larger authority over his wife; allowing him, for ſome miſdemeanors, *flagellis et fuſtibus acriter verberare uxorem;* for others, only *modicam caſtigationem adhibere.* But, with us, in the politer reign of Charles II., the power of correction began to be doubted; and a wife may now have ſecurity of the peace againſt her huſband, or, in return, a huſband againſt his wife. The courts of law will ſtill permit a huſband to reſtrain a wife of her liberty, in caſe of any groſs miſbehaviour. Blackſt. Com. book i. book ii.

If a wife bring forth a child during her huſband's abſence, though of many years; yet if he lived all the time *inter quatuor maria*, within the iſland, he muſt father the child; and the child, if firſt born, ſhall inherit. See BASTARD.

If a wife bring forth a child begot by a former huſband, or any other perſon, before marriage, but born after marriage with another man; this latter muſt own the child, and that child ſhall be his heir at law.

The wife, after her huſband's death, having no jointure ſettled before marriage, may challenge the third part of his yearly rent of land, during her life; and, within the city of London, a third part of all her huſband's moveables for ever. See DOWER, INTESTATE, and CUSTOM *of London.*

The wife partakes of the honour and condition of her huſband; but none of the wife's dignities come, by marriage, to her huſband.

Yet, the huſband, who marries a woman ſeiſed of lands in fee-ſimple, or fee-tail, *i. e.* of any eſtate of inheritance, and has by her iſſue born alive, which was capable of her eſtate, ſhall, on the death of his wife, hold the lands for his life, as tenant by the curteſy of England.

The Engliſh laws are generally eſteemed by foreigners as very hard, in reſpect to the women; and yet Chamberlayne is of a very different opinion, aſſerting, that the condition of wives in England is better than in any other country.

The diſabilities to which the wife is ſubject are for the moſt part intended for her protection and benefit. So great a favourite (ſays judge Blackſtone) is the female ſex of the laws of England.

Tertullian has two books, on the ornaments and attire of wives. In the ſecond, he labours to prove that a Chriſtian wife cannot, in conſcience, endeavour to pleaſe by her beauty, which ſhe knows to be naturally liable to raiſe looſe deſires; and that ſhe ought not only to avoid all affected beauty, but even to conceal and cover her natural beauty.

WIFE, *Mid, Obſtetrix.* See DELIVERY.

WIFFLISBURG, in *Geography.* See AVENCHES.

WIGAN, a borough and market-town in the hundred of Weſt-Derby, and county of Lancaſter, England, is ſeated near the riſe of the river Douglas, the banks of which are noted for a celebrated battle fought between king Arthur and the Saxons, when the latter were defeated. In the time of Henry VIII., Wigan is deſcribed by Leland as a "paved town, as big as Warrington, but better builded, and inhabited by ſome merchants, artificers, and farmers." In its preſent ſtate, it has a neat though irregular appearance; and has been lately much improved by the opening of two new ſtreets, and the erection of ſeveral handſome buildings. An extenſive trade is carried on in the manufacture of coarſe home-made linens, checks, calicoes, fuſtians, and other cotton goods. Here are alſo large braſs and pewter works.

Wigan is a borough by preſcription, and has had its privileges confirmed by the ſeveral charters of Henry III., Edward II., Edward III., Richard II., and Charles II. Its corporate body conſiſts of a mayor, recorder, twelve aldermen, and two bailiffs. Two members are returned to parliament; and the right of election is veſted in the free burgeſſes, in number about 200. The repreſentation of this borough has occaſioned ſome very expenſive conteſts; and it is ſaid to have coſt George Byng, eſq. 10,000*l.* in his oppoſition to the intereſt of ſir Fletcher Norton, and Simon Luttrell, eſq. Returns appear ſo early as the 23d and 35th Edward I., after which the privilege was ſuffered to be dormant for 240 years; no other return being made till 1ſt Edward VI.

The pariſh-church is ancient, and conſidered to be a handſome ſtructure: it conſiſts of a nave, a ſpacious chancel, and two ſide-aiſles. Among the monuments in the church is one to the memory of ſir Roger Bradſhaigh, and another to ſir William and lady Mabel Bradſhaigh. The remains of George Hole, rector of this church and biſhop of Cheſter, are depoſited within the communion-rails. He died Auguſt 23, 1668. The rectory is one of the beſt endowed in the kingdom, and the incumbent is always lord of the manor. In the town is a chapel of eaſe, three chapels for diſſenters, and one for Roman Catholics. A town-hall was built in 1721, at the joint expence of the earl of Barrymore and ſir Roger Bradſhaigh, the then repreſentatives of the borough. A free-ſchool was erected, and liberally endowed, about the beginning of the laſt century, by voluntary contribution; and upwards of 30 years ago, the ſame liberality eſtabliſhed a blue-coat ſchool for 30 boys. A commodious workhouſe has been alſo built at the expence of the inhabitants of the town, where the neceſſitous and ſuperannuated poor are comfortably accommodated; induſtry in the more able are furniſhed with the means, and the meritorious are encouraged and rewarded. A diſpenſary has been erected, and is ſupported by the benevolence of the inhabitants of the town and its vicinity.

At the north end of the town is a monumental pillar, erected in 1679 by Alexander Rigby, eſq., then ſheriff of Lancaſhire, to commemorate the valour and loyalty of ſir Thomas Tyldeſley, who was ſlain on this ſpot in 1651, in the action wherein the earl of Derby was defeated by colonel Lilburne.

In a field near Scholes-bridge, contiguous to this town, a ſpring was lately diſcovered, which has obtained the name of *Wigan Spa*, or New Harrowgate, as the water reſembles that of Harrowgate in Yorkſhire.

The population of Wigan, which has been progreſſively increaſing, was, in the year 1801, according to the return to parliament, 10,989; the number of houſes, 2236. In 1811, the former had increaſed to 14,060, and the latter to 2686.

The pariſh of Wigan contains twelve townſhips, in three of which, beſides that in the town, are chapels of the eſtabliſhment,

blishment, ſubordinate to the mother church. Three of theſe townſhips, Haigh, Aſpinall, and Hindley, are worthy of notice for the production of the fineſt cannel or candle coal, which is found in large blocks as black as jet, and will bear a beautiful poliſh. (See COAL, *Cannel.*) The Liverpool and Leeds canal, and the river Douglas, afford navigable communication between this town and ſeveral other towns. On an eminence in this townſhip, about a mile north of Wigan, is Haigh-hall, the ancient ſeat of the Bradſhaighs, a family of high antiquity and diſtinction, but now extinct; from whom it deſcended by marriage to the earl of Balcarras, who now reſides here. This venerable manſion was built at different periods; the chapel is ſuppoſed to be coeval with the reign of Edward II. In the vicinity of Wigan originally ſtood the ancient family manſion of the Marklands.

Four miles weſt of Wigan is the village of Holland, or Up-Holland, whence the illuſtrious but ill-fated family of Holland derived their name.

About three miles north of Wigan is the village of Blackrode, at which place the Rev. John Whitaker fixes the Roman ſtation, named Coccium. Mr. Percival and Mr. Watſon both agree with Mr. Whitaker in placing Cocclum here; but theſe opinions are ſatisfactorily refuted by the hiſtorian of Whalley, who contends that this ancient ſtation was at Ribcheſter.—Beauties of England and Wales, vol. ix. Lancaſhire, by J. Britton, F.S.A.

WIGEON PENELOPE, *Anas Penelope* of Linnæus, in *Ornithology*, is a well-known bird. (See DUCK.) Its bill is lead-coloured, and the end of it black; the head, and upper part of the neck, of a bright light bay; the forehead paler, in ſome almoſt white; the plumage of the back, and ſides under the wings, are elegantly marked with narrow, black and white undulated lines; the breaſt is of a purpliſh hue, ſometimes, though rarely, marked with round black ſpots; the belly white; and the vent-feathers black. In ſome birds the coverts of the wings are almoſt wholly white; in others of a pale brown, edged with white; the greater quill-feathers are duſky; the outmoſt webs of the middle feathers of a fine green, the tips black; the laſt are elegantly ſtriped with black and white; the two middle feathers of the tail are longer than the others, black, and ſharp pointed; the reſt aſh-coloured; the legs duſky.

The head of the female is of a ruſty brown, ſpotted with black; the back is of a deep brown, edged with a paler; the tips of the leſſer quill-feathers white; the belly white.. Pennant.

WIGGER, in *Geography*, a river of Switzerland, which runs into the Aar, 3 miles N.W. of Zoffingen.

WIGHT, ISLE OF. See ISLE *of Wight*.

WIGHT, *Iſle of*, a county of Virginia, on the right ſide of James river, about 40 miles long and 15 broad, watered by the Nanſemond. It contains 9186 inhabitants, including 4041 ſlaves.

WIGLEN, a ſmall iſland in the North ſea, near the coaſt of Norway. N. lat. 65°.

WIGSTADT, a town of Bohemia, in the circle of Konigingratz; 6 miles N.E. of Geyerſberg.

WIGSTADTEL, or WAROW, a town of Sileſia, in the principality of Troppau; 10 miles S. of Troppau. N. lat. 49° 38′. E. long. 17° 47′.

WIGTON, a town of Cumberland, England, ſtands in a fine dry open country; and within the laſt thirty years has been greatly increaſed in population, from the introduction of manufactures. In the year 1811 its inhabitants amounted to 2977, who occupied 643 houſes.

The firſt manufactories eſtabliſhed here were for different kinds of coarſe linens; but ſince the year 1785, this buſineſs has received a conſiderable check by the encouragement given to the various branches of the cotton trade, which flouriſh in great vigour. In 1790 a manufactory for printing calicoes was eſtabliſhed at Spittle, about a quarter of a mile from the town, and ſeems likely to become an important undertaking, as the goods are in high repute, and the ſituation extremely convenient for extending the works.

The preſent church was erected in 1788: its neatneſs is eminently contraſted with the ancient fabric, which was a dark gloomy ſtructure, built, according to the Chronicon Cumbriæ, by Odoard de Logiz, to whom the barony was given by Waldeof, ſon of earl Goſpatrick. The materials it was conſtructed with were procured from the Roman ſtation at Old Carliſle, as appears from the ſtones being marked in a ſimilar manner to thoſe that may yet be obtained there. In removing the foundations of the old tower, two Roman ſepulchral inſcriptions were diſcovered. The ſtreets are tolerably ſpacious, and many of the buildings are handſome and modern. In the year 1723, an hoſpital was founded here, under the will of the Rev. John Thomlinſon, A.M. for ſix indigent widows of Proteſtant beneficed clergymen, epiſcopally ordained; and incorporated by the name of "The Governeſs and Siſters of the College of Matrons, or Hoſpital of Chriſt in Wigton." The endowment has been augmented by ſome ſmall benefactions: the allowance to each widow is about eight pounds annually. A free-ſchool was alſo eſtabliſhed here in 1780; chiefly by the contributions of the inhabitants, aided by the benevolence of Dr. Thomlinſon's brother. In this town, obſerves Mr. Gough, was anciently an hoſpital or free chapel, dedicated to St. Leonard, to which, Mr. Pegge is of opinion, belongs a ſeal found in Pickering-caſtle, Yorkſhire: it is of wood, and has the repreſentation of the Deity, with the crucifix, circumſcribed *Sigillvm Wighton*.

About one mile ſouth from Wigton are the ruins of the conſiderable Roman ſtation, now called Old Carliſle, but generally ſuppoſed to have been the Olenacum of the Notitia, where the Ala Herculea were in garriſon. Veſtiges of ancient buildings are very conſpicuous; the foundations of numerous ruined edifices being ſcattered over many acres, as well within the vallum as on every ſide, without excepting to the weſtward, where the ground deſcends precipitouſly to the brook Wiſa. The ſtation itſelf occupied an elevated ſcite, and commanded an extenſive view north and north-weſt. Its form is an oblong ſquare 170 paces in length and 110 broad, with obtuſe angles, defended by a double ditch and vallum, and having an entrance near the middle of each ſide. The military way, on which it ſtands, is very broad and diſtinct, and leads immediately to Carliſle and the Wall. Within the vallum, a well was diſcovered a few years ago, about three feet in diameter, and regularly lined with ſtones. Various inſcriptions, ſacrificing inſtruments, coins, altars, ſmall images, ſtatues on horſeback, urns, and other veſtiges of antiquity, have been found at this ſtation.

Several antiquities, diſcovered near this place in the courſe of the laſt century, have been deſcribed in different volumes of the Gentleman's Magazine, particularly in thoſe for the years 1748, 1756, and 1757.

Clea-hall, a ſeat of ſir Henry Fletcher, bart., whoſe family obtained it by an intermarriage with the female heir of a branch of the Muſgraves, ſtands on a cultivated ſpot in the midſt of an elevated and dreary moor.—Beauties of England and Wales, vol. iv. Cumberland, by J. Britton and E.W. Brayley.

WIGTOWN, a royal borough, market-town, and the capital of the fhire of the fame name, Scotland, is fituated on the fide of a hill near the confluence of the river Bladenock, at the diftance of 105 miles S.W. by S. from Edinburgh. It is of very high antiquity, and appears to have received its charter of incorporation from king Robert Bruce. The civil government is vefted in a provoft, two baillies, and twelve counfellors. Wigtown unites with the boroughs of Whitehorn, New Galloway, and Stranraer, in fending one member to the Britifh parliament. The church is in good repair. A well-fupplied market is held weekly, and five fairs annually. Being the fhire-town, the fheriffs' courts are holden here. A grammar-fchool is eftablifhed, and well conducted. The parifh of Wigtown is in the form of an oblong-fquare, extending five miles in length and four in breadth, and comprehends about 5500 acres. The climate is cold, but remarkable for producing health and longevity. A great diverfity prevails in the foil and furface: towards the fouth it is interfperfed with hills, which are almoft entirely arable, with a dry, light, and fertile mould; the north-weft corner is more varied and lefs productive; and the north-weft part is principally covered with mofs, and appears to have been formerly an arm of the fea. The greater part is inclofed; and the fpirit of agricultural improvement is much encouraged. Particular attention is paid to the repairs of the roads and bridges. The population of the parifh, at the enumeration of the year 1811, amounted to 1711. In the weftern part of the parifh is a large circle of ftones, called "The Standing Stones of Torhoufe," which is fuppofed to have been a temple of the Druids.—Beauties of Scotland, vol. ii. Wigtownfhire. Gazetteer of Scotland, 1806. Carlifle's Topographical Dictionary of Scotland, 2 vols. 4to. 1813.

WIGTOWN *Bay*, a bay of the Irifh fea, on the S. coaft of Scotland, at the mouth of the river Cree, between the counties of Wigtown and Kircudbright.

WIGTOWNSHIRE, the weftern part of the diftrict of Galloway, forms the fouth-weftern extremity of Scotland. It is bounded on the E. by Kircudbright, on the S.E. by Wigtown bay, on the S. and W. by the Irifh fea, and on the N. by Ayrfhire. It is of an irregular figure, of which the greateft length is about thirty miles, and the breadth nearly twelve. The fuperficial contents are 469 fquare miles, or 238,721 Scottifh acres. The fhire comprehends three royal boroughs, Wigtown, Stranraer, and Whitehorn; alfo the town of Portpatrick, and thirteen other parifhes. By the population return of the year 1811, the number of houfes is ftated to be 5402; that of the inhabitants 26,891; namely, 12,205 males, and 14,686 females. The fhire fends one member to the imperial parliament, and the three boroughs unite to fend another. Wigtownfhire is one of the moft level counties in Scotland; and the hills are in general free from projecting rocks, and very acceffible to the plough. The navigation along the coaft is fo uninterrupted, that it may be regarded as one of the moft eligible fituations in the ifland, in point of natural advantages, for a trading diftrict. The richeft lands lie upon the coaft, where the means of improvement are to be met with in the greateft abundance: the inland and more elevated parts have a confiderable mixture of heath and mofs, but are all in a greater or lefs degree fufceptible of improvement. There are few mountains in Wigtownfhire. The Cairnpat, near Portpatrick, is one of the moft confiderable: it rifes 800 feet above the level of the fea. The fummit bears all the marks of having been a military ftation, being furrounded by three ftone walls, with very ample fpaces between them; and commands a profpect of Loch-ryan, and Luce bay, which by advancing inland form the peninfula, called the Rhynns of Galloway, in which Portpatrick is fituated.

The *rivers* of this county are of no great importance. The Cree forms part of its eaftern boundary. The next ftream to the weftward is the Bladenocb, which rifes from a lake called Loch Macbeary, fituated moftly between the two parifhes of Kirkowen and Penningham. There are feveral fmall iflands in it; upon the largeft of which are the remains of a confiderable building and fmall garden. The river Bladenoch, which has its fource in this lake, runs in a fouth-eaftern direction for about two-thirds of its length; after which it takes a more eafterly courfe, and empties itfelf into the bay of Wigtown: its whole length is about twenty-four miles. Tarff is a ftream which rifes in the precincts of Ayrfhire, and after a courfe of twelve miles, in a fouth-eafterly direction, falls into the Bladenoch in the parifh of Kirkowen. Luce-water is a fmall river, which runs into the great bay of that name. Salmon are caught in it; and it is obferved that the fkin of the falmon, when it firft goes up the river, which is deeply tinged with mofs, is of a filvery colour, but after remaining fome time, it becomes of a brownifh-yellow.

Wigtownfhire has feveral frefh-water *lakes*, but none of particular importance. In the parifh of Sorbie is one of three miles in circumference, well ftored with pike, perch, and eels. It is called Dowalton lake, becaufe the ancient powerful chiefs, the Macdowals, had their refidence near it. In the parifh of Ince are fifteen lakes, of different degrees of extent, abounding with fifh of feveral kinds, and frequented by a variety of water-fowls. Swans emigrate from Ireland, particularly in fevere winters, and continue in thefe lakes till fpring. The fhire of Wigtown is deeply penetrated by navigable bays. Wigtown bay and Luce bay advance in a direction nearly parallel far into the country towards the north. At the fame time, from the northern part of the county, the long and narrow bay called Loch-ryan advances fouthward towards the bay of Luce, and peninfulates an extenfive territory, which appears to have long remained divided from the reft of Scotland. Loch-ryan is a beautiful as well as a fafe and commodious bay for fhipping. It is about ten miles in length from north to fouth: the entrance into it is nearly two miles broad. It is bounded on the eaft by the parifh of Balantrae, in Ayrfhire, and on the weft by Millar Point, a headland in the parifh of Kirkholm. About three or four miles from the mouth of the loch, on the eaft fide, is the little village of Cairn; contiguous to which is a commodious bay with good anchoring ground, and depth of water fufficient for fhips of any burthen; and all veffels entering into or coming out of the frith of Clyde feek this bay in ftormy weather. King William's fleet anchored here in their paffage to Ireland. Befides the Cairn bay, there are feveral other good anchoring bays in the loch. Luce bay, which advances from the fouth towards Loch-ryan, is far more extenfive. In dark and hazy weather, veffels often miftake Luce bay for the Irifh channel, and when keeping a northerly courfe, fometimes run on fhore, before the error is difcovered. The bay of Luce contains a great variety of leffer bays, fome of which are capable of being converted into convenient harbours; and mariners acquainted with them find anchoring places, in which they are in fafety from almoft every wind. The coaft around the bay of Luce is very various: in fome places it confifts of a fine gravel beach; at other points fteep rocks project into the fea, forming a bold inacceffible fhore. The moft fouthern point of the coaft, or rather of Scotland, is called the Mull of Galloway: in the weftern fide of it rifes a very elevated coaft: it is about the extent of a mile, and projects itfelf as the boundary between the Irifh fea and the bay of Luce. In a high wefterly wind a prodigious fwell of fea rolls round the point, and is then awfully grand. Here the fea has formed caverns, which are rendered dreadful by a fetting-in tide and a ftrong wefterly wind. The noife is like loud claps of thunder. Ships pafs and repafs this point from England, Ireland, and the weft of Scotland.

Though the *agriculture* of this county is yet but in an inferior ftate, great exertions are making to bring the foil under the beft management of which it is capable. Still, however, the defects of the foil, added to the imperfect ftate of the hufbandry which has hitherto exifted, greatly deprefs the value of the territory. The earl of Stair's eftate is faid to extend to about 55,000 acres, but produces an annual rental of no more than 11,000*l.* fterling. There are in this county great tracts of flow mofs, of that foft confiftence which renders it almoft inacceffible, and of no utility either for agriculture or pafturage. Little hopes are yet entertained of the practicability of improving this fort of territory. But it is confidently afferted, that an immenfe field of mofs of this defcription below Newton Douglas might by proper management be floated into the fea, leaving fome thoufand acres of rich clay behind. The great trunks of trees that are found in the moffes of this county, afford full proof of its having been formerly covered with wood. The renewal of the forefts, however, proves a very arduous tafk; and in certain expofures on the coaft has repeatedly baffled the hopes of the moft ingenious and attentive planters. Wood, corn, and potatoes, in this expofure, are more or lefs injured, according to their vicinity to the fea; whereas, when protected from it, they are found to grow with their ufual vigour. Shelter, therefore, either natural or artificial, muft be had on this coaft before wood can be planted with any chance of fuccefs. Scottifh firs, which ferve to nurfe up plantations in many other parts of the country, are unfortunately found to thrive worfe here than any other fpecies of wood. Under this difficulty, the earl of Galloway fortunately difcovered the valuable properties of the pinafter, or maritime pine, which he obferved to grow with a degree of luxuriancy fuperior to any other in his plantations. He has fince increafed the propagation of that tree, and now finds that under its protection, almoft any other wood may be planted with fuccefs. Attempts are making to introduce dairy-farms into this county, for the purpofe of fupplanting the univerfal practice of breeding cattle. One farmer, upon this plan, has no lefs than eighty milking cows: he ufes his whole milk in the manufacture of cheefe, which he exports to the Clyde. A remarkable breed of fmall white-faced fheep, peculiar to the coaft of this county, deferves notice. It is called the Mochrum breed. Thefe are faid to be of Spanifh extraction, an idea the more readily adopted, from the quality of their wool, which is of the fine clothing fort, of a texture fuperior to moft in Scotland, and but little inferior to real Spanifh. This breed, which is at prefent of an under fize, is well-fhaped, hardy, and found by proper attention to improve much, both in weight of carcafe and wool.

The mineral productions of the county are but few: the parifh of Kirkmaiden, which forms the fouthern part of the peninfula that bounds the bay of Luce on the weft, contains valuable quarries of flate, of which confiderable quantities are wrought and fent to market. Here are feveral natural caverns, in one of which is a petrifying water, dropping from the roof. In the parifh of Inch, fituated upon Loch-ryan, are feveral mineral fprings: one, with a fulphurous impregnation, has been found ufeful in ftomachic and fcorbutic complaints. There is alfo a chalybeate fpring. Some appearances of coal have been thought to exift here; but that valuable mineral has hitherto been fought in vain. In this quarter, towards Ayrfhire, is a bold rocky fhore, containing feveral natural excavations or caverns, extending eighty or an hundred yards under ground. The parifh of Whitehorn, in the fouth-eaftern part of the county, produces very fine variegated marble, and alfo flate of a ftrong quality. The chief natural defect incidental to this county is the want of coal, a defect common to it with almoft the whole of the fouthern border of Scotland. Was it not for this check to the eftablifhment of manufactures, it might be likely to affume fome fhare of commercial importance. Though of fmall extent, it has an ample fea-coaft, which affords great facility for exporting the produce of its agriculture and dairies. This facility is fo great, that the inhabitants of Wigtownfhire are fometimes in dread of fcarcity, in confequence of the greater part of their produce being carried to Glafgow, Paifley, or Liverpool, where a market is always to be obtained.—Beauties of Scotland, vol. ii. Wigtownfhire, 1805. Gazetteer of Scotland, 1806.

WIGWORM Point, a cape on the coaft of Patagonia, in the ftraits of Magellan; 3 miles N.E. of Cape Providence.

WIHACS, or Wihats. See Bihacs.

WIHENAIS, a town of Sweden, in the province of Savolax; 40 miles N. of Chriftina.

WIHR, or Weyer, a town of France, in the department of the Upper Rhine; 6 miles W. of Colmar.

WIHRBACH, a river of France, which runs into the Rhine, 7 miles above Germerfheim.

WIKES, in *Agriculture*, a term ufed to fignify temporary boundaries or marks, fet up in order to divide the fwaths to be mown; fuch as the boughs of trees, in the common fields and meadows in different diftricts; as well as fuch boughs when fet upon hay-cocks and ftouks of corn for the taking of tithes, and other fuch purpofes.

WIKINISH Creek, in *Geography*, a river of Pennfylvania, which runs into the Sufquehanna, N. lat. 40° 32′. W. long. 77° 1′.

WILAUF, a river of Wurtemberg, which runs into the Rems, near Schorndorf.

WILBASSEN, or Wilbadessen, a town of Weftphalia, in the bifhopric of Paderborn; 8 miles S.E. of Dringenberg.

WILBRAHAM, a townfhip of Maffachufetts, in the county of Hampfhire, with 1776 inhabitants; 10 miles E. of Springfield.

WILBURG, a citadel of Auftria; 8 miles E.S.E. of Ips.

WILBYE, John, in *Biography*, one of our beft madrigalifts of queen Elizabeth's reign. In his firft fet, the following are well-known: "Lady, when I behold the rofes fprouting;" and "Flora gave me faireft flowers:" but, "Hard by a cryftal fountain," which, according to Hearne, (Lib. Nig. Scacc.) ufed annually to be fung by the fellows of New college, Oxon, we are unable to find. Thofe words are adjufted to the mufic of Giov. Croce, in the fecond book of Mufica Tranfalpina, and are fet by Morley in the Triumphs of Oriana; but appear not either in the firft or fecond fet of Madrigals publifhed by Wilbye, and we know of no other.

WILD Alben, in *Geography*, a mountain of the duchy of Stiria; 7 miles N.N.W. of Muertzenfchlag.

Wild *Angelica*, *Basil*, *Briar*, *Campion*, *Carline Thistle*, *Carrot*, *Chervil*, *Cisily*, *Climber*, *Lettuce*, *Liquorice*, *Madder*, *Marjoram*, *Melic*, *Mint*, *Mustard*, *Oat*, *Radish*, *Rape*, *Rocket*, *Tare*, *Thyme*, and *Vine*, in *Agriculture*. See Weed.

Wild-*Fire*, or *Erysipelas*, a disease in sheep, which affects the skin, and which, if not well attended to, is liable to spread very quickly among the flock. It is attended with considerable inflammation in many cases, though but seldom with blisters over the body. It commonly takes place towards the latter end of summer, and does not continue more than eight days at a time, although such sheep as are once affected with it are very liable to have it again. It was formerly a practice with shepherds to bury the sheep that were affected with this disease in the ground at the door of the fold, with their feet upwards, which, they believed, acted as a charm to drive it from the flock. But this folly is now done away with.

In the cure of this affection of the skin, recourse may be had to evacuations from the bowels by the use of calomel, or purging-salts, dissolved in warm water, for three or four days; then sulphur with nitre may be given in pretty full doses, cooling washes being used at the same time. Strengthening remedies should afterwards be employed, such as oak, or other barks of the same nature. During the cure, the sheep should be kept from being too much exposed to cold, and in a dry sound pasture, being well fed when necessary.

Wild-*Fire*, *Ignis Gregalis*, or *Græcus*. See *Wild*-Fire.

Wild-*Fire Arrows*, such as were trimmed with wild-fire, and shot burning, to stick in the sails or rigging of ships in a fight. See Fire-*Arrow*.

Wild-*Fowl*. See *Water*-Fowl, and Decoy.

Wild-*Goose*, *Anas Anser*. See Duck.

Wild-*Goose Chace*. See Chace.

Wild-*Honey*. See Honey.

Wild-*Land*, *Reclaiming of*, in *Agriculture*. See *Reclaiming* Lands.

Wild-*Olive*. See Elæagnus.

Wild *Service-Tree*, in *Agriculture* and *Gardening*, a deciduous tree of considerable growth, which is much cultivated in the field and pleasure-ground. It has been observed, that this tree is sometimes planted in orchard-grounds among fruit-trees, but that it should be put in pleasure-grounds, plantations, or on lawns, for its ornamental effect in the autumnal season.

If trained up with straight clean stems, service-trees will grow to the height of thirty or forty feet; in that case, they should be planted among forest-trees, or in the back parts of large shrubberies. But those who wish to plant them as flowering shrubs must head them down when young, to make them throw out horizontal shoots; they may then be planted among the middling-sized shrubs, which will make a beautiful variety, both when in flower, and when bearing fruit. These trees grow to a considerable size when properly managed, and are very much used by wheelers and others, on account of the wood being all, what they call, heart-wood.

The fruit has been found excellent for feeding game, and other sorts of birds and fowls.

WILDAU, in *Geography*, a town of the duchy of Stiria, on the west side of the Muchr; 12 miles S. of Gratz.

WILDBAD, a town of Wurtemberg, celebrated for its warm-baths; 30 miles N.E. of Strasburg. N. lat. 48° 40′. E. long. 8° 26′.

WILDBERG, a town of Wurtemberg, on the Nagold; 3 miles N. of Nagold. N. lat. 48° 33′. E. long. 8° 48′.—Also, a town of Prussia, in the province of Oberland; 12 miles S. of Ortelsburg.

Wildberg, or *Wildbergen*, a town of the Middle Mark of Brandenburg; 28 miles N. of Brandenburg. N. lat. 52° 55′. E. long. 12° 38′.

WILDE, James, in *Biography*, a Swedish historian, was born in Courland in 1679, and educated at Riga; and having quitted that city in 1695, he sought farther improvement in several German academies, graduating M.A. at Griefswald. At the age of 21, such was his proficiency in various branches of literature, he was appointed co-rector of the cathedral school at Riga, and soon after teacher of politics, history, and eloquence, in the royal gymnasium of that place. Qualified by his talents and acquirements for a higher rank in the department of instruction, he was invited, in 1703, to be professor of history in the academy of Pernau; but declining this office, he was, in the following year, nominated by Charles XII. to fill the chair of Latin eloquence and poetry, which he occupied for five years. During his stay at Aix-la-Chapelle, which he visited in 1709 for the recovery of his health, the Russians made an irruption into Livonia, and he lost his library, with all his documents and papers. From hence, instead of returning to his native country, he proceeded to Stockholm, and offered his services to the senate. Such were the existing troubles at that time, that it was not till the year 1713 that government appointed him to be professor of eloquence and poetry at Griefswald. But he preferred a humble and more private situation as tutor to the two sons of count Cronhielm, with whom he made a tour to England, Holland, France, and Germany. Pursuing a similar tour with a young Holstein count, and becoming acquainted with the duke of Holstein, he was appointed his cabinet-secretary, in connection with the professorship of the law of nature and nations at Kiel. And in the same year king Frederick made him historiographer to the kingdom; on which office he entered at Stockholm in November 1719. His works were numerous and learned; but his constitution was feeble, so that he sunk under his labours, and died in 1755. Although he was more than thirty years old when he went to Sweden, he obtained a thorough acquaintance with the Swedish history: he was also well acquainted with the public law of Germany; and in his earlier years he had raised himself by writing Latin poetry. He was also a good philosopher, and a theologian, and often preached. His memory was singularly retentive; and this served him in various works which he composed after having lost his sight in 1741. Many of his works were lost at the capture of Pernau. During his tour with the sons of count Cronhielm, he published at Frankfort, in 1717, "Diatriba de Jure et Judice Legatorum á Stephano Cassio;" "Sueciæ Historia Pragmatica, quæ vulgo jus publicum dicitur, &c." Holm. 1731, 4to.; "The Foundation, Nature, Origin, and Antiquity of the Swedish Laws, with an Account of the Changes and Alterations which have been made in them," ibid. 1736, 4to.; "Puffendorf's Introduction to the History of Sweden, with Additions, Proofs, and Notes," by J. Wilde; "I. Part," ibid. 1738, 4to.; "II. Part," ibid. 1743, 4to.; "Preparatio hodegetica ad Introductionem Puffendorfii in Svethuci status Historiam, &c." ibid. 1743, 4to. Gen. Biog.

Wilde, in *Geography*, a river of Prussian Lithuania, which runs into the Russe.

WILDE-

WILDEBERG, a town of Pomerelia; 2 miles S. of Marienburg.

WILDEMAN, a town of Weftphalia, in the principality of Grubenhagen, near which are fome mines of filver and lead; 6 miles S.W. of Goflar.

WILDENBERG, or WILDENBORG, a town of the duchy of Berg; 10 miles E. of Homberg.

WILDENBERG, a town and caftle of France, in the department of the Rhine and Mofelle; 10 miles W. of Kirn.

WILDENBRUCH, a town of Hinder Pomerania; 5 miles S. of Balm.

WILDENECK, a town of the duchy of Carniola; 10 miles S.E. of Stein.

WILDENFELS, a town of Saxony, in the circle of Erzgebirg; 5 miles S.E. of Zwickau.—Alfo, a citadel in the territory of Nuremberg; 3 miles W.S.W. of Bezenftein.

WILDENFURT, a town of Saxony, in the circle of Neuftadt; 2 miles N.N.E. of Weyda.

WILDENHOF, a town of Pruffia, in Natangen; 23 miles S. of Brandenburg.

WILDENS, JOHN, in *Biography*, was born at Antwerp in 1584. He became an admired painter of landfcapes, but under whom he acquired the art is unknown. He appears to have been a diligent obferver of nature, and to have ftudied much in the open air; as his ftudies of forefts, fields, &c. are numerous. When he had obtained confiderable reputation, his talents introduced him to the notice of Rubens, who employed him to affift in executing the landfcape parts of back-grounds, which he did with fo great felicity, that there appears no diffimilarity in ftyles in the pictures on which they both took their refpective parts. Two of his beft pictures are in the chapel of St. Jofeph at Antwerp, embellifhed with figures by Lang Jan: the fubject of one is the Flight into Egypt, and of the other a repofo. He died in 1644, aged 60.

WILDENSCHWERT, in *Geography*, a town of Bohemia, in the circle of Chrudim; 9 miles E. of Hohenmaut.

WILDENSTEIN, a town of Germany, in the margravate of Anfpach; 7 miles S.E. of Creilfheim.

WILDENTHAL, a town of Saxony, in the circle of Erzgebirg; 7 miles S.S.W. of Schwartzenberg.

WILDERNESS, in *Gardening*. There is nothing fo great an ornament to a large garden as a wildernefs, when properly contrived, and judicioufly planted.

The wildernefs fhould always be proportioned to the fize of the garden, and fhould never be fituated too near the houfe: becaufe the trees perfpire fo large a quantity of watery vapours, as makes the air very unwholefome: though vegetables ferve, as modern experiments have fufficiently afcertained, to purify and meliorate the air. See AIR.

The wildernefs fhould never be fo placed as to block up a good profpect; but where the view naturally ends with the verge of the garden, or little more, nothing terminates it fo well as a fine plantation of trees. The fize of the trees fhould be confidered, and tall growing ones fhould be planted in larger places; fmaller, in lefs extenfive; evergreens alfo fhould be kept by themfelves, and placed moft in fight, not mingled confufedly among the trees which caft their leaves. The walks fhould be large and not numerous; the large walk is beft made ferpentine, and this fhould not be entered upon in the grand walks of the garden, but by fome private walk.

It is too common a method to difpofe the trees in wildernefles, in form of regular fquares, triangles, &c. but this is faulty; for as nature fhould be ftudied in thefe works of fancy, the moft irregular is the moft pleafing plantation. The walks for the fame reafon are much more pleafing when they run in wild meanders, than when they interfect one another in ftudied and regular angles. The winding walks fhould be made to lead to an open circular piece of grafs, with a ftatue, an obelifk, or a fountain: or, if an opening large enough for a banqueting-houfe be contrived in the middle, it will afford a very pleafing fcene. The trees fhould gradually rife from the fides of the walks and openings, one above another, to the middle of the quarters, where the largeft trees fhould ftand, by which means the heads of all the trees will appear in view, but their ftems will not appear in fight.

Not only the growth of trees is to be confidered in the planting of a wildernefs, but their nakedneffes are to be confidered and hid. The larger growing trees are allowed a proportionable diftance, and their ftems hid by honeyfuckles, rofes, fpiræas, and other low-flowering fhrubs. Thefe may alfo be planted next all the walks and openings; and at the foot of thefe, near the walks, may be fet rows of primrofes, violets, and daffodils, with other the like flowers; behind the firft rank of lower flowering fhrubs fhould be planted thofe of a fomewhat higher ftature, as the *althæa-frutices*, the cytifufes and guelder-rofes; and behind thefe may be rows of the talleft flowering fhrubs, as the lilacs, laburnums, and the like; and behind thefe, the heads only of the lower growing trees will appear, which fhould be backed gradually with thofe of higher growth to the centre of the quarter; from whence the heads of the trees fhould defcend every way to the walks, or openings. The grand walks and openings fhould always be laid with turf, and kept well mowed; but, befide thefe, there ought to be fmaller ferpentine walks through the feveral quarters, where perfons may retire for privacy; thefe fhould be left with the bare earth, only kept clear of weeds, and laid fmooth.

Thefe walks fhould be made as winding as poffible, and a few wood-flowers planted along their fides will have a very good effect. The ever-greens fhould be allotted a peculiar part of the wildernefs, and fuch as fronts the houfe; and in the planting of thefe, the fame regard is to be had to their growth, that the talleft trees be planted hindmoft, and their ftems hid by fhorter ones, and fo on, down to the verge: as in the firft row may be planted lauruftines, boxes, fpurge, laurels, junipers, and favins; behind thefe, laurels, hollies, and arbutufes; next behind thefe, yews, alaternuffes, phillereys, cypreffes, and Virginian cedars; behind thefe, Norway and filver firs, and the true pine; and finally, behind thefe, the Scotch pine and pinafter. Thefe will have a very beautiful appearance, as their tops will only be feen, and make a fheet of green, which may alfo be very beautifully varied, from the artful admixtures of the feveral fhades of green which the various plants have.

In all thefe plantations, the trees, however, fhould not be fet in formal ftiff rows, but in a loofe variety, proportioned to their manner of growth. Miller.

WILDERSDORF, in *Geography*, a town of Auftria, on the Zeya; 8 miles W.S.W. of Zifterftorf.

WILDESHAUSEN, a town of Weftphalia, with a diftrict formerly belonging to the archbifhopric and duchy of Bremen, and afterwards to the duchy of Brunfwick, in which it is infulated. It is fituated on the Hunte, and contains about 312 houfes. The inhabitants are partly Roman Catholics; in the bailiwick are 30 villages; 20 miles S.S.W. of Bremen. N. lat. 52° 52′. E. long. 8° 27′.

WILDING, in *Rural Economy*, a four auftere fort of apple, often ufed with others that correct thefe qualities, for making home cyder. See CYDER.

WILDING, *Royal*, an excellent cyder-apple. It is faid, in the Gloucefter Report on Agriculture, to be a native of Dimock; that it is a free, clean, and handfome grower; makes excellent cyder, is a great favourite among the planters in the upper part of the foreft-diftrict of that county, and is much introduced in the vale, on the eaft fide of the Severn. See CYDER.

WILDS, a term ufed by our farmers to exprefs that part of a plough by which the whole is drawn forwards.

The wilds are of iron, and are of the form of a gallows, whence they are by fome called the gallows of the plough, but improperly; the gallows of the plough being properly that part formed by the crow-ftaves, and the tranfverfe piece into which they are mortifed at the top. The wilds confift of two legs, and a tranfverfe top-piece: one of the legs, and the top-piece, are all of one piece of iron; and the other leg, which is loofe, has a hole in the top, into which the end of the tranfverfe piece is received: both thefe legs pafs through the box of the plough, which is that tranfverfe timber through which the fpindles of the wheels run. Thefe legs are pinned in behind the box with iron pins: the holes through the box at which thefe legs pafs, are not made at right angles, but flanting upwards, fo that the forepart of the wilds is higher than the hinder part; were it not for this, the upper part of the crow-ftaves would lean quite back when the plough is drawn.

The ufe of the notches in the wilds is to give the plough a broader or narrower furrow; if the links are moved to the notches on the right-hand, it brings the wheels toward the left, which gives the greater furrow; and, on the contrary, a fmaller furrow is made when the links are moved to the notches on the left. The legs of the wilds fhould be nineteen inches, and their diftance eight inches and a half; they muft be made ftrong, and the links muft be placed in different notches, that the front of the plough may be kept fteady, and the wheels not be drawn one before the other. Thefe links are of iron alfo, and are each fix inches and a half long, and to thefe are faftened the chains of the harnefs, by which the whole plough is drawn along.

WILDSAUBACH, in *Geography*, a river of Germany, which runs into the Elbe, 6 miles below Drefden.

WILDSEE, a lake of the duchy of Stiria; 8 miles E. of Neumarck.

WILDSHUT, a town and caftle of Bavaria; 5 miles N.N.W. of Lauffen.

WILDSTADT. See WILLSTADT.

WILDUNGEN, a town of Germany, in the county of Waldeck; 7 miles S.S.E. of Waldeck. N. lat. 51° 7′. E. long. 9° 8′.

WILEHENGEN, a town of Switzerland; 9 miles W. of Schaffhaufen.

WILEIA, a town of Samogitia, on the Niemen; 25 miles S.S.E. of Rofienne.

WILF, in *Agriculture*, a term ufed provincially to fignify the white willow. See WILLOW.

WILFERSDORF, in *Geography*, a town of Auftria; 4 miles W. of Brugg.

WILHELMSDORF, a town of Pruffia, in Oberland; 13 miles S. of Holland.

WILHELMSHOF, a town of Germany, in the duchy of Anhalt Bernburg, near Hartzgerode.

WILHELMSPURG, a town of Auftria; 8 miles S. of St. Polten.

WILHELMSTEIN, a town of France, in the department of the Roer; 7 miles S.W. of Juliers.

WILHELMSTHAL, or NEUSTADTEL, a mine-town of Silefia, in the principality of Glatz; 15 miles S.E. of Glatz. N. lat. 50° 3′. E. long. 16° 42′.

WILIA, a river of Lithuania, which runs into the Niemen, near Kowno, in the palatinate of Troki.

WILINGO, a town of Sweden, in the province of Schonen; 7 miles N. of Helfingborg.

WILITZ, a town of Bohemia, in the circle of Kaurzim; 5 miles N.N.W. of Kaurzim.

WILKES, JOHN, in *Biography*, was born in London in 1727, and finifhed his ftudies at the univerfity of Leyden. Soon after his return to England, he married a Mifs Mead, who was a lady of large fortune, and fettled at Aylefbury. This lady, though highly refpectable both in her character and connections, and belonging to a diffenting family as well as himfelf, was older than he, and in other refpects an unfuitable wife, fo that the attachment was originally formed, on his part, from lucrative motives: one daughter was the fruit of this connection. Mr. Wilkes, thus furnifhed with the means of profufion, lived in an expenfive ftyle, and being little anxious about domeftic happinefs, affociated with the gay and licentious, to whofe habits and manners his principles and character were facrificed. Urged by his partial friends who thought him qualified for public life, he offered himfelf, in 1754, as a candidate for the town of Berwick, but his views were difappointed. In this and in feveral other inftances, he counteracted the inclinations and wifhes of his wife, fo that their continued connection was a fource of difquietude, and they determined to feparate. In 1757 he was returned as a member for the borough of Aylefbury, the confequence of which was an increafe of expenditure, that involved him in pecuniary embarraffments, and led him to difhonourable practices, and particularly to an attempt of freeing himfelf from the obligation of paying his wife's annuity, in which he failed of fuccefs. His parliamentary patron was earl Temple, by whofe influence he was chofen reprefentative for Aylefbury; and from whofe intereft he expected to obtain fome place under government, which the perplexity of his circumftances rendered particularly defirable. But he was once and again difappointed; and he afcribed his failure to the interference of lord Bute. In 1762 he connected himfelf, as a political writer, with lord Temple and Mr. Pitt, and defended them, whilft he expofed the miniftry, on occafion of the rupture with Spain, in a pamphlet entitled "Obfervations on the Papers relative to the Rupture with Spain." This publication was followed in 1763 by an ironical dedication to lord Bute, of Ben Jonfon's "Fall of Mortimer," in which he indulged unreftrained levity againft the "favourite," as he was called, and his antipathy to the Scottifh nation; which was further manifefted in a periodical paper called "the North Briton," commenced in 1762, and intended to counteract "the Briton," which Smollet conducted in defence of lord Bute's adminiftration. The North Briton, however, was written with a fpirit fo confonant to the fentiments of the public at that period, that it probably contributed to the refignation of that nobleman in April 1763. The 45th number of this periodical work was publifhed on the 23d of April, and contained fo fevere and farcaftic a comment on the king's fpeech, that his minifters, under the fanction of the crown-lawyers, determined upon a profecution: and the home fecretary of ftate, lord Halifax, iffued a "general warrant;" *i. e.* a warrant, in which no particular names were fpecified, for the apprehenfion of the authors, printers, and publifhers of that paper. As foon as it was difcovered that Wilkes had given orders for the printing, he was taken into custody, and brought before the two secretaries of state. Perfectly self-possessed, and avowing the illegality of his arrest, he refused to answer any interrogatories; and a habeas corpus which had been sued out for him being evaded, he was closely confined in the Tower. However, he was soon after brought by habeas corpus before the court of common pleas, when lord chief justice Pratt declared the opinion of that court against the legality of his commitment, so that he was discharged amidst the acclamations of the audience and of the populace. In the course of these proceedings he was deprived of his commission as colonel, by the king's order; and his patron, lord Temple, lost his post of lord-lieutenant of the county. This nobleman, at his own expence, availed himself of the legal decision against general warrants, and commenced actions against the king's messengers, the secretaries, the under secretary, and the solicitor of the treasury; in all which the prosecutors obtained damages, which were paid by the crown, in consequence of an express order of council. Thus the doctrine of the illegality of such warrants was established, and for this accession to the cause of liberty the public were indebted to John Wilkes, lord Temple, and lord chief justice Pratt, afterwards lord Camden. Wilkes, not satisfied with this triumph, proceeded, against the advice of friends, to set up a press in his own house, and to reprint the North Briton; for which he was again prosecuted to conviction. Having withdrawn to France in 1763, he was expelled from the house of commons, because he did not appear to answer the charges that were produced against him. The next attack that was directed against him was occasioned by his printing an indecent and profane piece, called "Essay on Woman," and said to have been written by Mr. Potter, son of the archbishop of the same name; and as some scandalous reflexions on a bishop were introduced in this piece, complaint of breach of privilege was made in the house of lords; and on a prosecution, he was found guilty of both the crimes of blasphemy and libel. By his continued absence, he incurred the penalty of outlawry. Upon a change of ministry he returned to England, and delivered himself to custody; and confiding in his popularity, he offered himself as a candidate to represent the city of London; but failing in this object, he was immediately elected for the county of Middlesex. Although his sentence of outlawry was reversed as illegal, he was condemned for his two libels to an imprisonment of 22 months, and a fine of 1000*l.* In 1769 he was charged with being the author of a pamphlet relating to the riots, occasioned by his imprisonment, and expelled from the house; and being immediately re-elected, he was declared incapable of a seat in the house during the existing parliament. He now became popular as the martyr of liberty, and large sums were collected towards the payment of his debts. He was again re-elected, and his election was declared void. At the next election, the court-candidate, colonel Luttrel, whose votes were about a fourth of those of Mr. Wilkes, was declared the sitting member. This measure caused dissatisfaction and complaint through the country, and produced petitions for the dissolution of parliament. Wilkes, though excluded from parliament, was chosen an alderman of the city of London; and in the exercise of his office as a magistrate, he resisted with his usual spirit exactions of authority which he considered as illegal; and actually liberated one of the printers of newspapers in which the speeches of members of parliament were detailed, and who had been arrested by royal proclamation. Two others were released by lord mayor Crosby and alderman Oliver, who being members of the house were committed to the Tower. Wilkes was ordered to attend at the bar of the house; but in a letter to the speaker, he objected, that in the order for attendance, no notice was taken of his being a member of the house, and his attendance in his place had not been desired, which forms, he said, were essential: he also demanded his seat, and then he would give a full account and justification of his conduct. The house, sensible of the difficulty to which it had subjected itself, saved its authority by adjourning for the day on which Wilkes was ordered to attend. In 1772 Wilkes was chosen one of the sheriffs for London and Middlesex, and in 1774 lord mayor of London. Having conducted himself with propriety and reputation in his public offices, he was re-elected in 1776 a representative for the county of Middlesex; and was allowed to take his seat without opposition. In parliament, he opposed the measures that occasioned the American war; and on the accession of the Rockingham administration, he carried his motion for rescinding the decision of the house of commons, which gave Luttrel a seat by a minority of votes. In 1779 he succeeded in his application for the office of chamberlain in the city of London, and retained it during the remainder of his life. Tired of political conflicts, the latter years of his life passed off without much notice, so that, to adopt his own expression, he was an "extinguished volcano;" and he expired at the house of his daughter in 1797, in the 73d year of his age. His private history affords no memorial that is either amusing or instructive. The early errors of his conduct cast a shade over his character. His literary talents and attainments, devoted as he was to pleasure, and engaged in business, never attracted much notice; though as a companion he knew how to render himself agreeable. Although his patriotism might possibly originate in disappointed views and expectations, he was consistent and steady in maintaining the cause to which he was attached; and he was, either intentionally or incidentally, and by an intrepidity and self-possession which he possessed in an eminent degree, the instrument of gaining some important advantages to public and private liberty. Alm. Mem. of Wilkes. Ann. Reg. Gen. Biog.

WILKES, in *Geography*, a town of Ohio, in Gallia county, with 187 inhabitants.—Also, a county of the state of Georgia, bordering on South Carolina, containing 7066 inhabitants. Tobacco is the chief produce, of which 3000 hogsheads were exported in 1788.—Also, a county in the N.W. corner of North Carolina, with 7247 inhabitants, including 790 slaves.—Also, a town of North Carolina; 50 miles W. of Salem.

WILKESBARRE, formerly WYOMING, called also *Wilkesburg*, a town of Pennsylvania, and chief town of Luzerne county; situated on a plain, bounded on one side by the Susquehanna, and on the other by a range of mountains, and containing about 150 wooden dwelling-houses, a church, court-house, and gaol, with 1225 inhabitants. A dreadful massacre was committed in this place, during the American war, by the Indians under the command of colonel Butler, which is recorded in most histories of that war, and which will ever remain a blot on the English annals. Several of the houses, to which the unfortunate victims retired to defend themselves on being refused quarter, are still standing, perforated in every part with balls; the remains of others that were set on fire are also still to be seen, nor will the inhabitants on any account suffer them to be repaired. N. lat. 45° 13′. W. long. 75° 50′. Weld's Travels, vol. ii.

WILKINS, DAVID, in *Biography*, a learned antiquary, was born in 1685, and in early life more than once made the tour of Europe, acquiring a knowledge of most modern languages. In 1715 he was appointed by archbishop Wake keeper

keeper of the Lambeth library, of which he made a catalogue, and for his three years' labour in this way he was recompenfed with feveral preferments, fuch as the rectories of Hadley and Monk's Ely, the archdeaconry of Suffolk, and a canonry of Canterbury. Among his principal publications we may reckon "Novum Teftamentum Copticum," Oxon, 1716, 4to.; an edition of "Leges Saxonicæ ecclefiafticæ et civiles," with many valuable additions, 1721, fol.; "Joannis Seldeni Opera omnia," 1726, 3 vols. fol.; "Pentateuchus Copticus," 1731, 4to.; "Concilia Magnæ Britanniæ," 4 vols. fol. 1736; and a learned preface to bifhop Tanner's "Britannico-Hibernica." He married the eldeit daughter of Thomas, lord Fairfax, fettled in Scotland, and died in 1745, in his 60th year. Nichols's Lit. Anecd. Gen. Biog.

WILKINS, JOHN, D.D., an Englifh prelate, was born near Daventry, in Northamptonfhire, in 1624, and finifhed his education at Magdalen-hall, Oxford, where he graduated M.A. He afterwards took orders, and became chaplain, firft to lord Say, and then to Charles, count palatine of the Rhine. At the commencement of the civil war he joined the parliament, took the folemn league and covenant, and became warden of Wadham college. In 1649 he graduated D.D., and in 1656 married the fifter of Oliver Cromwell. In 1659 he was nominated head of Trinity college, Cambridge; but being ejected on the reftoration of king Charles II., he became preacher to the fociety of Gray's-Inn, London, and rector of St. Lawrence, Jewry; about which time he was introduced into the Royal Society as fellow and one of the council, and advanced to the fee of Chefter. He was diftinguifhed by his moderation, and was reproached on this account by his enemies, who reprefented him as wavering in his religious principles. Several bifhops cenfured him with uncandid feverity, among whom were archbifhop Sheldon, bifhop Fell, and archbifhop Dolben, making no allowance for the favourable difpofition which he was led to manifeft towards the diffenters by his education under Mr. John Dod, his grandfather, a truly pious and learned man, who difapproved many things in the church of England long before the grand feparation which took place on account of Laud's impofitions and feverities. After the Reftoration he was a moderate conformift, and difpofed to be indulgent in many things, for the fake of preventing religious diffenfions. On this account he incurred hatred and obloquy. He at length fell a victim to the ftone, occafioned by his fedentary habits, and clofe application to ftudy; and died, with a tranquillity and firmnefs becoming a wife man and a Chriftian, at the houfe of his friend Dr. Tillotfon, in Chancery-lane, London, in November, 1672. Bifhop Wilkins was not only an able divine, but a good mathematician and aftronomer; and well fkilled in mechanics and experimental philofophy. As a writer he was judicious and plain; and he ftudied more to be ufeful than to pleafe. Generous in his difpofition, he neither fought honour nor riches. The revenues which he received from the church he fpent in its fervice; and whilft he was fecure from want, he did not wifh to be richer. His character is thus delineated by Dr. Burnet: "He was a man of as great a mind, as true a judgment, as eminent virtues, and of as good a foul, as any he ever knew; and though he married Cromwell's fifter, yet he made no other ufe of that alliance but to do good offices, and to cover the univerfity of Oxford from the fournefs of Owen and Goodwin. At Cambridge he joined with thofe who ftudied to propagate better thoughts, to take men off from being in parties, or from narrow notions, from fuperftitious conceits, and fiercenefs about opinions. He was alfo a great obferver and promoter of experimental philofophy, which was then a new thing, and much looked after. He was naturally ambitious, but was the wifeft clergyman I ever knew. He was a lover of mankind, and delighted in doing good." He alfo poffeffed, according to this hiftorian, "a courage which could ftand againft a current, and againft all the reproaches with which ill-natured clergymen ftudied to reproach him." His principal works are the following: *viz.* "The Difcovery of a New World; or, a Difcourfe tending to prove that it is probable there may be another habitable World in the Moon," London, 1638, 4to., written when he was only twenty-four years of age; "Difcourfe concerning the Poffibility of a Paffage to the World in the Moon;" "Difcourfe concerning a new Planet, tending to prove that it is probable our Earth is one of the Planets," ibid. 1640, 8vo.; "Mercury; or, the Secret Meffenger: fhewing how a man may with privacy and fpeed communicate his thoughts to a friend at any diftance," ibid. 1641, 8vo.; "Mathematical Magic; or, the Wonders that may be performed by Mechanical Geometry," in two books, ibid. 1648 and 1680, 8vo. Thefe latter five, compofing his mathematical works, were printed at London in one volume, 8vo. 1708. "Effay towards a real Character and a philofophical Language," ibid. 1668, fol.; "Of the Principles and Duties of Natural Religion," two books, ibid. 1675, 8vo. publifhed by Dr. Tillotfon. Alfo, "Sermons preached on feveral Occafions," and fome others. Life prefixed to his Philofophical and Mathematical Works.

WILKINSON, in *Geography*, a county of Georgia, with 2154 inhabitants, including 318 flaves.—Alfo, a county of the Miffiffippi, with 5068 inhabitants, including 2630 flaves.

WILKOMIERS, a town of Lithuania, in the palatinate of Wilna, on the Swienta, near its union with the Wilna; 44 miles N.N.W. of Wilna.

WILKS, a county of North Carolina, with 9054 inhabitants.

WILKUSCHKE, a town of Pruffia; 5 miles N.N.E. of Ragnitz.

WILL, VOLUNTAS, is ufually defined a faculty of the mind, by which it embraces or rejects any thing reprefented to it, as good or evil, by the judgment.

Others will have it to be the mind itfelf, confidered as embracing or refufing; adding, that as the underftanding is nothing elfe but the foul, confidered as *perceiving*; fo the will is nothing elfe but the foul, confidered as *willing*, &c.

Mr. Locke more intelligibly defines the will, a faculty which the foul has of beginning or forbearing, continuing or ending, feveral actions of the mind, and motions of the body, barely by a thought or preference of the mind, ordering, or as it were commanding, the doing, or not doing, fuch and fuch a particular action. This power which the mind has, to order the confideration of any idea, or the forbearing to confider it; or to prefer the motion of any part of the body to its reft, and *vice verfâ*, is what we call the will. See POWER.

The actual exercife of that power, is what we call *volition*, or willing; and the doing or forbearing of any action confequent on fuch order of the mind, is called *voluntary*. So far, according to this writer, as a man has a power to think or not to think, to move or not to move, according to the preference or direction of his own mind, fo far he is free: and hence liberty, he fays, is not an idea belonging to volition or preferring, but to the perfon having the power of doing, or forbearing to do, as the mind fhall choofe or direct. On the other hand, wherever any performance or forbearance is not equally in a man's power; wherever doing or not doing will wil not equally follow upon the preference of his mind; there he is not free, though perhaps the action may be voluntary. Accordingly, where thought is wholly wanting, or the power to act or forbear according to the direction of thought, there neceffity takes place; this, in an agent capable of volition, when the beginning or continuation of any action is contrary to the preference of his mind, is called *compulfion*: when the hindering or ftopping of any action is contrary to his volition, it is called *reftraint*. Agents that have no thought, no volition at all, are in every refpect neceffary agents.

Father Malebranche lays it down, that the will is that to the foul, which motion is to the body; and argues, that as the Author of nature is the univerfal caufe of all the motions in matter, fo he is of all the inclinations in the mind; and that as all motions are direct, unlefs their courfe be diverted and changed by fome foreign caufe; fo all inclinations are right, and could have no other end but the enjoyment of truth and goodnefs, were there not fome foreign caufe to determine the natural impreffion to evil ends.

Accordingly, he defines will to be the impreffion, or natural motion, which carries us towards good indeterminately, and in the general; and the power the mind has, to direct this general impreffion towards any particular object that pleafes it, is what he calls *liberty*.

Ariftotle diftinguifhes two kinds of acts of the will, *viz.* βούλησις, *willing*, *volition*; and προαίρεσις, *election*. The firft, that employed about the ultimate end; the latter, about the means.

The fchoolmen alfo diftinguifh the actions of the will into *elicit* and *commanded*. Elicit acts, *actiones elicitæ*, are thofe immediately produced by the will, and really inherent in it; fuch are *willing* and *nilling*. Commanded acts, *actiones imperatæ*, are effects produced by other powers; *v. gr.* the fenfitive, intellective, or locomotive powers, at the command or inftigation of the will. As to *follow*, *ftay*, *fight*, *fly*, &c.

But others will have the former kind properly to belong to the underftanding; and only the latter to the will.

The word will is taken in three fenfes:

1. For the power or faculty of willing, in which fenfe it is, we have confidered it above.

2. For the act or exercife of this power; as, when we fay, No man wills his own deftruction.

3. For a habit, or a conftant difpofition and inclination to do any thing. In which fenfe juftice is defined a conftant will to give every one what belongs to him: "Juftitia eft cõnftans et perpetua voluntas jus fuum unicuique tribuendi." Inftit. Juftin.

Will, *Antecedent*. See Antecedent.

Will, *Free*. See Liberty, and Freedom.

Will, *Laft Will*, or *Teftament*, in *Law*, a folemn act, or inftrument, by which a perfon declares his mind and intention as to the difpofal of his goods, effects, &c. after his death. See Testament.

This act or inftrument is emphatically ftyled the will of the deceafed, becaufe it directs the difpofal of the whole or part of his property, by written or oral inftructions properly witneffed and authenticated, according to his pleafure. Some have diftinguifhed between a teftament and a will; a will being properly limited to land, and a teftament only to chattels, requiring executors, which a will only for land doth not require: fo that every teftament is a will, but every will is not a teftament. However, the words have been commonly ufed indifcriminately.

Wills, *Hiftory of*. Wills or teftaments, fays judge Blackftone, are of very high antiquity. We find them among the ancient Hebrews: not to mention what Eufebius and others have related of Noah's teftament, made in writing, and witneffed under his feal, by which he difpofed of the whole world, a more authentic inftance of the early ufe of teftaments occurs in the facred writings (Gen. chap. xlviii.), in which Jacob bequeaths to his fon Jofeph a portion of his inheritance double to that of his brethren; which will we find executed many hundred years afterwards, when the pofterity of Jofeph were divided into two diftinct tribes, thofe of Ephraim and Manaffeh, and had two feveral inheritances affigned them; whereas the defcendants of each of the other patriarchs formed only a fingle tribe, and had only one lot of inheritance. Solon was the firft legiflator that introduced wills into Athens; but in many other parts of Greece they were totally difcountenanced. In Rome they were unknown, till the laws of the Twelve Tables were compiled, which firft gave the right of bequeathing; and among the northern nations, particularly among the Germans, teftaments were not received into ufe. Hence it appears, that the right of making wills and difpofing of property after death, is merely a creature of the civil ftate, which has permitted it in fome countries, and denied it in others, and fubjected it to various reftrictions and regulations, where the law allows it.

With us in England, this power of bequeathing is coeval with the firft rudiments of the law; not indeed, that it extended originally to all a man's perfonal eftate. See Rationabili *parte bonorum*.

It is alfo fufficiently clear, that, before the Conqueft, lands were devifable by will. But, upon the introduction of the military tenures, the reftraint of devifing lands naturally took place, as a branch of the feodal doctrine of non-alienation without the confent of the lord. By the common law of England fince the Conqueft, no eftate, greater than for term of years, could be difpofed of by teftament; except only in Kent, and in fome ancient burghs, and a few particular manors, where their Saxon immunities by fpecial indulgence fubfifted. But when ecclefiaftical ingenuity had invented the doctrine of *ufes*, as a thing diftinct from the land, ufes began to be devifed very frequently, and the devifee of the ufe could in chancery compel its execution. However, when the ftatute of ufes, *viz.* 27 Hen. VIII. cap. 10. had annexed the poffeffion to the ufe, thefe ufes, being now the very land itfelf, became no longer devifable: whereupon the ftatute of wills was made, *viz.* 32 Hen. VIII. cap. 1. explained by 34 & 35 Hen. VIII. cap. 5. which enacted, that all perfons being feifed in fee-fimple (except feme-coverts, infants, ideots, and perfons of nonfane memory) might by will and teftament in writing devife to any other perfon, except to bodies corporate, two-thirds of their lands, tenements, and hereditaments, held in chivalry, and the whole of thofe held in focage; which now, through the alteration of tenures by the ftatute of Charles II. 12 Car. II. cap. 25. amounts to the whole of their landed property, except their copyhold tenements. As for copyhold and other cuftomary lands, thefe are devifable or not, according to the cuftom of the refpective manors. And generally, a devife of copyhold will not pafs, without a furrender to the ufe of the will. In the cafe of a child or widow, a court of equity, in favour of thefe, will fupply a defect of furrender (2 Vez. 582. 5 Vez. 557.); fo alfo, when there is a general devife of real eftate to pay debts, and there is no real eftate but copyhold: alfo where a copyhold is in the hands of truftees, the perfon for whom the lands are holden in truft may devife the fame without furrender. (2 Atk. 38. 1 Vez. 489.) And though the court will fupply the defect of a furrender for the benefit of children, yet the rule doth not extend to grand-children, or to a natural child, and consequently not to any more distant kindred. (2 Vez. 582. 1 Wilson, 161. 6 Vez. 544.) And if a man, seised of copyhold lands, surrenders the same to the use of his will, and executes a will, not attested by any witnesses, yet it shall direct the uses of the surrender: for the clause in the statute, which requires the testator's signing in the presence of three witnesses, is confined only to such estates as pass by the statute of wills of 34 & 35 Henry VIII., which doth not extend to copyhold. (2 Atk. 37. 7 East's Rep. 299.) See MORTMAIN.

By 29 Car. II. cap. 3. any estate *pur auter vie* shall be devisable by a will in writing, signed by the party so devising the same, or by some other person in his presence and by his express directions, attested and subscribed in the presence of the devisor by three or more witnesses; and if no such devise thereof be made, the same shall be chargeable in the hands of the heir, if it shall come to him by reason of a special occupancy, as assets by descent, as in case of lands in fee-simple; and in case there be no special occupant thereof, it shall go to the executors or administrators of the party that had the estate thereof by virtue of the grant, and shall be assets in their hands.

One that hath money to be paid him on a mortgage may devise this money when it comes. God. O. L. 391.

And if the feoffee in mortgage, before the day of payment which should be made to him, maketh his executors and die, and his heir entereth into the land as he ought; it seemeth in this case, that the feoffor ought to pay the money at the day appointed to the executors, and not to the heir of the feoffee: but yet the words of the condition may be such, as the payment shall be made to the heir; as if the condition were, that if the feoffor pay to the feoffee or to his heirs such a sum at such a day, there after the death of the feoffee, if he dieth before the day limited, the payment ought to be made to the heir at the day appointed. 1 Inst. 209, 210.

And hereby it appeareth, that the executors do more represent the person of the testator, than the heir doth that of the ancestor; for though the executor be not named, yet the law appoints him to receive the money, but so doth not the law appoint the heir to receive the money unless he be named. 1 Inst. 209, 210.

A person may devise by his will the right of presenting to the next avoidance, or the inheritance of an advowson. And if such devise be made by the incumbent of the church, the inheritance of the advowson being in him, it is good, though he die incumbent; for though the testament hath no effect but by the death of the testator, yet it hath an inception in his life-time: and so it is, though he appoint by his will who shall be presented by the executors, or that one executor shall present the other, or doth devise that his executors shall grant the advowson to such a man. Wats. c. 10.

But where an advowson was devised to the first or other son of B, that should be bred a clergyman and be in holy orders, and if B should have no such son, to C; both devises were holden by the court of common pleas to be void, as depending on too remote a contingency; for the rule of law is, that the contingency on which such an executory devise hinges must take effect within some life in being, or 21 years afterwards; but it was uncertain that the son of B, if he ever should have any, would take, or be able to take orders within 21 years of the death of his father. Proctor *v.* the Bishop of Bath and Wells, and others, 2 H. Bla. 358.

If upon articles for a purchase, the purchaser die, having devised the land before a conveyance executed, the land will pass in equity; for the testator had an equity to recover the land, and the vendor stood trustee for the testator, and as he should appoint, till a conveyance executed. 1 Chanc. Cas. 39. 2 Vern. 679.

For the vendor of the estate is, from the time of his contract, considered as a trustee for the purchaser; and the vendee, as to the money, is considered as a trustee for the vendor. 1 Atkyns, 573.

So if a man covenants to lay out a sum of money in the purchase of lands, generally; and deviseth his real estate before he hath made such a purchase: the money to be laid out will pass to the devisee. Id.

But if a man, having made his will, afterwards contracts for the purchase of lands; the lands contracted for will not pass by the will, but descend to the heir at law. Id.

But if a good title cannot be made of the lands; as the heir in such case cannot have the lands, so he shall not have the money intended to be laid out. Id.

If a man have a lease for ever so many years, determinable upon life or lives, that is, if such or such live so long; this estate may well enough be given and disposed by will, because it is but a chattel. Went. 19.

A lease for years may also be devised to A for life, remainder to B. And if the lease be renewable, and A renew, B shall contribute to the fine so partaking of the benefit of the renewal.

If the testator, by his last will and testament, do give or bequeath to another any debt due unto him, or a thing in action belonging unto him, the legacy is good and effectual in the law, and may be recovered in this manner, that is to say, if the testator do make the legatary executor of that particular debt or thing in action bequeathed, then the legatary as executor thereof may commence suit in his own name, and recover the same to his own use, against him by whom it was due; but if the testator do not make the legatary executor of the debt or thing in action bequeathed, then his remedy lieth in the ecclesiastical court, where he may convent the executor, and compel him either to sue for that debt in a court competent, and upon recovery and payment thereof to pay it over to the legatary, or else to make a letter of attorney to the legatary for the recovery of the debt or thing in action bequeathed in the name of the executor to the use of the legatary. Swin. 187, 188.

Albeit the testator have no such thing of his own as is bequeathed, yet nevertheless the legacy is good in law; therefore, if the testator do bequeath a horse or a yoke of oxen, the legacy is good in law, though the testator have neither horse nor ox of his own. But who shall make choice, in this case, of the thing so bequeathed, is a question not to be neglected: and the solution is this; that if the words of the devise be directed to the legatary, as if the testator shall thus say, I will that A B shall have a horse, the choice doth belong to the legatary; but if the words be directed to the executor, as if the testator shall thus say, I will that my executor give to A B a horse, the election doth belong to the executor. Provided nevertheless, that to whomsoever the election doth belong, whether to the legatary, or to the executor, they must not be unreasonable in their election, but frame themselves according to the meaning of the testator; otherwise the legatary might make choice of the best horse in the country, and the executor of the worst, contrary to the meaning of the deceased. Swin. 188.

If there be two joint-tenants of lands, and one of them deviseth that which to him belongs, and dieth; this is no good devise, and the devisee takes nothing, because the devise

vise doth not take effect until after the death of the devisor, and then the surviving joint-tenant takes the whole by prior title, to wit, from the first feoffment. Gilbert on Wills, 120.

And although the jointure is severed before the testator's death, yet if the will be made before the severance, it will have no effect; unless there is a republication of the will after the partition. Bur. Mansf. 1496.

So also a man cannot give or bequeath by will any of those goods or chattels which he hath jointly with another: for if he should bequeath his portion thereof to a third person, this bequest is void by the laws of this realm; and the survivor, which had those goods or chattels jointly with another, shall have that portion so bequeathed, notwithstanding the said will. Swin. 189.

But otherwise it is with the tenants in common (God. O. L. 131.) and coparceners. For there is no survivor between coparceners, but the part of each is descendible, and consequently may be devised. (Co. Lit. 185. *b.*) And a deed of partition is not a revocation of a devise of his moiety by tenant in common. Luther *v.* Ridley, cited in 3 P. Wms. 169.

By 20 Hen. III. cap. 2. widows may bequeath the crop of their ground, as well of their dowers, as other their lands and tenements; saving to the lords of the fee all such services as be due for their dowers and other tenements. And this is only in affirmance of the common law. (2 Inst. 80.) But by 27 Hen. VIII. cap. 10. a married woman, having a jointure made, shall not have any dowry of the residue of her husband's lands.

By 28 Hen. VIII. cap. 11. if the incumbent before his death hath caused any of his glebe land to be manured and sown, at his proper costs and charges, with any corn or grain; he may make and declare his testament of all the profits of the corn growing upon the said glebe land so manured and sown.

But if the testator is lessee for years, and sow the land a short time before his lease expires, and then dies, before the corn can possibly be ripe within the term, in this case a devise thereof is void, because he himself could not have reaped it after the expiration of the term, if he had lived. Swin. 191.

Not only that thing may be devised or bequeathed by the testator, which is truly extant, or hath an apparent being at the time of the making of the will or death of the testator; but that thing also which is not in *rerum natura*, whilst the testator liveth: therefore, it is lawful for the testator to bequeath the corn which will be sown or grow in such soil after his death, or the lambs which shall come of his flock of sheep the next year, depasturing in such a field. But if there be no such corn growing in that soil, nor any lambs arising out of that flock, then the legacy is destitute of effect, because no such thing is extant at all as was bequeathed. But if the testator devise a certain quantity of grain or number of lambs, as for the purpose, twenty quarters of corn or twenty lambs, and doth will and devise, that the same shall be paid out of the corn which shall grow in such a field, or arise out of his sheep depasturing in such a ground; though not so much or no corn at all there grow, or not any or not so many lambs there arise, yet nevertheless the executor is compellable by law to pay the whole legacies entirely; because the mention of the soil and of the flock was rather by way of demonstration than by way of condition, rather shewing how or by what means the said legacy might be paid, than whether it should be paid at all yea or no. Swin. 186.

Those things which after the death of the testator descend to the heir of the deceased, and not to his executor, cannot be devised by testament, except in such cases wherein it is lawful to devise the lands, tenements, or hereditaments.

If a man be seised of a house, and possessed of divers heir-looms, that by custom have gone with the house from heir to heir, and by his will deviseth away these heir-looms; this devise is void: for the will taketh effect after his death; and by his death, the heir-looms by ancient custom are vested in the heir, and the law prefers the custom before the devise. And so it is, if the lord ought to have a heriot against his tenant, and the tenant deviseth away all his goods; yet the lord shall have his heriot for the reason aforesaid. 1 Inst. 185.

The testator may devise all goods and chattels which he hath in his own right, but not those which he hath in the right of another as executor. Swin. 185.

An administrator cannot make a testament of those goods which he hath as administrator to any person dying intestate; because he hath not any such goods to his own proper use, but ought therewithal to pay the debts of the dead person, and to distribute the rest according to law. Swin. 189.

The husband cannot devise such goods as his wife hath as being executrix to another, nor such things as are in action, as debts due to her before marriage by obligation or contract, unless he and his wife recover the same during marriage, or that he renew the bonds, and take them in his own name; otherwise after his death they remain to her. 1 Inst. 351.

But the husband may, at any time during the coverture, release a bond given to his wife. And where the husband makes a settlement, the bonds to his wife, being part of her fortune, will notwithstanding his death in the life-time of his wife, before the security be changed, be decreed in equity to his executor; he being considered in that case as a purchaser for a valuable consideration. Cases in the time of L. Talb. 168.

A man may by his will dispose of his chattels and personal estate that he shall for the future acquire, any time after the making his will, to the time of his death. And this is necessary from the reason of the thing; because the chattels and personal estate are in a continual fluctuation; and if the law were not so, it would create very great confusion, or else would render it necessary for a man to make a new will every day. Gilb. 122.

But it is not so with lands, for they are fixed and permanent: and, therefore, if a man maketh his will, and deviseth therein all the lands which he shall have at the time of his death; and after that, he purchaseth lands, and dieth without republication or making a new will; in this case, though his intent to the contrary is very apparent, yet it is a void devise: for a man cannot devise any lands but what he hath at the time of making his will. And this was adjudged upon great deliberation, by Holt chief justice and the court, in the case of Bunker and Cook: and the judgment was affirmed afterwards upon a writ of error in the house of lords, Feb. 24, 1707. Gilb. 122.

But, by Holt chief justice: If he republished his will, in such manner, and with such circumstances, as are necessary to complete execution of an original will; then the purchased lands will pass as by an original will. (11 Mod. 127.) And in truth this seemeth to make it a new will, to all intents and purposes; and not a republication of the old one.

But a codicil, which concerneth only personal legacies, will not amount to a republication of the will, so as to pass lands purchased after the making of the will. 2 Vern. 625.

If

If a man deviseth all his lands for payment of his debts, and purchaseth lands afterwards: the lord keeper said he would decree a sale, though there were no precedent articles. 2 Cha. Ca. 144.

If a man hath a lease, and disposeth of it specifically by his will; and after surrenders it and takes a new lease, and after dies; the devisee shall not have this last lease, because this was a plain countermand of his will. Golds. 93.

But in the case of Stirling and Lydiard, Nov. 21, 1744, where a man devised all and singular his leasehold estate, goods, chattels, and personal estate whatsoever, and afterwards renewed a lease; it was held by the lord chancellor Hardwicke clearly, that the leasehold estate passed by the will.

If a man deviseth a term for years, which he hath not at the time of the devise, but purchaseth some time before his death; Holt chief justice doubted whether this would be good. But Mr. Peere Williams says, that notwithstanding the doubt which the court of king's bench seems to have had in that case, it hath been clearly held to pass by such a will. 3 P. Wms. 169.

Wills, *Persons capable of making.* Every person hath full power and liberty to make a will, that is not under some special prohibition by law or custom: which prohibitions are principally upon three accounts; for want of sufficient discretion; for want of sufficient liberty and free will; and on account of criminal conduct.

In the first class are to be reckoned infants, under the age of fourteen if males, and twelve if females; which is the rule of the civil law. By statute 34 & 35 Hen. VIII. cap. 5. wills or testaments made of any manors, lands, tenements, or other hereditaments, by any person within the age of twenty-one years, shall not be taken to be good or effectual in law; for until that time, by the common laws of this realm, they are accounted infants. (Swinb. 74.) But by custom in particular places, they may devise lands before the age of twenty-one. (God. O. L. 21. Wentw. 24.) But no custom of any place can be good, to enable a male infant to make any will before he is fourteen years of age. (Law of Exec. 153.) If the testator is not of sufficient discretion, whatever be his age, that will overthrow his testament. Accordingly, madmen, or otherwise *non compotes*, ideots or natural fools, persons grown childish by age or distemper, such as have their senses besotted with drunkenness; all these are incapable, by reason of mental disability, to make any will as long as such disability lasts. To this class may also be referred such persons as are born deaf, blind, and dumb; who, as they have always wanted the common inlets of understanding, are incapable of having *animum testandi*, and their testaments are therefore void. It has been maintained that persons deaf and dumb, who understand what a testament meaneth, and that are desirous of making one, may by signs and tokens declare their testament: and that a blind person may make a nuncupative testament, by declaring his will before a sufficient number of witnesses; and that he may make his testament in writing, provided the same be read before witnesses, and in their presence acknowledged by the testator for his last will. Swinb. 95, 96.

Persons of the second description are by the civil law of various kinds; as prisoners, captives, and the like. But the law of England does not make such persons absolutely intestable; but only leaves it to the discretion of the court to judge, upon the consideration of their peculiar circumstances of duress, whether they could be supposed to have *liberum animum testandi*. With regard to feme-coverts, our laws differ still more materially from the civil. Among the Romans, a married woman was as capable of bequeathing as a feme-sole. But with us, a married woman is not only utterly incapable of devising lands, being excepted out of the statute of wills, 34 & 35 Hen. VIII. cap. 5. but also she is incapable of making a testament of chattels, without the licence of her husband, who frequently, upon marriage, covenants with her friends to allow her that licence: his assent, therefore, must be given to the particular will in question, without which it will not be a complete testament. Her will, therefore, operates in the nature of an appointment, the execution of which the husband by his bond, agreement, or covenant, is bound to allow. The queen-consort is an exception, for she may dispose of her chattels by will, without the consent of her lord: and any feme-covert may make her will of goods, which were in her possession *in auter droit*, as executrix or administratrix; for these can never be the property of her husband: and if she has any pin-money or separate maintenance, it is said she may dispose of her savings thereout by testament, without the controul of her husband. But if a feme-sole makes her will, and afterwards marries, such subsequent marriage is esteemed a revocation in law, and entirely vacates the will.

Persons of the third class are, first, all traitors and felons, from the time of conviction; for then their goods and chattels, and all such lands, tenements, and hereditaments, as they shall have in their own right, use, or possession, of any estate or inheritance, at the time of such treason committed, or at any time after, are forfeited to the king. The testament before made doth, by reason of the same conviction, become void both in respect of goods, and also in respect of lands, tenements, and hereditaments. But if a person, attainted of treason, obtain the king's pardon, and be thus restored to his former estate, he may make his testament, and his former testament is good. (Swinb. 97.) Neither can a *felo de se* make a will of goods and chattels, for they are forfeited by the act and manner of his death; but he may make a devise of his lands, for they are not subjected to any forfeiture. (3 Inst. 55.) Outlaws also, though only for debt, are incapable of making a will, so long as the outlawry subsists, for during that time their goods and chattels are forfeited; but he that is outlawed in an action personal, may make his testament of lands, for they are not forfeited. (Swinb. 107.) An outlaw in a personal action may in some case make executors; for he may have debts upon contract, which are not forfeited to the king; and those executors may have a writ of error to reverse the outlawry. (Cro. Eliz. 851.) Coke observes, that an excommunication (meaning the greater excommunication) is worse than an outlawry; for if a plaintiff, who is an executor, be outlawed, his outlawry cannot be pleaded to disable him from proceeding in the suit, because it is in the right of another; but if he is excommunicated, it is otherwise, because every man that converses with such a person is excommunicated himself (1 Inst. 134.); that is, after he is denounced excommunicate, and they are admonished not to converse with him. (Ayl. Par. 266.) As for persons guilty of other crimes, short of felony, who are by the civil law precluded from making testaments, (as usurers, libellers, and others of a worse stamp,) by the common law their testaments may be good.

Will, *Nature and Incidents of a.* Wills or testaments are divided into two sorts, *viz. written* and *verbal* or *nuncupative:* of which the former is committed to writing; the latter depends merely upon oral evidence, being declared by the testator *in extremis* before a sufficient number of witnesses, and afterwards reduced to writing. A codicil is a supplement to a will.

 As

As *nuncupative* wills and codicils are liable to great impositions, and may occasion many perjuries, the statute of frauds, 29 Car. II. cap. 3. hath laid them under many restrictions; except when made by mariners at sea, and soldiers in actual service. As to all other persons, it enacts, 1. That no written will shall be revoked or altered by a subsequent nuncupative one, except the same be in the life-time of the testator reduced to writing, and read over to him and approved; and unless the same be proved to have been so done by the oaths of three witnesses at least; who, by 4 & 5 Ann. cap. 16. must be such as are admissible upon trials at common law.

2. That no *nuncupative* will shall be good, where the estate bequeathed exceeds 30*l.*, unless proved by three such witnesses, present at the making of it, and unless they or some of them were specially required to bear witness to it by the testator; and unless it was made in his last sickness, in his own habitation, or where he had previously resided at least ten days, except he be surprised with sickness on a journey, or from home, and dies without returning to his dwelling.

3. That no *nuncupative* will shall be proved by the witnesses after six months from the making, unless it were put in writing within six days; nor shall it be proved till fourteen days after the death of the testator, nor till process hath first issued to call in the widow, or next of kin, to contest if they think proper.

As to *written* wills (*viz.* those that concern not the devise of lands), they need not any witness of their publication. A testament of chattels, written in the testator's own hand, though it has neither his name nor seal to it, nor witnesses present at its publication, is good; provided sufficient proof can be had that it is his hand-writing. (Swinb. 353. Gilb. Rep. 260.) And though written in another man's hand, and never signed by the testator, yet if proved to be according to his instructions, and approved by him, it hath been held a good testament of the personal estate. However, it is the safer and more prudent way, and leaves less in the breast of the ecclesiastical judge, if it be signed or sealed by the testator, and published in the presence of witnesses. It is said in 3 Salk. 396. that by the canon law, and also by the common law, two witnesses are requisite to prove a will of goods; for one witness by the civil law, unto which the other laws are conformed in this matter, is as no witness at all. 1 P. Wms. 13.

The statute of frauds and perjuries, 29 Car. II. cap. 3. directs, that all devises of lands and tenements shall not only be in writing, but signed by the testator, or some other person in his presence, and by his express direction; and be subscribed, in his presence, by three or four credible witnesses. In the construction of this statute, it has been adjudged that the testator's name, written with his own hand at the beginning of his will, as, "I John Mills do make this my last will," &c. is a sufficient signing, without any name at the bottom; though the other is the safer way. (3 Lev. 1.) It hath been said, that if the testator only put his seal to the will, without signing it, this is a sufficient signing within the statute; because signing is no more than a mark to distinguish a man's act, and sealing is a sufficient mark to know it to be his will. (Gilb. 93.) Others, however, have held that sealing without signing was not sufficient. (1 Wilson, 313. 2 Vezey, 459.) Signing being only mentioned in the statute, sealing is not necessary. (God. O. L. 5. 1 Wentw. 29.) It has also been determined, that though the witnesses must all see the testator sign, or at least acknowledge the signing, yet they may do it at different times. But they must all subscribe their names as witnesses in his presence, lest by any possibility they should mistake the instrument. In one case determined by the court of king's bench, the judges would not allow any legatee, nor consequently a creditor, where the legacies and debts were charged on the real estate, to be a competent witness to the devise. This determination occasioned the statute 25 Geo. II. cap. 6. which restored both the competency and credit of such legatees, by declaring void all legacies given to witnesses, and thereby removing all possibility of their interest affecting their testimony. The same statute likewise established the competency of creditors, by directing their testimony to be admitted; but leaving their credit (like that of all other witnesses) to be considered, on a view of all the circumstances, by the court and jury before whom such will shall be contested. And in a much later case, M. 31 Geo. II. the testimony of three witnesses, who were creditors, was held to be sufficiently credible, though the land was charged with the payment of debts. By stat. 29 Car. II. cap. 3. all declarations or creations of trusts or confidences, of any lands, tenements, or hereditaments, shall be manifested and proved by some writing signed by the party who is by law enabled to declare such trust, or by his last will in writing, or else they shall be utterly void, and of none effect. And all grants and assignments of any trust or confidence shall likewise be in writing, signed by the party granting or assigning the same by such last will or devise; or else shall be utterly void, and of none effect.

No testament is of any effect till after the death of the testator; and, therefore, if there be many testaments, the last overthrows all the former; but the republication of a former will revokes one of a later date, and establishes the first again. Although no man can die with two testaments, because the latter doth always infringe the former; yet a man may die with divers codicils, and the latter doth not hinder the former, so long as they be not contrary. (Swinb. 15.) All codicils are part of the will; therefore, a codicil merely for a particular purpose, as to change an executor, and confirming the will in all other respects, does not revive a part of the will revoked by a former codicil. If two testaments be found, and it doth not appear which was the former or latter, both testaments are void; but if two codicils be found, and it cannot be known which was the first or last, and one and the same thing is given to one person in one codicil, and to another person in another codicil, the codicils are not void, but the persons therein named ought to divide the thing betwixt them. Swinb. 15.

If codicils are regularly executed and attested, they may be proved as wills are. So if they are found written by the testator himself, they ought to be taken as part of the will, and to be proved in common form by the oath of the administrator with the will annexed; and in case of opposition, by witnesses to the hand-writing and finding: and it hath been usual to exhibit an affidavit of the hand-writing and finding, before a probate or administration passes even in common form.

But in case of a real estate, a codicil cannot operate, unless it be executed according to the statute. 1 Atk. 426.

By stat. 29 Car. II. cap. 3. no devise in writing of lands, tenements, or hereditaments, or any clause thereof, shall be revocable, otherwise than by some other will or codicil in writing, or other writing declaring the same, or by burning, cancelling, tearing, or obliterating the same by the testator himself, or in his presence, and by his directions and consent; but all devises and bequests of lands and tenements shall remain and continue in force, until the same be burnt, cancelled, torn, or obliterated by the testator, or by his directions

tions in manner aforefaid, or unlefs the fame be altered by fome other will or codicil in writing, or other writing of the devifor, figned in the prefence of three or four witneffes declaring the fame.

And no will in writing concerning any goods or chattels or perfonal eftate fhall be repealed, nor fhall any claufe, devife, or bequeft therein be altered or changed, by any words, or will by word of mouth only, except the fame be in the life of the teftator committed to writing, and after the writing thereof read unto the teftater, and allowed by him, and proved to be fo done by three witneffes at the leaft.

A will which will pafs perfonal eftate is not a fufficient revocation of a former will, by which a real eftate is devifed. Comyns, 451.

Although the ftatute fays, that no will in writing concerning perfonal eftates fhall be repealed by word of mouth only, except the words be put into writing, and read to and allowed by the teftator, and proved to be fo done by three witneffes; yet where a man by will in writing devifed the refidue of his perfonal eftate to his wife, and fhe dying, he afterwards by a nuncupative codicil bequeathed to another all that he had given to his wife, this was refolved to be good: for by the death of the wife, the devife of the refidue was totally void; and the codicil was no alteration of the former will, but a new will for the refidue. 1 Abr. Caf. Eq. 408.

Alfo, the ftatute hath not taken away revocations of wills by act of law; as if the teftator afterwards make a feoffment, or do any other act inconfiftent with the will: but fuch revocation remains as before the ftatute. Carth. 81.

If a man devifes lands to one and his heirs, and afterwards mortgages the fame lands to another for years or in fee; though a mortgage in fee is a total revocation at law, yet in equity it fhall be a revocation *pro tanto* only. 1 Abr. Eq. Caf. 410.

And the reafon is, becaufe a mortgage is not confidered as a conveyance of the eftate, but only as a charge upon it; being merely a fecurity, and in the confideration of equity carries only a chattel intereft, the creditor gains nothing real, it affords no dower, and goes to executors. Sparrow and Hardcaftle, May 6, 1754. 3 Atk. 798.

But if lands be devifed to one in fee, and afterwards mortgaged to the fame devifee; this is a revocation *in toto*, being inconfiftent with the devife: but if the mortgage had been to a ftranger, it had been a revocation *quoad* the mortgage only. Prec. Cha. 514.

If a man feifed in fee devifes it to one in fee or for life, and afterwards makes a leafe to another for years; this, even at law, fhall not be a revocation but during the years. 1 Roll's Abr. 616.

So if a hufband poffeffed for forty years devifes it to his wife, and after leafes the land to another for twenty years, and dies; this leafe is not any revocation of the whole eftate, but only during the twenty years, and the wife fhall have the refidue by the devife. Id.

But where a man feifed of a leafe for lives devifed it, and afterward furrendered the old leafe, and took a new one to him and his heirs for three lives; it was decreed, that this renewal of the leafe was a revocation of the will as to this particular. For by the furrender of the old leafe, the teftator had put all out of him, had divefted himfelf of the whole intereft; fo that there being nothing left for the devife to work upon, the will muft fall, and the new purchafe, being of a freehold defcendible, could not pafs by a will made before fuch purchafe. 3 P. Wms. 166. 170.

But where the teftator devifed all and fingular his leafehold eftate, and afterwards renewed a leafe; it was held by lord Hardwicke clearly, that this leafehold eftate paffed by the will: for that this is not a fpecific legacy, but only an enumeration of the feveral particulars of the perfonal eftate, but yet is a general devife of the whole. 3 Atk. 199.

Though a covenant or articles do not at law revoke a will; yet if entered into for a valuable confideration, amounting in equity to a conveyance, they muft confequently be an equitable revocation of a will, or of any writing in nature thereof. 2 P. Wms. 624.

A woman's marriage is alone a revocation of her will. Id.

A man made a will, and appointed one (who was no relation) to be his executor. He afterwards went abroad, where he became a governor of one of the plantations, and fent over for an Englifh woman of his acquaintance, whom he married, and had children by; and died, without an actual revocation of his will. Yet it was determined, that this total alteration of his circumftances was an implied revocation. 1 P. Wms. 304.

It is an eftablifhed maxim, that wills fhould be conftrued favourably. Accordingly, the intention of the teftator is called by lord Coke the polar-ftar, to guide the judges in the expofition of wills. In divers inftances, relating to the interpretation of wills, collateral evidence hath been admitted in the court of chancery to explain the teftator's intention. But notwithftanding thefe cafes, the courts have been very unwilling to admit of parol evidence in relation to any thing that appears on the face of a will; and it is certain that too much caution cannot well be ufed in this particular, efpecially when it is confidered that the ftatute of frauds and perjuries, which was made to prevent perjury, contrariety of evidence, and uncertainty, binds the courts of equity as well as the common-law courts; as alfo that little regard ought in many cafes to be had to the expreffions of the teftator, either before or after the making his will, becaufe poffibly thefe expreffions might be ufed by him, on purpofe to conceal or difguife what he was doing, or to keep the family quiet, or for other fecret motives and inducements which cannot after his death be found out. 2 Bac. Abr. 310.

Notwithftanding that wills are generally favoured by the law; yet where the teftator endeavours to eftablifh a fettlement againft the reafon and policy of the common law, the judges will reject it. Gilb. 110. 2 Bac. Abr. 79.

Alfo where the teftator by his will maketh no other difpofition of his eftate than the law itfelf would have done, had he been filent; there fuch a will is ufelefs, and fhall be rejected: and, therefore, if a devife be made to a perfon and his heirs, which perfon is heir at law to the devifor; this is a void devife, and the heir fhall take by defcent as his better title; for the defcent ftrengthens his title, by taking away the entry of fuch as may poffibly have right to the eftate; whereas if he claims by devife, he is in as by purchafe. Gilb. 110. 2 Bac. Abr. 79.

Alfo devifes are void and rejected, where the words of the will are fo general and uncertain, that the teftator's meaning cannot be collected from them; and, therefore, where a man by will gave *all* to his mother, the general words did carry no *lands* to his mother; for fince the heir at law hath a plain and uncontroverted title, unlefs the anceftor difinherits him, it would be fevere and unreafonable to fet him afide, unlefs fuch intention of the teftator is evident from the will; for that were to fet up and prefer a dark and at beft but a doubtful title to a clear and certain one. Gilb. 112. 2 Bac. Abr. 81.

The claufe of "perfect mind and memory" is more ufual than neceffary in a will, and yet not hurtful. (Swinb. 7.)

But

But in case of contest, it is necessary to prove the sanity of the testator. 2 Atk. 56.

For the different modes of devise, and the legal meaning of the appropriate terms by which they are expressed, we refer to Burn's Ecclesiastical Law, *ubi infra*.

From the above accounts it follows, that testaments may be avoided three ways: 1. If made by a person labouring under any of the incapacities before mentioned. 2. By making another testament of a later date. And, 3. By cancelling or revoking it.

The Romans were wont to set aside testaments, as being *inofficiosa*, deficient in natural duty, if they disinherited or totally passed by (without assigning a true and sufficient reason) any of the children of the testator. But if the child had any legacy, though ever so small, it was a proof that the testator had not lost his memory nor his reason, which otherwise the law presumed. Hence probably, says Blackstone, has arisen that groundless vulgar error of the necessity of leaving the heir a shilling or some other express legacy, in order to effectually disinherit him; whereas the law of England, though the heir or next of kin be totally omitted, admits no *querela inofficiosa*, to set aside such testament. Burn's Eccl. Law, vol. iv. art. WILL. Blackst. Com. book ii.

WILLS *of Seamen and Marines*. By the statute 26 Geo. III. c. 63. no will made by any petty officer or seaman in the king's service, whereby any wages, pay, prize-money, or allowance of money of any kind due for such service is bequeathed, shall be valid, unless, if made while the party is in the service, it be signed before and attested by the captain, or the officer then commanding, and one of the signing officers of the ship to which the party belongs, and unless it specify in the body thereof the name of the ship, and the number at which the maker of the will stands upon the ship's books, and contains a full description of the residence, profession, or business of the person in whose favour it is made, and the day of the month and the place where it was executed, or by the agent of any of his majesty's hospitals or quarters appointed to receive sick and wounded seamen, in which the party may be at the time; or if made by such officer or seaman discharged from the service, within the bills of mortality, unless it be attested by the officer appointed by the treasurer of the navy to inspect such wills; or if made at any of the ports where seamen's wages are paid, unless it be attested by the treasurer of the navy, chief or second clerk there; or if made at any other place, unless it be attested by the minister and churchwardens of the parish in England or Ireland, or by two elders of the parish in Scotland. In order to obtain a probate thereof, the will must be sent to a proctor by the inspector of wills appointed by the treasurer of the navy.

If any such petty officer or seaman should die intestate, the person claiming administration must apply by petition to the said inspector, who is to grant a certificate directed to a proctor, that letters of administration may pass in favour of the petitioner, if entitled thereto by law.

If any proctor, register, or other officer of any ecclesiastical court shall be aiding and assisting in procuring probate of a will, or letters of administration, for the purpose of enabling any person to receive such wages, pay, prize-money, or allowance of money of any kind, without first obtaining the certificate from the inspector of seamen's wills, or person authorized to officiate for him, every such proctor, register, or other officer, shall forfeit 500*l.*, and for ever after be incapable of acting in any capacity in any ecclesiastical court in Great Britain or Ireland.

And by the 32 Geo. III. c. 34. after the 1st day of August 1792, no letter of attorney or will of a non-commissioned officer of marines or marine shall be valid unless made according to the 26 Geo. III. c. 63.

All are to be deemed petty officers, seamen, marines, &c. except such as are rated upon the books of such ship, admirals or flag officers, and their secretaries, captains, and lieutenants, masters, second masters, and pilots, physicians, surgeons, chaplains, boatswains, gunners, carpenters, and pursers, captains of marines, captain lieutenants of marines, lieutenants, and quarter-masters of marines.

Every lieutenant, on board any of his majesty's ships, shall upon a page of every muster book of such ship sign his name for the purpose, and for the purpose only, that the inspector of seamen's wills, or such person as shall be deputed by him, may have an opportunity of comparing the same with the name of any such lieutenant attesting the will, &c. executed by or in favour of any petty officer, seaman, non-commissioned officer of marines or marine.

And all captains of ships shall, upon their monthly muster books or returns, specify which of the men, mentioned in the said returns, have granted or issued any will or testament during that month or space of time from the preceding returns, by inserting the date thereof opposite to the party's name. The muster books, &c. in case of sailing from any foreign station, at a time when no opportunity shall offer of transmitting them to the navy-board, to be left with the naval officer of the place, if any, or with some respectable merchant, with directions to forward the same to the commissioners of his majesty's navy by the first safe opportunity, and in case of the removal of the commander, to be delivered over to his successor and a receipt given for the same.

Provided that it shall be lawful for the minister of any parish, to whom the inspector of seamen's wills shall transmit his check of any letter of attorney or will, passed and allowed by him, to deliver the said check to the attorney or executor in the said letter of attorney or will named and appointed. And all seamen's letters of attorney, and wills made prior to the 1st of August 1786, and those of marines prior to the 1st of August 1792, shall be examined and inspected by the inspector of seamen's wills for the purpose of preventing frauds, forgeries, or impositions of any kind therein; and if such inspector shall see no cause to suspect the authenticity of the same, he shall affix the stamp of his office, and issue checks for the same, but if he shall see good cause to suspect the truth and authenticity of such letter of attorney or will, he shall report the same to the treasurer, or to the paymaster of the navy, and shall enter his caveat against such letter of attorney or will, which shall prevent any money from being had or received thereon until the same shall be authenticated to the satisfaction of the said treasurer or paymaster.

The wages, pay, prize-money, or allowances of petty officers or seamen, non-commissioned officers of marines, and marines dying intestate, are to be paid only upon letters of administration obtained in the following manner:

The person claiming such administration shall send or give in a note or letter to the inspector of seamen's wills, stating the name of the deceased, the name of the ship or ships to which he belonged, and that he has heard or been informed of his death, and requesting the inspector to give such directions as may enable him to procure letters of administration to the deceased, or to the like effect, upon receipt whereof the inspector of seamen's wills shall deliver or send to the person claiming such administration, a paper in a peculiar form of words, which paper being duly filled up and certified shall be returned to the treasurer, or to the paymaster of his majesty's navy, London, who upon receiving the

the same shall direct the inspector of seamen's wills to examine the same, and make such inquiry relative thereto as may appear to him necessary on that behalf; and being satisfied, he shall forthwith make out a certificate for obtaining letters of administration, and pursue the course minutely described in Burn's Ecclesiastical Law, art. *Wills*.

By 32 Geo. III. c. 34. the following sums are to be paid for the seal, parchment, writing, and suing forth of probates of wills and letters of administration granted in pursuance of this act, for the purpose of receiving wages, or pay, or allowances of money of any kind, which shall remain due to the deceased, *viz.*

	£.	*s.*	*d.*
For probates of wills, if the goods and chattels are under the value of 20*l.* - - - -	0	15	2
For letters of administration - - -	1	4	2
For probates of wills under 40*l.* - - -	1	8	8
For administration - - - - - -	1	17	8
For probates of wills under 60*l.* - - -	1	11	2
For administration - - - - - -	2	8	6
For probates of wills under 100*l.* - -	1	13	8
For administration - - - - - -	2	11	0
For commissions or requisitions to swear executors or administrators:			
Under 20*l.* - - - - - -	0	15	0
And under 100*l.* - - - - -	1	3	0

But if the probates or letters of administration be granted to the widow, children, father, mother, brother, or sister, in pursuance of this act, for the same purpose of receiving wages, or pay, or allowances of money of any kind, which shall remain due to such warrant or petty officer, &c. then the following sums are to be paid, *viz.*

	£.	*s.*	*d.*
For probates of wills under 20*l.* - - -	0	6	0
For administration - - - - - -	0	14	0
For probates of wills under 40*l.* - - -	0	19	6
For administration - - - - - -	1	7	6
For probates of wills under 60*l.* - - -	1	3	0
For administration - - - - - -	1	11	0
For probates of wills under 100*l.* - -	1	7	6
For administration - - - - - -	1	15	6
For commissions or requisitions to swear executors or administrators:			
Under 20*l.* - - - - - -	0	12	0
Under 40*l.* - - - - - -	0	15	6
Under 60*l.* - - - - - -	0	16	6
Under 100*l.* - - - - - -	0	18	6

And no more than 5*s.* are to be taken for the suing forth of the probate of any will or letters of administration granted to the widow, children, father, mother, brother, or sister of any such seaman or marine, &c. and 5*s.* for commissions or requisitions to swear such widow, &c. unless the goods amount to 100*l.*: which last-mentioned charge of 5*s.* must be understood to be demandable where the probate or letters of administration are not for the purpose of receiving wages, or pay, or allowances of money remaining due, but for general purposes, as to obtain administration of the goods and chattels of the deceased.

A bill of the expences of obtaining letters of administration to creditors, is to be laid before and taxed by one of the registers of the prerogative court of Canterbury, or their deputies, who are entitled to a fee of 3*s.* 4*d.* for the same; and the proctor is to transmit such letters of administration with the bill of expences so certified, to the treasurer or paymaster of his majesty's navy. Proctors taking more than the prescribed sums forfeit 50*l.*, and registers and other officers of any ecclesiastical court, procuring letters of administration or probate contrary to this act and the 26 Geo. III., to be incapacitated to act, and forfeit 500*l.*

WILL, *Qualification and Office of the Executor of a.* See EXECUTOR, EXECUTOR *de son Tort*, and JOINT-*Executors.* See also DEBTS, DEBTEE-*Executor*, INVENTORY, and LEGACY.

WILL, *Probate of a.* See PROBATE.

WILL, *Estate at*, in *Law*, is where lands and tenements are let by one man to another, to have and to hold at the will of the lessor; and the tenant by force of this lease obtains possession. Every estate of this kind is at the will of both parties, landlord and tenant: so that either of them may determine his will, and quit his connection with the other at his own pleasure, under certain restrictions. For, if the tenant at will sows his land, and the landlord, before the corn is ripe, or reaped, puts him out, the tenant shall have the emblements, and free ingress and egress to cut and carry away the profits. But where the tenant himself determines the will, the landlord shall have the profits of the land. The law is careful, that no such sudden determination of the will by one party shall tend to the manifest and unforeseen prejudice of the other. This appears in the case of emblements just mentioned; and also, the lessee after the determination of the lessor's will shall have reasonable ingress and egress to fetch away his goods and utensils. And if rent be payable quarterly or half-yearly, and the lessee determines the will, the rent shall be paid to the end of the current quarter or half-year. Upon the same principle, courts of law have of late years inclined as much as possible against construing demises, where no certain term is mentioned, to be tenancies at will: but have rather held them to be tenancies from year to year, so long as both parties please, especially where an annual rent is reserved: in which case they will not suffer either party to determine the tenancy even at the end of the year, without reasonable notice to the other. Blackst. Com. vol. ii.

WILL *with a Whisp.* See IGNIS *Fatuus.*

WILL'*s Cove*, in *Geography*, a creek on the N.E. coast of the island of St. Christopher, to the S.W. of Muddy Point.

WILL'*s Creek*, a river of Maryland, which runs into the Potomack, N. lat. 39° 30′. W. long. 78° 47′.

WILLACH. See VILLACH.

WILLAERT, ADRIAN, in *Biography*, the disciple of John Mouton, and master of Zarlino, has been long placed at the head of the Venetian school of counterpoint by the Italians themselves. He was born at Bruges in Flanders, and during his youth studied the law at Paris; if with the view of making it his profession, there must have been an early conflict between legislation and music, which having a powerful advocate in his own heart gained the cause; for by his own account (see JOSQUIN) he went to Rome in the time of Leo X., where he found that his motet, "Verbum bonum et suave," was performed in the pontifical chapel, as the work of that renowned composer; he therefore must have been a contrapuntist some time, before any of his works could have travelled to Rome.

The account which Zarlino gives of this motet (P. i. p. 175.) having passed for a work of Josquin, excited our curiosity to see it; and finding it among the Motetti della Corona, in the British Museum, we scored it; but discovered that the predilection for a great name had operated too powerfully in favour of this composition while Josquin was imagined to be the author of it; for it is neither written with the clearness, dexterity, nor even correctness, of that wonderful contrapuntist: there is not only confusion in the

the parts and defign, in many places, but fomething very harfh and unpleafing in the harmony, particularly in the clofes without a fharp feventh, both in the key-note and in the fifth. The motet is in fix parts, soprano, two countertenors, tenor, baritono, and bafe. Some of thefe fevenths would doubtlefs have been made fharp in performance by the fingers of thofe times, in obedience to a rule for fharpening afcending fevenths in minor keys, and flattening them in defcending.

The lift of his works, in Walther's Dictionary, though ample, is far from complete. The motet Verbum bonum, juft mentioned, was publifhed at Foffombrone in 1519, forty-three years before Zarlino made him an interlocutor in his dialogue (Ragionamente), at Venice; and it can hardly be imagined that no others of his compofitions appeared till 1542, when, we are told, that his motets for fix voices were publifhed. In the Fior de Motetti, lib. i. Venice, 1539, there is a Pater-nofter, in four parts, by Adriano; and in the fame year the firft book of his motets, for four voices, was republifhed in the fame city by Ant. Gardano, in folio, under the following pompous title: "Famofiffimi Adriani Willaert, Chori Divi Marci illuftriffimæ Reipublicæ Venetiarum Magiftri, Mufica Quatuor Vocum (quæ vulgo Motectæ nuncupatur) noviter omni ftudio, ac diligentia in lucem edita." This edition, which, we find by the title, was not the firft, is preferved in the Britifh Mufeum. Indeed, for near fifty years after his name firft appeared, hardly a collection of motets or madrigals was publifhed to which he did not contribute; but the moft fplendid and curious work of this author, that we have feen, is preferved in the Britifh Mufeum. It was publifhed at Ferrara, 1558, by his fcholar and friend, Francefco Viola, another of the interlocutors in Zarlino's Ragionamente, under the title of Mufica Nova, in three, four, five, fix, and feven parts. In the dedication of this work to Alfonfo d'Efte, duke of Ferrara, the editor, his maeftro di capella, calls Adriano (the name by which he is always mentioned by the Italians) his mafter, and fays, that he is ftrongly attached to him, not only for his wonderful abilities in mufic, but integrity, learning, and the friendfhip with which he has long honoured him. Zarlino, in like manner, omits no opportunity of exalting the character of his mafter. Thefe are honourable teftimonies of regard, which feem the more worthy of being recorded, as, either from the worthleffnefs of the mafter, or ingratitude of the fcholar, they are but feldom beftowed.

In the cantus part there is a wooden cut of the author: "Adrian Willaert Flandrii Effigies." And indeed the compofitions are of that kind for which he was moft renowned, and fuch as the editor thought would conftitute the moft durable monument of his glory. In the tenor part there are many canons of very curious conftruction; fome with two and three clefs, and a different number of flats and fharps for the feveral parts, which are moving in different keys at the fame time; and one particularly curious, in feven parts, "Præter rerum feriem," of which three are in ftrict canon of the fourth and fifth above the guide; the tenor leading off in G, the fextus following in C, and the feptima pars in D, while the reft move in free fugue.

Zarlino (P. iii. p. 268.) affigns to Adriano the invention of pieces for two or more choirs; and Piccitoni (Guida Armonica) fays, that he was the firft who made the bafes in compofitions of eight parts, move in unifons or octaves; particularly when divided into two choirs, and performed at a diftance from each other, as then they had occafion for a powerful guide. The dexterity and refources of this author, in the conftruction of canons, are truly wonderful, as is, indeed, his total want of melody; for it is fcarcely poffible to arrange mufical founds, diatonically, with lefs air or meaning, in the fingle parts. But there are many avenues through which a mufician may travel to the temple of Fame; and he that purfues the track which the learned have marked out, will perhaps not find it the moft circuitous and tedious; at leaft theorifts, who are the moft likely to record the adventures of paffengers on that road, will be the readieft to give him a caft. A learned and elaborate ftyle conceals the want of genius and invention, more than the free and fanciful productions of the prefent times.

Adriano lived to a great age, and filled a very high mufical ftation, maeftro di capella of St. Mark's church at Venice. His works and fcholars were very numerous; and among thofe to whom he communicated the principles of his art, there were feveral who afterwards arrived at great eminence; fuch as Cipriano Rore, Zarlino, and Coftanzo Porta. In the title of a book, publifhed at Venice, 1549, there are "Fantafie," or "Ricercari," compofed dallo excellentiffimo Adrian Vuigliart, and Cipriano Rore, fuo difcepolo. P. Martini, in his Saggio di Contrappunto, P. ii. p. 266. calls Adrian Willaert the mafter of Coftanzo Porta. Burney.

WILLAFANS, in *Geography*, a town of France, in the department of the Doubs; 3 miles S.E. of Ornans.

WILLAKALA, a town of Sweden, in Finland; 48 miles E. of Biorneborg.

WILLAWAKY, an Indian town on the N.W. coaft of lake Michigan. N. lat. 47° 45′. W. long. 87° 10′.

WILLDENOVIA, in *Botany*, received its name from profeffor Thunberg, in honour of Dr. Charles Lewis Willdenow, late profeffor of botany at Berlin, well known as the author of many learned botanical writings, but efpecially by his *Species Plantarum*, of which the immortal work of Linnæus, bearing the fame title, is the bafis. The addition of effential characters, and of many new fpecies, befides thofe accumulated in profufion, with great intelligence and difcrimination, from authors fubfequent to Linnæus, might entitle this to rank as an original work; were not the Linnæan part of it too fervile a tranfcript, not only of miftakes, of remarks contradicting each other, and of evidently falfe fynonyms; but in general of errors of the prefs, and wrong citations of plates and pages, which prove that the refpective books, though in every body's hands, were not confulted. The learned editor happily lived to complete the firft part of the fifth volume, comprifing the order of *Filices*, in which he was well verfed. That he left the reft of the *Cryptogamia* unattempted, is perhaps rather fortunate than otherwife. The *Mufci*, *Lichenes*, and *Fungi*, each form a ftudy by themfelves, and are treated of feparately by different authors. They would have added enormoufly to Willdenow's work, and could, after all, have proved but a compilation. If the fcience goes on as it has done, an univerfal botanift will be nearly as impoffible a character as an univerfal naturalift is at prefent.

Another genus (fee SCHLECHTENDALIA) was dedicated to Willdenow by Cavanilles, which is retained in Lamarck's Illuftrations, t. 685, by the name of *Vildenovia*. The change of orthography at the conclufion we readily adopt, inftead of the uncouth *Willdenowa*, or *Willdenowia*, and it is now likewife followed by Thunberg himfelf, in his *Flora Capenfis*.—Thunb. in Stockh. Tranf. for 1790, 28. Prodr. 14. Fl. Capenf. v. 1. 312. Willd. Sp. Pl. v. 4. 717. Poiret in Lamarck Dict. v. 6. 177.—Clafs and order, *Dioecia Triandria*. (Triandria Monogynia; *Thunb.*)—Nat. Ord. *Tripetaloideæ*, Linn. *Junci*, Juff. *Reftiaceæ*, Brown Prodr. v. 1. 243.

Gen. Ch. Male, *Cal.* Perianth inferior, of numerous, imbricated, membranous, pointed, permanent glumes, longer than

than the fruit. *Cor.* Petals six, equal, erect, oval, membranous, permanent. *Stam.* Filaments three, capillary, shorter than the corolla; anthers ovate-oblong.

Female, *Calyx* and *corolla* as in the male. *Pist.* Germen superior, roundish; style very short, two or three-cleft; stigmas two or three, downy. *Peric.* Drupa dry, roundish, smooth. *Seed.* Nut solitary, of one cell.

Eff. Ch. Male, Calyx of many imbricated glumes. Corolla of six petals, permanent.

Female, Calyx and corolla as in the male. Style one. Stigmas two or three. Drupa with one seed.

Obs. This genus differs from RESTIO (see that article), chiefly in having a single-seeded *drupa* instead of a *capsule*, opening by valves, and containing several *seeds*. We have here merely altered the phraseology respecting the *calyx*, which in *Restio* is termed, rather improperly, a *catkin*.

1. W. *striata*. Striated Willdenovia. Thunb. in Stockh. Transf. for 1790, 27. t. 2. f. 1. Fl. Cap. v. 1. 312. Willd. n. 1. Poiret n. 3.—Stem leafless, round, striated.—Native of the Cape of Good Hope, as are likewise the two following species. The *stem* is two feet high, or more, erect, rushy, hard and rather shrubby, branched, usually simply forked, rarely three-forked, round, jointed, striated, smooth; the branches also round, striated. *Sheaths* at each joint and subdivision solitary, ovate, close, brown, smooth. *Leaves* none. *Flowers* terminal, solitary, erect, the size of a pea. Scales of the *calyx* about ten, rarely fewer, or more, loosely imbricated, equal, oblong, pointed, brown, smooth, the length of the nail, membranous at the edges. *Corolla* white, much shorter than the *drupa*, and pressed close to its sides. *Style* in two short, broad, yellow divisions. *Stigmas* short, obtuse, brown. *Drupa* ovate, black, dotted; sometimes, according to Thunberg, of two cells, which last circumstance, if real, greatly invalidates the generic character.

2. W. *teres*. Smooth Willdenovia. Thunb. in Stockh. Transf. for 1790, 28. t. 2. f. 2. Fl. Cap. v. 1. 314. Willd. n. 2. Poiret n. 1.—Stem and branches leafless, round, smooth and even. The *stem* of this species is shrubby, much branched, jointed, simply or triply forked, erect, a foot or more in height, not striated; its branches somewhat level-topped. *Sheaths* at each subdivision ovate, brown, smooth, as long as the nail. *Flowers* terminal, solitary, erect. Scales of the *calyx* about six, ovate, awned, grey and smooth. *Petals* very short, emarginate, shining, surrounding the base of the *fruit*. *Style* undivided, very short. *Stigmas* feathery, tapering, purplish. *Drupa* hard, ovate, black, smooth, of one cell.—This plant differs from the foregoing in having fewer *calyx-scales*, a smooth and more branched *stem*, long tapering *stigmas*, and a smooth, not dotted, *fruit*. Poiret, who had seen a specimen, attributes to the present species the fleshy cylindrical body, with six notches, surrounding the base of the *corolla* externally, which Willdenow calls a *nectary*, and admits into his generic character. We have seen but few and incomplete specimens of any of the genus, and therefore cannot judge of the part in question, but we presume the term *nectary* must here be misapplied. Thunberg does not mention it in his *Flora*.

3. W. *compressa*. Compressed Willdenovia. Thunb. in Stockh. Transf. for 1790, 28. t. 2. f. 3. Fl. Cap. v. 1. 315. Willd. n. 3. Poiret n. 2.—Stem leafy, smooth and even; branches compressed. *Stem* two feet high, or more, shrubby, erect, smooth in every respect, simply or triply forked; its branches compressed, or semi-cylindrical, wand-like. *Sheaths* of the subdivisions ovate, pointed. *Leaves* on the young branches, and resembling them, thread-shaped, tapering. *Flowers* terminal, solitary, upright, the size of a pea. Scales of the *calyx* ovate, awned, smooth, membranous at the edges. *Petals* ovate, acute, as long as the *fruit*. *Style* undivided. *Stigmas* three, feathery. *Drupa* ovate, compressed, obtuse, grey. *Thunberg*.

WILLEBROD, in *Biography*, the apostle of Friseland, was an Anglo-Saxon, and born in Northumberland about the year 658, and educated in the abbey of Rippon, where he engaged in the religious profession. At the age of 33, he accompanied eleven of his countrymen into Batavia, and employed himself for three or four years in converting the Frisians who were under the French dominion; and having met with great success, he went to Rome, and received from pope Sergius the pallium, ordaining him archbishop of Friseland. Pepin gave him a residence at Wilteburg, now Utrecht, of which he was the first prelate. Embarking from Friseland for the north, he penetrated into Denmark, and in his return was cast by a storm on an island called Fosteland, supposed to be the same with Heligoland. He afterwards baptized Pepin, son of Charles Martel, and spent the rest of his life in propagating Christianity among the Batavians. His colleague and assistant was Winfrid, his countryman, surnamed Boniface, the apostle of Germany. He died in 740, at the age of 82; was buried at his abbey of Esternac, in the diocese of Treves, and honoured with canonization. His life was written by the celebrated Alcuin. Mosheim. Moreri.

WILLEMSTADT, or WILLIAMSTADT, in *Geography*, a strong town of Holland, situated upon that part of the Meuse called Buttervliet, built in 1584, by William I., prince of Orange, from whom it receives its name. This fortress is one of the keys of Holland, and defended with seven bastions and double fosse; it has also a good harbour, but which it is sometimes dangerous for vessels to enter at certain times of the year. It was besieged by the French in the year 1793, but by the brave resistance of the governor and garrison, assisted by the English, with gun-boats, &c. the besiegers were compelled to retire with great loss; 12 miles S.W. of Dort. N. lat. 51° 41′. E. long. 4° 18′.

WILLENBERG, or WILDENBERG, a town of Prussia, in the province of Oberland; 93 miles S. of Königsberg. N. lat. 53° 11′. E. long. 20° 53′.

WILLERING, a town of Austria, on the Danube; 4 miles W. of Lintz.

WILLERSDORF, a town of Bavaria, in the bishopric of Bamberg; 5 miles S.W. of Forcheim.

WILLET'S BAY, a bay on the north-west coast of the island of St. Christopher, about a mile to the south-west of Dieppe Bay.

WILLIAM I., called "the Conqueror," king of England, and duke of Normandy, in *Biography*, was the natural son of Robert, duke of Normandy, by Arlotta, the daughter of a tanner, and born in 1024. When his father went on a pilgrimage to Jerusalem, and his son was only nine years of age, he caused the states of the duchy to swear allegiance to William, as his heir. On his return in 1033, Robert died; and the consequence was a variety of dissensions among the barons of the duchy, in which Henry I. of France took a part; so that when William arrived at majority, he found his dominions in a low and distracted state. But his vigour and exertions soon restored order and submission, and general tranquillity through his duchy. Edward the Confessor, at this time king of England, had no children; and the archbishop of Canterbury, who was a Norman, recommended his adopting William as his successor, and he was commissioned by the king to inform the duke of his intention. However, as he had not publicly divulged his purpose, Harold, the son of earl Godwin, ascended the throne without opposition, on his decease

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in 1066. Harold, however, had previoufly taken a folemn oath to affift William in accomplifhing the purpofe of Edward refpecting the fucceffion; and his perfidy excited the indignation of William, and induced him to prepare for difpoffeffing Harold of the Englifh throne by force of arms. His intentions were no fooner announced than he was joined by a great number of military adventurers; and upon an appeal to Rome, the pope fanctioned the conteft, and fent him a confecrated banner. Thus encouraged, he affembled a fleet of 3000 veffels, and an army of 60,000 men; and determining on invading England, landed on September 28, 1066, at Pevenfey, in Suffex. Harold, as foon as he received this intelligence, marched from York, and having recruited his forces at London, haftened to encounter the Normans, who were encamped near Haftings. On the 14th of October the two armies engaged, and after a fevere battle, which lafted during a whole day, the Englifh were defeated, with the lofs of Harold and his two brothers. William loft no time in availing himfelf of this victory; but having reduced the town and caftle of Dover, and received the fubmiffion of the Kentifh men, proceeded towards London. In his way he was met by Edgar Atheling, who had been proclaimed legal heir to the monarchy, Stigand, archbifhop of Canterbury, and fome of the principal nobility, who made an offer to him of the crown; and on Chriftmas-day, 1066, after a kind of tumultuous election, he was crowned at Weftminfter-abbey by the archbifhop of York, and took the coronation-oath. Having adopted meafures for conciliating his fubjects, and overawing thofe who were adverfe to him, he re-croffed the fea to Normandy, taking with him as hoftages Edgar, the primate, and feveral of the principal nobility. Soon after his departure, the Englifh were treated contumelioufly and oppreffively by the Normans, whofe conduct excited infurrections, and led to a confpiracy for the maffacre of all who remained in the country. This intelligence occafioned William's return in December 1067; and among other meafures of a more conciliatory nature, he imprudently renewed the tax called "danegelt," which excited infurrections through various parts of the kingdom. As foon as thefe infurrections were fuppreffed, his queen, Matilda, was crowned at Weftminfter: but new troubles arofe from the union of the two principal nobles, Edwin and Morcar, with the kings of Scotland and Denmark, and the prince of North Wales, which threatened an extenfive revolt. The confpiracy for this purpofe was difcovered and crufhed, and meafures were taken for preventing the evils that were likely to refult from it. From this time William's government became daily more and more defpotic; and the nobility of the country, perceiving that their ruin was the object of his contemplation, prepared to leave the kingdom. Infurrections broke out in various parts of the country, and the means which he adopted for fuppreffing them were in the higheft degree rigorous and deftructive. As a meafure of future prevention, he brought from Normandy the feudal conftitution into England, and divided moft of the lands into baronies, which he granted to the moft confiderable of his followers, under the condition of certain fervices and payments; and thefe fubdivided their fhares on fimilar tenures, among others, chiefly foreigners, of inferior rank. The ecclefiaftical property of the kingdom was regulated upon a fimilar fyftem; and under various pretences, the Normans fuperfeded the Englifh in the poffeffion of all church dignities. In order to favour this expulfion of the Englifh dignitaries, a legate from the pope was, for the firft time, admitted into this country, and a reverence for the fee of Rome, fimilar to that which fubfifted on the continent, was inculcated on all Britifh fubjects; whilft the king took care, by referving certain powers to himfelf, to guard the civil fovereignty againft papal ufurpations. In order further to fubjugate the minds of the Englifh, and reduce them to the ftate of a conquered people, the king projected the abolition of their language; and by admitting at court no other language befides the French, he caufed all the youth in the fchools of the kingdom to be inftructed in it, and the laws to be drawn up in that language, which was alfo ufed in all judicial pleadings and writings.

Having fuppreffed an infurrection which broke out in 1071 by the inftigation of the earls Edwin and Morcar, and in the following year negotiated a peace with Malcolm, king of Scotland, he was called to Normandy in 1073, on occafion of a revolt in that country. In 1075 his prefence was neceffary in England to check a confpiracy among the Norman barons, whom he had diftinguifhed by his favour, and who were joined by Waltheof, an Englifh nobleman, on whom he had beftowed his niece Judith. Waltheof, in this confpiracy, fell a facrifice to the treachery of his wife. In the following year, *viz.* 1076, the haughty and ambitious Hildebrand, who was now pope Gregory VII., required William to do homage for his kingdom to the holy fee, alleging a promife to this purpofe, and alfo to pay the accuftomed Englifh tribute. William denied his promife of homage, which he refufed to render, but remitted to Rome the Peter-pence; and whilft he would not allow the Englifh prelates to attend a general council fummoned by Gregory, he permitted the pope's legate to convene a fynod at Winchefter for eftablifhing the celibacy of the clergy. On his return to Normandy in this year, he found the country engaged in a civil war, in confequence of a rebellion excited by his fon Robert. On this occafion the father and fon had a perfonal encounter; but when the fon difcovered that he was thus engaged, he was ftruck with horror, fell at his father's feet, and implored forgivenefs. The father was at firft unrelenting; but they were afterwards reconciled. About the year 1081, William ordered that furvey of the landed property of the kingdom to be made which is recorded in Domefday-book. (See Domesday. For an account of the impolitic as well as cruel manner in which he indulged his paffion for the chace, we refer to the article Forest.) The latter years of his life furnifhed various occafions of affliction and difquietude. The death of his queen Matilda, to whom he was affectionately attached, was an event that took place in 1083, and was the caufe of undiffembled forrow and lamentation. The preparations made by the king of Denmark and the earl of Flanders for an invafion of England occafioned to him no fmall degree of anxiety: and when he was refcued from this danger by the death of the Danifh king, he was called into Normandy in 1086, to repel the incurfions of fome French barons; and fufpecting that the king of France had inftigated them to thefe acts of hoftility, he commenced a war againft him in 1087, in the profecution of which he even laid wafte the country at the approach of harveft by the moft cruel devaftation. But an accidental injury which he received in mounting his horfe ftopped his career, and terminated in his death. Alarmed by the near profpect of diffolution, his mind was haraffed with remorfe in the review of the atrocious conduct with which he was chargeable, and he fought relief by donations to the church, to which perfons of his character have commonly reforted, and by the pardon and releafe of fome of his enemies. By his laft teftament he bequeathed to his eldeft fon Robert the counties of Normandy and Maine, and to his fecond fon William, the crown of England, and to his third fon, Henry, the property of his mother. He expired at the abbey of St. Gervais, near Rouen,

Rouen, on September 9, 1087, in the 63d year of his age, and the 21ſt of his reign over England, leaving five daughters, as well as ſons. "William the Conqueror at his death," ſays one of his biographers, "was the moſt powerful and greateſt ſovereign of his time. He poſſeſſed ſuperior talents, political and martial, and employed them with ſingular vigour and induſtry. But his paſſions were ſtrong, his diſpoſition was ſevere and mercileſs, and his ambition and love of rule cauſed him to diſregard all reſtraints of juſtice and humanity. There never was a more fortunate uſurper of a throne, which he tranſmitted to a long and ſtill ſubſiſting line of deſcendants; and the eſtabliſhment of his dynaſty is the moſt conſpicuous era of Engliſh hiſtory." Rapin. Hume. Henry. Lyttleton. Gen. Biog.

WILLIAM II., ſurnamed *Rufus*, ſecond ſon of the Conqueror, and king of England by his father's nomination, was crowned at Weſtminſter in September 1087, and recognized as king when he was about 27 years of age. His brother Robert ſucceeded to the dukedom of Normandy by the diſpoſition of his father, which proved the occaſion of much diſcontent and conteſt; partly becauſe the great barons poſſeſſed eſtates both in England and Normandy, and under ſeparate governments; and partly becauſe Robert was the eldeſt ſon, and the moſt popular. A conſpiracy was ſoon formed by the maternal brothers of the late king, in which many nobles concurred for depoſing William. But William, poſſeſſing a certain portion of his father's vigour, took meaſures for defeating them. With this view he conciliated the native Engliſh, took poſſeſſion of the caſtles and perſons of the unfortunate barons, baniſhed them to Normandy, and beſtowed their eſtates on his faithful adherents. When he was firmly ſeated on the throne, he forgot his promiſes of relieving the Engliſh from oppreſſion, and even enhanced the ſeverity of the foreſt laws. The death of Lanfranc, whom he reſpected, left him at liberty to ſeize vacant biſhoprics and abbeys, and to beſtow church lands on his captains and favourites. In 1090 he viſited Normandy with hoſtile intentions reſpecting his brother; but a negociation took place, and they were reconciled. Robert accompanied William to England, and commanded an army which was ſent againſt Malcolm, king of Scotland. But a variance ſoon took place between the brothers, occaſioned by the encroaching and treacherous diſpoſition of William, which led him to excite the Norman barons to rebel againſt Robert. Whilſt William was proſecuting hoſtile meaſures againſt his brother, he was recalled to England in 1095, to ſuppreſs a conſpiracy among the barons in the north, whom he ſpeedily defeated and ſeverely puniſhed. The ſpirit of cruſading having at this time pervaded Europe, Robert was ſeized with the mania, and mortgaged his dukedom to William for 10,000 marks, in order to enable him to unite with the cruſaders in 1096. William, having gone over to the continent to take poſſeſſion of Normandy and Maine, was taken extremely ill, and apprehending danger, reſolved to repair the injury which he had done to the church, and to ſupply the vacancy of the archbiſhopric of Canterbury, which had continued from the death of Lanfranc. The eccleſiaſtic nominated on this occaſion was Anſelm, who, notwithſtanding the diſinclination he had manifeſted againſt accepting the appointment, was afterwards a zealous defender of the rights of the church, and of eccleſiaſtical authority in general. The king and the primate ſoon diſagreed; and though a ſynod was aſſembled for the depoſition of the archbiſhop, the king failed in the attempt. But when Anſelm deſired permiſſion to leave the kingdom, he obtained leave; but his temporalities were ſeized, and the pope received him as a confeſſor in the cauſe of religion. William's French acquiſitions were the occaſion of trouble to him; for whilſt he was hunting in the New Foreſt, he received information that the citadel of Maine was beſieged, and he therefore haſtened to Dartmouth, and determined to embark without delay. As the weather was tempeſtuous, the mariners expreſſed ſome apprehenſion of danger; the king, however, was reſolute and perſevering, and aſked them if they had ever heard of a king who was drowned. Having accompliſhed his object, he was applied to by the duke of Guienne, who was under the influence of the paſſion for cruſading, for the loan of a ſum of money, as a mortgage on his rich provinces of Guienne and Poitou. William accepted the propoſal; but whilſt he was preparing to carry over the money, and to take poſſeſſion of the provinces, he was accidentally killed in the New Foreſt. Having alighted from his horſe after a chaſe, a ſtag ſprung up near him; and a French gentleman, Walter Tyrrel, perceiving the animal, ſhot off an arrow, which glancing from a tree, entered the king's breaſt, and penetrated to the heart. Tyrrel immediately fled, and embarking for France, joined the cruſaders. The king's body was found by the country people, and interred without ceremony at Wincheſter. This happened on Auguſt 2, 1100, when the king was in the 40th year of his age, and the 13th of his reign. The character of William Rufus has been unfavourably repreſented, both on account of the depredations which he committed in the church, and of his indifference to religion. "The incidents of his reign," ſays a biographer, "prove him to have poſſeſſed vigour and deciſion, courage and policy; but to have been violent, perfidious, and rapacious, and void of all ſenſe of juſtice and honour. One of his beſt public acts was the ſending Edgar Atheling into Scotland, to reſtore prince Edgar, ſon of Malcolm, to the throne of that kingdom, of which he was the lawful heir. He deſerves to be regarded as a promoter of the uſeful arts by his ſtill-remaining erections of the Tower, London-bridge, and Weſtminſter-hall." Gen. Biog.

WILLIAM III., king of England, prince of Orange, and ſtadtholder of Holland, was the poſthumous ſon of William II., prince of Orange, and of Mary, daughter of Charles I., king of England, and born on November 14, 1650, at a very intereſting period. His guardianſhip was divided between the princeſs-royal his mother, the princeſs-dowager his grandmother, and the elector of Brandenburg. During the negociations that ſucceeded the naval war between the Engliſh and Dutch republics, Cromwell, the protector, ſtipulated, that the prince of Orange, who was a branch of the houſe of Stuart, ſhould be for ever excluded from the ſtadtholderate; but on the event of the Reſtoration, the princeſs-royal petitioned, in 1662, that her ſon might be inveſted with the offices and dignities which belonged to his anceſtors; and ſoon after the act of excluſion againſt him was annulled. Although the ſtates of Holland would not admit, as a condition of peace in the ſucceeding war between England and the United States, the preliminary propoſed by Charles II. of elevating the prince to the ſtadtholderate, they formally adopted him as "a child of the ſtate," and placed him under the care of perſons who ſhould inſpire him with principles ſuited to his ſituation under a free government. After ſome ſubſequent debates concerning the rank which ſhould be aſſigned him, he was raiſed in 1670 to the dignity of firſt noble of Zealand, and then admitted into the council of ſtate. On occaſion of the war, which was declared by Lewis, and his penſioner Charles, againſt the United States in 1672, the public voice obliged the magiſtracy of Holland to revoke the perpetual edict procured by De Witt for aboliſhing the ſtadtholder-

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ate, and to confer that dignity with all its prerogatives upon William. Thus authorized by the States to change the regency in all the moft confiderable towns of Holland and Zealand, party oppofition was extinguifhed, and every propofal for the defence of the country was unanimoufly adopted. The prince, at this early age, fully juftified the confidence that was repofed in him by the firmnefs and elevation of his mind. At an extraordinary affembly of the ftates, he pointed out, in an elaborate fpeech, the pernicious confequences that muft refult from the "peace propofed by the French king, who was in poffeffion of three of the provinces; he fhewed the poffibility of raifing fupplies for a war in defence of their religion and liberty; and by the cool intrepidity of his manner and force of his arguments, he produced fuch an effect upon his before-defponding audience, that they concurred in the refolution of making every facrifice, rather than defert the caufe of their country. Vigorous meafures were entered upon; foreign alliances were formed; fortunate circumftances prevented the further advance of the French, who evacuated the province of Utrecht; Charles II. was obliged by his parliament to make peace, in 1674, with the Dutch, who in the fame year figned feparate treaties with the bifhop of Munfter and the elector of Cologne; and at length the three conquered provinces were re-united to the States General; and the conduct of the prince of Orange fo much ingratiated him with the ftates of Holland, that the offices of ftadtholder and captain-general were declared hereditary in his male line." In all his military actions, he difplayed both courage and wifdom; fo that the prince of Condé teftified in his favour, that at the battle of Seneff, "he had in every point acted like an old captain, except in venturing his life too like a young foldier." The humiliation of the French king feems to have been his favourite object; and with this view he wifhed to fix the Englifh court in the fame intereft. This was one motive which induced him to connect himfelf more clofely with the royal family, by a marriage with Mary, eldeft daughter of the duke of York. Accordingly he came into England in 1678, and then the nuptials took place which were fo fatisfactory to the nation, and which were afterwards followed by the moft important confequences. Without enlarging on the meafures purfued by the prince on the continent, we fhall direct our attention to thofe in which our own country was more immediately interefted. The fucceffion of the prince's father-in-law to the crown of England in 1685, inftead of ftrengthening the bonds of affinity by which they were attached to one another, ferved only to feparate them more widely. The king was a bigotted papift, and the prince was regarded as a great fupporter of the Proteftant caufe on the continent, and therefore they could not cordially concur in their views and operations. King James, whofe object was to render the Catholic religion predominant, began with endeavouring to procure for it a free toleration in Great Britain, by a repeal of the penal laws and the teft-act; and in order the more effectually to accomplifh his purpofe, he ftrongly folicited the prince of Orange to exprefs his concurrence and that of the princefs; but as they knew how unpopular the defign was in England, they refufed to grant it. About this time Lewis XIV., under the impulfe of his own bigotry, and that of thofe with whom he acted, repealed the edict of Nantes, which had fecured the privileges of his Proteftant fubjects; and by his harfh treatment of them, drove numbers of them out of his dominions, and thus excited a dread and hatred of popery through all Proteftant countries of Europe. The effect of this meafure with regard to the prince of Orange was, that it fufpended all party oppofition to him in Holland, and gave him additional importance in Europe, as the determined foe of French ambition. The arbitrary proceedings of king James alarmed all the friends of civil liberty, and of the eftablifhed religion in England; and apprehenfive of danger, they directed their views to the prince of Orange as their deliverer. Accordingly conferences were held with a confidential envoy whom he fent over to afcertain the public opinion; applications were made to the prince by feveral perfons of rank; and at length, when the birth of a prince of Wales difappointed all hopes of a Proteftant fucceffion, the leading men of different parties concurred in actually inviting him to come over, and to undertake the protection of the church and conftitution from threatening ruin. The prince confented, and with confummate prudence and fecrecy prepared for the interefting expedition; and as exifting circumftances afforded a profpect of a breach between the United States and their allies, and the king of France, he was thus enabled to augment the Dutch forces by fea and land without fufpicion. Having previoufly difperfed through the kingdom a declaration, ftating the grievances of the reign, and announcing his intention of bringing over an armed force to defend the nation from tyranny, and to procure the affembling of a free parliament, he put to fea in October 1688, with a fleet of about 500 veffels, and an army of 14,000 men. He was once driven back by a ftorm, but a fecond attempt fucceeded, fo that he gained the Englifh coaft without oppofition, (the king's fleet being windbound,) and on the 5th of November difembarked his troops at Torbay. Of the caufes, progrefs, and termination of the Revolution, we have given an account under the articles JAMES II. *of England*, and REVOLUTION. King William feated on the throne became fovereign of a powerful kingdom; but his tranquil poffeffion of the crown depended on a variety of circumftances which he could neither direct nor controul. The conflict of different parties was not eafily reftrained; nor were his difpofition and manners, which were cold and referved, notwithftanding all his excellent qualities, adapted to unite and conciliate the partifans of the old and new government. Amongft thofe who had taken an active part in the late meafures, or who had acquiefced during their progrefs, fome were diffatisfied with the total exclufion of James and his infant fon; and others could not approve the transfer of the crown by the will of the people. In Scotland, the appointment of William was the act merely of the whigs; and in Ireland, where the population was chiefly Catholic, the intereft of James was predominant. The church zealots in England were not pleafed with the tolerant principles manifefted by king William, and with the wifhes he expreffed for the comprehenfion of the diffenters. Thus circumftanced, the commencement of his reign was embroiled by the open oppofition and fecret intrigues of his enemies, and in the progrefs of it the collifion of parties was the occafion of much perfonal difquietude both to him and to the queen. His attention was for a confiderable time diftracted by the ftate of his native country, when war with France was renewed in 1689, by James's invafion of Ireland in the fpring of that year, when his intereft with the Catholics was powerful, and in which he was aided by the French king, and alfo by an infurrection of the Jacobite party in Scotland. Ireland feemed at this time to demand his principal exertions; for though marfhal Schomberg had been fent over in 1689 to oppofe the progrefs of the late king, little had been done to any important purpofe. Accordingly in the fummer of 1690, he embarked with a reinforcement for this country, and by the battle of the Boyne, in which Schomberg was killed,

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he routed the Irifh army, and totally difperfed it. James abandoned the conteft, and fled precipitately to France, leaving the reduction of the ifland to William, which was completely effected in the following year. Whilft he was thus engaged in military operations, a party fpirit agitated his domeftic government. The convention parliament, confifting of whigs, who were his decided friends, dreaded monarchical power, and refufed to fettle upon him the crown revenue for life. Hence he was led to diffolve the parliament in difguft; but he foon found that the new parliament, in which the influence of the tories preponderated, though it readily indulged his defires with regard to the revenue, and voted liberal fupplies for the Irifh war, was compofed of perfons that were not real friends to the principles which placed him upon the throne. We fhall leave to the details of hiftory the events that occurred on the continent in the profecution of the war againft France; and proceed to obferve, that in the year 1695 he fuffered a fevere lofs by the death of queen Mary, who had proved herfelf an affectionate wife, and both faithful and zealous in promoting his intereft; nor was his attachment to her lefs ardent and fincere. The deceafe of Mary revived the hopes of the Jacobites, and they were bufy and active in forming confpiracies, not fcrupling to concert the atrocious plan of affaffinating the king. In 1697 peace with France was concluded at Ryfwick, and Lewis was reduced to the neceffity of acknowledging William as the lawful fovereign of Great Britain, and to make no future attempts for difpoffeffing him of his throne. The next conteft that engaged political parties at home related to the reduction of the military eftablifhment. King William, attached to a military life, and not very confident with refpect to his own fecurity on the throne, wifhed to retain a greater force than parliament was difpofed to allow; which was no more than 7000 men, who were to be all natives; fo that he was under a neceffity, though with great reluctance, of parting with his favourite Dutch guards. The next political object that engaged the king's attention was connected with the balance of power in Europe, and that was the fucceffion to the crown of Spain, upon the death of Charles II., who was in a declining ftate of health, and who had no iffue. In 1701 the king of Spain died, and left a teftament in favour of the grandfon of Lewis XIV., which will was accepted by the French king; and of courfe preparations were made by William and the Dutch for renewing the war with France. This meafure was further rendered neceffary by the death of James II. in the fame year, and Lewis's acknowledgment of his fon as king of Great Britain. On the meeting of the parliament at the end of this year, William made a fpeech on the ftate of affairs, on his own propofed conduct, and on the neceffity of mutual confidence between the crown and people. This fpeech was much applauded, and was anfwered by a very loyal addrefs. Thus was his reign, which had been diftinguifhed by its viciffitudes and trials, and by the extenfive and permanent benefits that refulted from it, drawing to its termination. A fall from his horfe gave a fhock to his enfeebled conftitution, and brought on a fever, the iffue of which he tranquilly expected; and he expired on the 8th of March, O.S. 1702, in the 52d year of his age, and 13th of his reign.

The character of king William has been varioufly delineated by political writers of different fentiments and difpofitions. All allow that he poffeffed confiderable political talents, and though in his military operations he was often unfuccefsful, few perfons exceeded him in his ability for repairing loffes, and making a good clofe of a campaign. Although, as we have before faid, his manners were cold and referved, he was not deftitute of fenfibility. The partifans of James, and thofe who difapproved of the Revolution, have cenfured his conduct in depofing his father-in-law; but public liberty and the welfare of a nation muft be ever regarded as paramount to private duties. He never fought power otherwife than for accomplifhing the important and beneficial ends to which his views were directed; and therefore he cannot be juftly charged with a culpable degree of ambition. Whatever may be the opinion of erroneous and interefted individuals of the jacobites and tories of more ancient or modern times, "he will ever be gratefully remembered," as one of his biographers fays, "by the United Netherlands, as the great founder of their freedom and independence; and will be honoured as the deliverer of the Britifh iflands from tyranny, civil and religious, as long as a due fenfe of the benefits of that deliverance fubfifts among their inhabitants."

Though the Jacobites in England would not allow that this prince had any mufic in his foul, Bonnet Bourdelot, in his "Hift. de la Muf. et de les Effets," fays, "that he had been informed by a friend, one of the attendants of the prince of Orange, afterwards king of England, that in the year 1688, the prince being then at the Hague, and, as may be fuppofed, deeply engaged in reflexions on the critical fituation of his affairs at that time, had three choice muficians to play to him whenever he found himfelf too much agitated and thoughtful."

William *of Naffau*, prince of Orange, and founder of the Dutch republic, was born in Germany in 1533, and defcended from Lutheran parents, though, being introduced into the fervice of Mary queen of Hungary, and afterwards of Charles V., he conformed to the Catholic religion. He was trained to military and civil employments of high rank; and as he had ample poffeffions in the Low Countries, he attained to the dignity of governor of the provinces of Holland, Zealand, and Utrecht, under the Spanifh government. His character is very highly drawn, and is faid to have combined magnanimity, prudence, bravery, equanimity in all fortunes, fingular penetration and fagacity, retentive memory, popular eloquence, and the art of conciliating men's affections. Upon the introduction of the inquifition by the bigotry of Philip II., a flame broke out in the Netherlands; and the prince of Orange, with the counts Egmont and Hoorn, did every thing in their power to reftrain the feverities exercifed on a religious account, and to induce the Spanifh court to recal cardinal Granvelle, to whofe influence folely they were owing; and in this effort they fucceeded in 1564. On occafion of the fanguinary meafures propofed in the councils of Philip, and carried into execution by the duke of Alva, the prince of Orange, the moderation of whofe temper caufed him to be fufpected, furrendered his employments, and retired with his family, in 1567, to his brother at Naffau. Alva, having arrefted counts Egmont and Hoorn, and occafioned them to be condemned and executed, cited the prince of Orange to anfwer charges of fedition and treafon that were preferred againft him; and on his non-appearance, his eftates were confifcated, and his eldeft fon, a ftudent at Louvain, was carried off into Spain. William, who about this time feems to have declared himfelf a Proteftant, levied an army with a view of penetrating into Brabant; but Alva's military fkill defeated his purpofe, and he was under a neceffity of difbanding his troops. Still determined on relieving his country, he made another application in 1571 to feveral Proteftant powers for fuccour, but they were all averfe from encountering the power of Spain. At length he obtained from the court of France fome fupplies of money, and was then enabled to fit out a fmall fquadron, which, in in 1572, took poffeffion of the port of Brill. This trivial fuccefs roufed the fpirits of the Netherlanders, and feveral places in Zealand and Holland declared for the Orange party. At length a convocation of nobles and deputies from the principal towns in Holland took place at Dordrecht, and forming themfelves into an independent ftate, chofe William for their chief. Convinced by the maffacre of the Proteftants in France, that it was in vain to expect affiftance from that quarter, he difmiffed his troops, and retired to Holland; and whilft Alva was exercifing his ufual feverities, the people of Holland and Zealand alone remained in arms againft the Spanifh government; and the prefence of William gave order and ftability to the new republic. Although the duke of Alva was recalled from his government in 1573, the caufe of independence was in a very precarious ftate. However, in 1574, the ftates of Holland and Zealand conferred on William the fovereign authority during the war, and formed a treaty of union and alliance with each other. Peace with the court of Spain could not be obtained otherwife than on terms which could not be accepted; and the afpect of affairs in 1576 was very difcouraging. At length, however, the death of Requefens, who had fucceeded Alva as governor, and the depredations to which the towns of Brabant and Flanders were expofed, favoured William in his efforts to accomplifh a general union of the provinces of the Low Countries for mutual defence; and this was effected by the treaty, called the pacification of Ghent. William was now juftly regarded as the true patron of public liberty. At the beginning of the year 1579, the duke of Parma being the Spanifh governor, the union of Utrecht was figned, which was the bafis of the confederation of the Seven United Provinces, all of which, by their deputies, concurred in forming it. When the feparation of the Catholic and Proteftant Netherlands took place, the latter, being diftreffed, fought the affiftance of France, by nominating, in 1580, the duke of Anjou, brother to Charles IX. king of France, for their fovereign, and renouncing their allegiance to Philip; but the adminiftration of Holland and Zealand was ftill entrufted with the prince of Orange. Philip, afcribing this meafure to William, iffued an edict of profcription againft him; in confequence of which his life was in danger, and an attempt was made to affaffinate him. At length he fell a victim to the fanaticifm of a native of Franche-Compte, who was urged forward by a Cordelier and a Jefuit, who, under pretence of bufinefs, obtained accefs to him, and fhot him through the body. He fell, and ejaculating "My God! have mercy upon me and thy poor people," inftantly expired, on July 10, 1584, having nearly completed his 52d year. He was interred with great honour and teftimonies of refpect, at Delft. He was four times married, and had iffue by each wife. His fecond fon, Maurice, fucceeded to his authority in the United Provinces. (See MAURICE.) William, having been educated in a court, acquired the manners and habits of a ftatefman, and was charged with diffimulation and proud ambition. But his objects were always pure and patriotic, and he zealoufly preferved the liberties of his country; and, though he has been traduced by the advocates of defpotifm, he has received the higheft tokens of refpect from a people who gratefully acknowledge him as the principal author of their freedom and independence. Univ. Hift. Gen. Biog.

WILLIAM *of Wykeham*, an Englifh prelate, was born in 1324, at Wykeham in Hampfhire, and by the liberality of a patron, educated at Winchefter fchool, and afterwards recommended to Edyngdon, bifhop of Winchefter, who introduced him into the fervice of king Edward III. about his 23d year. Acquiring extraordinary fkill in architecture, he was appointed in 1356 clerk of the king's works in two manors, and furveyor of the royal works at the caftle and in the park of Windfor. The king was fo highly fatisfied with his conduct in thefe fimilar departments, that he recompenfed him by feveral preferments, civil and ecclefiaftical. In 1359 he was nominated chief warden and furveyor of the royal caftles of Windfor, Leeds, Dover, and Hadlam, and of feveral other caftles, manors, and parks. Whilft he had only the clerical tonfure, he enjoyed many ecclefiaftical dignities; and, in order to his further advancement in the church, he was ordained prieft in 1362. In the following year he was made warden and jufticiary of the royal forefts fouth of Trent, and in 1364 keeper of the privy-feal. He was alfo chief of the privy-council, and governor of the great council; and befides other civil preferments which he enjoyed, he fucceeded Edyngdon, in 1366, as bifhop of Winchefter, which paved the way for his elevation to the poft of high-chancellor in 1367, of which latter dignity, however, he was divefted in 1370. Thus poffeffing ample means of munificence in a ftate of celibacy, and a liberal fpirit, his profeffion as an architect led him to repair and erect numerous buildings in his fee at an expence of no lefs than 20,000 marks. He alfo directed his attention to the improvement and proper difcipline of the religious houfes comprehended within his diocefe. For the better education of his clergy, he laid the foundation of a college in Oxford, which was to be fupplied with ftudents from a feminary at Winchefter. He was interrupted, however, in his liberal defigns of general utility by an impeachment for mifconduct in the adminiftration of public affairs, occafioned by the influence of the duke of Lancafter, who had conceived a prejudice againft him; and, in confequence of this impeachment, his temporalities were feized to the king's ufe, and he was banifhed from court. The clergy, however, interfered, and the people regarded him as a fufferer from the duke's exorbitant power; fo that a tumult enfued, that procured the reftoration of his temporalities, and his recovery of the royal favour, a little while before the king's death. During the turbulent reign of Richard II. Wykeham conducted himfelf with caution, and fucceeded in the eftablifhment of his two colleges. For that at Oxford he obtained a patent in 1379, and it was completed in 1386. It is now known by the name of the New college. His college or fchool at Winchefter was finifhed in 1393. He alfo undertook the repair of the cathedral, which was a Saxon edifice of the eleventh century, and in the courfe of ten years rebuilt it in the Gothic ftyle. (See WINCHESTER.) In 1384 he was induced, againft his inclination, to accept the office of high-chancellor, which he refigned again in 1391, after having reftored the public tranquillity. When the king recovered his authority, he procured a parliament in 1397, which impeached feveral of the commiffioners, who had almoft divefted him of his authority, of high treafon; but Wykeham, who was one of them, efcaped with a forced loan of 1000*l.* He attended the firft parliament of Henry IV. in 1399, which depofed Richard, but was not prefent at the council, which adjudged him to perpetual imprifonment. As his health declined, he was difabled from performing the duties of his office; and therefore nominated coadjutors in his bifhopric, fettled all his temporal and fpiritual concerns, and with tranquillity waited his difmiffion from the world. This happened in September 1404, when he had finifhed his 80th year. His remains were interred in his own chapel or oratory in Winchefter cathedral, where a tomb of white marble was erected to his memory. Lowth's Life of William of Wykeham. Biog. Brit.

WILLIAM, *Sweet*, in *Botany*. See DIANTHUS, and PINK.

WILLIAMS, DANIEL, D.D. in *Biography*, an eminent non-conformift divine, was born at Wrexham, in Denbighfhire, about the year 1643 or 1644. The difadvantages of his early education were counterbalanced by the natural vigour of his mind, and by future application. Devoting himfelf to the miniftry among Proteftant diffenters, he was one of the firft who had refolution to engage in it, after the privations and fufferings which followed the Act of Uniformity in 1662. At the age of 19 years he was admitted a preacher among the Prefbyterians, and for feveral years officiated occafionally in feveral parts of England. Being here in danger of perfecution, he accepted an invitation to become chaplain to the countefs of Meath in Ireland, where diffenters enjoyed a greater degree of liberty; and fome time afterwards he became paftor to a refpectable congregation in Wood-ftreet, Dublin. Here he continued for nearly twenty years, exercifing his miniftry with acceptance and ufefulnefs, and conducting himfelf fo as to maintain harmony with his brethren in the miniftry, and to fecure refpect and efteem from the Irifh Proteftants in general. During his refidence in Dublin, he married a lady of an honourable family, with a confiderable eftate. Towards the clofe of the reign of James II., his oppofition to popery rendered his fituation in Ireland unpleafant to him, and he therefore came over to England in 1687, and fettled in London. Here he joined thofe minifters who oppofed an addrefs to the king on occafion of his difpenfing with the penal laws; and by his firmnefs and intrepidity contributed in no fmall degree to their unanimous rejection of it. Out of his own funds, and by his wealthy connections, he procured relief for thofe Irifh Proteftants who fought refuge in London from the tyranny and perfecution of Tyrconnel. After the Revolution in 1688, which was an event that gave him and his brethren inexpreffible fatisfaction, he was often confulted by king William on Irifh affairs; and his reports concerning the abilities and character of Irifh refugees, who were capable of ferving the government, were duly regarded. On occafion of his vifit to Ireland, in the year 1700, for fettling his own affairs, his conduct in the inftances now fpecified was gratefully acknowledged. Towards the latter end of the year 1688, he was unanimoufly chofen paftor to a numerous congregation of Prefbyterians in Hand-alley, Bifhopfgate-ftreet; and in this connection he fpent the remainder of his days, devoting to charitable purpofes the falary which he received from his congregation. With the famous Richard Baxter he cultivated an intimate acquaintance; and at his death, in 1691, he was chofen to fucceed him at the Merchants' Tuefday lecture in Pinners'-hall. Some of his fellow-lecturers advanced what he conceived to be Antinomian tenets; and thefe dangerous notions he thought it to be his duty to oppofe. Hence arofe a fufpicion of his orthodoxy, and an attempt to exclude him from the lecture. Their defign was fruftrated by a majority of the fubfcribers; but as their oppofition was inveterate, it was thought moft advifable to feparate and to eftablifh another Tuefday lecture at Salters'-hall. Three of the moft refpectable of the old lecturers, *viz.* Dr. Bates, Mr. Howe, and Mr. Alfop, feceded with Mr. Williams.

Upon the publication of the works of Mr. Crifp, who avowed himfelf the champion of Antinomianifm, Mr. Williams undertook to refute them; and in 1692 publifhed his "Gofpel Truth ftated and vindicated, &c." 8vo.; a work which, though now almoft forgotten, was defervedly approved by the principal London minifters of that period; and as it is diftinguifhed by great clearnefs and ftrength of argument, as well as a truly Chriftian temper, it ferved to check the pernicious errors which were then induftrioufly circulated. It was defended by the author in his "Defence of Gofpel Truth, &c." 8vo., and in a "Poftfcript" to a new edition of his work, and alfo in other pieces. Againft the charge of Socinianifm, an appeal was made to Dr. Stillingfleet, then bifhop of Worcefter, and Dr. Jonathan Edwards of Oxford, who were deemed mafters and judges in this controverfy; and they honourably acquitted the author, with many expreffions of refpect for him. Difappointed in their efforts to induce fufpicion of his orthodoxy, his enemies indulged their malignity further by arraigning the purity of his morals. Indignant as he well might be at this attack, he fubmitted his conduct to the inveftigation of the United London Minifters, who concurred in the report of their committee, "that he was entirely clear and innocent of all that was laid to his charge." The attachment of his congregation, it fhould be obferved, was not in the leaft degree diminifhed by the malignant mifreprefentations of his enemies.

In the year 1701, Mr. Williams, after having been for fome time a widower, married a fecond wife of confiderable fortune and diftinguifhed worth, who furvived him.

During the reign of queen Anne he exerted himfelf, though ineffectually, in oppofing the bills againft occafional conformity, and for impofing the facramental teft upon the diffenters in Ireland. In 1707 he ufed all his influence with his friends in Scotland in promoting the union between the two kingdoms; and in the year 1709 he was honoured with the degree of D.D. by the univerfities of Edinburgh and Glafgow. Availing himfelf of his long acquaintance with the earl of Oxford, he took the liberty of remonftrating againft the political meafures which he was purfuing. The doctor's franknefs did not pleafe the ftatefman; and his refentment againft him for declaring unfavourable fentiments of the meafures of his adminiftration, and communicating them to his friends in Ireland, was deep and permanent. Upon the acceffion of king George I., he had the honour of prefenting an addrefs of congratulation to his majefty, at the head of the Proteftant diffenting minifters of the different denominations refiding in London and its vicinity; and it has been ever fince the cuftom for the body of fuch minifters to prefent addreffes on all public occafions, and they have the honour, as a body, of being received on the throne, and by their committees in the clofet, and of receiving a written anfwer. Soon after the acceffion of George I., the health of Dr. Williams began to decline; and at length an afthmatic diforder terminated his life on January 26, 1715–16, in the 73d year of his age. In the fequel of this article we fhall take advantage of literally tranfcribing the well-written account given of Dr. Williams by the Rev. Mr. Morgan, the highly refpectable and much efteemed librarian of the excellent inftitution which he has eftablifhed; under whofe infpection and care this library is gradually rifing into a reputation, which, by the contributions of its friends in books and money, and by the annual appropriation of a fmall fum out of the furplus of its founder's bequefts, will vie with the principal eftablifhments of a fimilar nature in the city of London.

"He had been bleffed by nature," fays our biographer, "with a ftrong and vigorous conftitution, and poffeffed a found penetrating judgment, and great ftrength of memory. The fubjects of his pulpit performances were always practical and ufeful; his fentiments folid, pertinent, and diftinguifhed by an uncommon variety; and his manner of enforcing them powerful and impreffive. He was remarkable for his boldnefs and courage in avowing and defending what he he conceived to be truth of importance, and 'pursued what he thought right with a blunt integrity and unſhaken reſolution.' At the ſame time his candour towards thoſe who differed from him, his kind treatment of perſons who had endeavoured to injure his own reputation, and his conſcientious tender regard for that of others, were prominent features in his character. He was a ſteady non-conformiſt upon principle; yet he maintained a charitable diſpoſition towards the eſtabliſhed church, and at the Revolution was very deſirous of promoting the ſcheme of a *comprehenſion*. Though he poſſeſſed an ample fortune, he exerciſed great frugality in his perſonal expences, for the noble purpoſe of being more uſeful to others who ſtood in need of aſſiſtance, and of more effectually ſerving the great intereſts of truth and virtue. The ſame laudable views governed him in the final diſpoſal of his property. By his laſt will, beſides liberal benefactions to numerous benevolent and charitable inſtitutions in London and Dublin, he provided for the ſupport of an itinerant preacher to the native Iriſh, of two perſons to preach to the Indians in North America, and of ſeveral charity-ſchools in England and Wales. He directed that a certain fixed ſum, from the income of his eſtates, ſhould be appropriated to the aſſiſtance of poor miniſters, the widows of poor miniſters, ſtudents for the miniſtry, and to other benevolent purpoſes. He alſo left eſtates to the univerſity of Glaſgow, which at preſent furniſh handſome exhibitions to ſix ſtudents for the miniſtry among Proteſtant diſſenters in South Britain, who are to be nominated by his truſtees. The laſt grand bequeſt in his will was for the eſtabliſhment of a library in London, for the benefit of the public. Having formed this deſign, he purchaſed Dr. Bates's curious collection of books, which he added to his own, and directed his truſtees to provide a proper building for their reception. Such an edifice was erected by them in Red-Croſs-ſtreet, Cripplegate, where the library was opened in 1729, and admiſſion to it is eaſily obtained by perſons of every deſcription, without any exception, upon application to one of the truſtees. Since it was firſt eſtabliſhed, very conſiderable additions have been made to it by legacies, as well as gifts of money and books; and it now contains upwards of 16,000 volumes, many of which are very valuable and rare, in the various departments of literature and ſcience. The founder's works were collected together, and printed at different periods, in 6 vols. 8vo.; the laſt conſiſting of Latin verſions of ſeveral of his tracts, which he directed to be publiſhed in that language for the uſe of foreigners." Memoir prefixed to his Works.

WILLIAMS, in *Geography*, a townſhip of Pennſylvania, in Northampton county, with 1243 inhabitants; 60 miles N. of Eaſton.

WILLIAM'*s Port*, a town of Maryland, on the Potomack; 5 miles S.W. of Hagars Town.

WILLIAM'*s River*, a river of Vermont, which runs into the Connecticut, N. lat. 43° 10'. W. long. 72° 24'.

WILLIAMSBOROUGH, a poſt-town of North Carolina, on a creek which falls into the Roanoke; 48 miles N.E. of Hillſborough.

WILLIAMSBURG, a county of the ſtate of South Carolina.—Alſo, a county of the ſtate of Virginia.—Alſo, a town of Virginia, ſituated on an iſthmus between York river and James river, a creek from each river coming up within a mile of the town, but not navigable for large veſſels. It was at one time the ſeat of government and reſidence of the governor, now removed to Richmond. It contains about 200 houſes, and 1200 inhabitants. The principal buildings are a college and town-houſe, an epiſcopal church, and an hoſpital for lunatics; 50 miles E.S.E. of Richmond. N. lat. 37° 13'. W. long. 76° 50'.—Alſo, a town of Maſſachuſetts, in Hampſhire, with 1122 inhabitants; 8 miles N.W. of Northampton.—Alſo, a town of New York, on the Geneſee; 288 miles N.N.W. of Philadelphia.—Alſo, a town of the ſtate of Ohio, on the Little Miami, in the county of Clermont, with 1251 inhabitants.—Alſo, a town of Maryland; 4 miles N. of Talbot.

WILLIAMSBURG, or *Joneſtown*, a poſt-town of Pennſylvania; 23 miles E.N.E. of Harriſburg.

WILLIAMSON, a townſhip of Ontario county, in New York, 206 miles from Albany, bounded N. and W. by lake Ontario. In 1810 the whole population conſiſted of 1139 perſons, and it had 55 ſenatorial electors. A red oxyd of iron is found in this town, which is a good pigment for painting.

WILLIAMSON, a county of Weſt Tenneſſee, with 13,153 inhabitants, including 3985 ſlaves.

WILLIAMSPORT, a poſt-town of Pennſylvania, on the weſt branch of the Suſquehanna, in the county of Lycoming, with 344 inhabitants.

WILLIAMSTOWN, a townſhip of the ſtate of Vermont, in Orange county, with 1353 inhabitants; 60 miles N. of Norwich.—Alſo, a poſt-town of North Carolina, on the Roanoke; 55 miles W. of Halifax.—Alſo, a town of Maſſachuſetts, in the N.W. corner of the ſtate, in the county of Berkſhire, with 1843 inhabitants; 132 miles W.N.W. of Boſton.—Alſo, a poſt-townſhip of Oneida county, in New York, erected in 1805, from a part of Mexico, and conſiſting of two townſhips of Scriba's patent, each being ſix miles ſquare. The population in 1810 conſiſted of 562 perſons, and 82 ſenatorial electors. The poſt-office was eſtabliſhed in 1812.

WILLICHIA, in *Botany*, was ſo called by Mutis, after Dr. Chriſtian Lewis Willich, a phyſician at Clauſthal, in Lower Saxony, who publiſhed at Gottingen, in 1747, 1762, and 1766, various obſervations and illuſtrations of Botany, of more or leſs importance, chiefly relating to the determination of ſpecies and their ſynonyms, with curſory remarks on variations or irregularities of ſtructure, exceptions to received characters, &c. The author died in 1776. —Linn. Mant. 553. Schreb. Gen. 32. Willd. Sp. Pl. v. 1. 189. Vahl Enum. v. 2. 39. Mart. Mill. Dict. v. 4. Juſſ. 418. Poiret in Lamarck Dict. v. 8. 798.—Claſs and order, *Triandria Monogynia*. Nat. Ord. uncertain, Juſſ. We ſhould preſume *Scrophulariæ*.

Gen. Ch. *Cal.* Perianth inferior, of one leaf, in four ovate, acute, ſpreading, permanent ſegments. *Cor.* of one petal, wheel-ſhaped, twice the length of the calyx: tube ſcarcely any: limb flat, in four roundiſh, convex ſegments. *Stam.* Filaments three, inſerted into the clefts of the limb, except the lowermoſt, and ſhorter than its ſegments; anthers erect, roundiſh, of two cells. *Piſt.* Germen ſuperior, roundiſh, compreſſed; ſtyle thread-ſhaped, the length of the ſtamens, declining towards the lower cleft of the corolla; ſtigma obtuſe. *Peric.* Capſule roundiſh, compreſſed, ſharp-edged, of two cells and two valves, with an oppoſite partition. *Seeds* ſeveral, roundiſh, minute. *Receptacle* globular, formed of two hemiſpheres.

Eſſ. Ch. Calyx four-cleft. Corolla four-cleft. Stamens in three of its clefts. Capſule ſuperior, of two cells, with many ſeeds.

1. W. *repens*. Creeping Willichia. Linn. Mant. 558. Willd. n. 1. Vahl n. 1.—Gathered in Mexico, by Mutis, whoſe deſcription, communicated to Linnæus, is our only ſource of information concerning this plant. The *root* is fibrous, annual. *Stem* herbaceous, creeping, thread-ſhaped, branched, hairy, about two feet in length. *Leaves* alternate, ſtalked, rather diſtant, orbicular, ſomewhat peltate, crenate,

crenate, hairy, an inch in diameter; reddiſh underneath. *Footſtalks* very long, hairy, thicker than the ſtem. *Flower-ſtalks* axillary, in pairs, ſingle-flowered, thread-ſhaped, hairy, the length of the footſtalks. *Flowers* ſmall, roſe-coloured, with a hairy *calyx*.

There is no ſpecimen in the Linnæan herbarium.

WILLIESBURG, in *Geography*, a poſt-town of Virginia; 243 miles S.S.W. of Waſhington.

WILLIMANTIC, a river of Connecticut, which runs into the Shetucket at Windham.

WILLINCK, a large townſhip of New York, at the S. end of Niagara county, erected in 1808; 315 miles W. of Albany. It compriſes about eighteen townſhips of the Holland company lands. The general character of the ſoil is, that it is good land for farming. In 1810 the population conſiſted of 2028 perſons, and there were 260 ſenatorial electors.

WILLING'S CREEK, a river of Weſt Florida, which runs into the Miſſiſſippi, N. lat. 30° 49′. W. long. 91° 21′.

WILLINGBOROUGH, a town of New Jerſey, in Burlington county, with 619 inhabitants; 14 miles N.E. of Philadelphia.

WILLINGTON, a town of Connecticut, in Tolland county, with 1161 inhabitants; 6 miles E. of Tolland.

WILLIS, BROWNE, in *Biography*, an eminent antiquary, the grandſon of Dr. Willis, a celebrated phyſician, was born at Blandford in 1682, and was removed from Weſtminſter-ſchool in the year 1690 to Oxford, where he was admitted a gentleman-commoner of Chriſt-church; and after leaving the univerſity he proſecuted his ſtudies for three years under Dr. Wotton. When he came into poſſeſſion of the family eſtate, he was returned in 1705 as a repreſentative for the town of Buckingham. In 1715 and 1716 he publiſhed two parts of a work, intitled "Notitia Parliamentaria; or, a Hiſtory of the Counties, Cities, and Boroughs in England and Wales, with Liſts of all the Knights, Citizens, and Burgeſſes," 8vo., to which in 1750 he added a third part, being an appendage to the journals of the houſe of commons, then printed. On the revival of the Society of Antiquaries in 1717, he was choſen a member; and he ſuſtained his reputation as an antiquary by various writings, among which are, "Surveys of the Four Welſh Cathedrals;" "Hiſtory of the United Parliamentary Abbeys and Conventional Cathedral Churches;" "Survey of the Cathedrals of England, with Parochiale Anglicanum," 3 vols. 4to.; "Hiſtory and Antiquities of Buckingham." In 1723 he received, in conſideration of his literary merit, from the univerſity of Oxford, the degree of A.M. by diploma. He manifeſted his attachment to the church by expending conſiderable ſums in repairing thoſe in the country, and thus injured his own fortune. But frugality in his perſonal and domeſtic expences compenſated this injury. He poſſeſſed a fine cabinet of Engliſh coins, which in 1741 he preſented to the univerſity of Oxford; the univerſity, in conſideration of his family, liberally paying for thoſe of gold by weight, and conferring upon him the degree of LL.D. With many peculiarities in his character, he claimed reſpect as a man of moral worth from thoſe who knew him. To him belonged the honour of having firſt placed the Engliſh eccleſiaſtical hiſtory and antiquities upon the firm baſis of records and regiſters, which he aſſiduouſly ſearched. He died in 1760, in the 78th year of his age. Biog. Brit.

WILLIS, THOMAS, an eminent phyſician, was born in 1621–2, at Great Bedwin, in Wiltſhire; and in 1636 admitted into Chriſt-church college, Oxford, where he took the uſual degree with a view to the clerical profeſſion. But he changed his purpoſe, and ſtudied phyſic, taking his bachelor's degree in 1646, and commencing medical practice at Oxford. He diſtinguiſhed himſelf by his ſteady attachment to the church of England, and alſo by his love of ſcience, ſo that he became one of the firſt members of that philoſophical ſociety at Oxford, which laid the foundation of the Royal Society of London. As a chemiſt, which was the character under which he was ambitious of excelling, he publiſhed in 1659 a work, intitled "Diatribæ duæ; prior agit de Fermentatione, altera de Febribus. His acceſſit Diſſertatio epiſtolica de Urinis." The recompence of his attachment to the cauſe of epiſcopacy and loyalty was the Sedleian profeſſorſhip of natural philoſophy at Oxford, conferred upon him after the Reſtoration, by the recommendation of archbiſhop Sheldon, ſoon after which he received the degree of doctor. Upon the eſtabliſhment of the Royal Society, he was one of its firſt members. In the year 1664, when he is ſaid to have diſcovered, and brought into uſe, the mineral water of Aſtrop in Northamptonſhire, he publiſhed his "Cerebri Anatome; cui acceſſit Nervorum Deſcriptio et Uſus." This work, on which his reputation principally depends, was followed in 1667 by his "Pathologia Cerebri et Nervoſi Generis, in qua agitur de Morbis convulſivis, et de Scorbuto." Before this year he was ſettled in London, and being nominated a phyſician in ordinary to the king, was advancing to the firſt rank in practice. His next publication was intitled "Adfectionum quæ dicuntur Hyſtericæ et Hypochondriacæ Pathologia Spaſmodica, vindicata contra reſponſionem epiſtolarem Nath. Highmori. Cui acceſſerunt Exercitationes Medico-Phyſicæ de Sanguinis Accenſione, et Motu muſculari," 1670. On occaſion of the loſs of his wife, a daughter of dean Fell, he amuſed himſelf by writing his work "De Anima Brutorum quæ Hominis Vitalis ac Senſitiva eſt; Exercitationes duæ," 1672, in which he conſiders the ſoul of brutes as the ſame with the vital principle in man, corporeal in its nature and periſhing with the body. After his ſecond marriage, he began to print in 1673 his "Pharmaceutice Rationalis, ſive Diatriba de Medicamentorum Operationibus in Humano Corpore;" but he did not live to publiſh this work, as he was carried off by a pleuriſy in 1675, at the premature age of 54, in the full vigour of his faculties and zenith of his reputation. Dr. Willis had no powers for appearing with advantage and brilliancy in ſociety; but he was intent on ſcience and practice, frugal, pious, and charitable. His works engaged great attention on their firſt publication; but in conſequence of modern improvements, they have ſunk in the public eſtimation, though they are not altogether neglected. They are written in a rich and elegant Latin ſtyle. Haller. Biog. Brit.

WILLIS, in *Geography*, a town of the ſtate of New Jerſey; 33 miles S.E. of Burlington.

WILLIS's *Creek*, a river of Virginia, which runs into James river, N. lat. 37° 40′. W. long. 78° 18′.

WILLIS's *Iſland*, a ſmall iſland in the South Atlantic ocean, near the north-weſt coaſt of the iſland of Georgia, ſo named by captain Cook, from one of his crew who diſcovered it in the year 1775. S. lat. 54°. W. long. 38° 23′.

WILLISAU, a town of Switzerland, and capital of a bailiwick, in the canton of Lucerne; 15 miles W. of Lucerne.

WILLISTON, a poſt-town of the ſtate of Vermont, in the county of Chittenden, with 1195 inhabitants; 25 miles N. of Newhaven.

WILLISTOWN, a townſhip of Pennſylvania; 15 miles S.W. of Philadelphia.

WILLMAR, a town of the county of Henneberg; 7 miles S.E. of Meinungen.

WILLOBOCKE, a river of Yorkſhire, which runs into the Swale.

WILLONGTALYS, a lake of Vermont. N. lat. 44° 45′. W. long. 71° 58′.

WILLOUGHBY, a town of England, in the county of Warwick, ſituated on a navigable canal, on the borders of Northamptonſhire; 14 miles S.E. of Coventry.

Willoughby *Bay*, a bay on the ſouth-eaſt coaſt of the iſland of Antigua. N. lat. 17° 10′. W. long. 61° 25′.

Willoughby *Lake*, a lake of the ſtate of Vermont.

WILLOW, &c., in *Botany*. See Salix.

Our common willows in the ſpring ſeaſon, when they are in flower, produce a quantity of cottony matter, which might be put to ſome uſe.

The Chineſe are induſtrious enough to collect this cotton as it falls from their willows; and the women and children, among the poorer people, card it, and pick out the ſeeds, and render it fit for many uſes in the place of cotton.

The poor people, in ſome part of the Indies, make a ſort of liquor of the flowers of their willows before they are opened, which intoxicates them very ſuddenly; and the dry huſks of the ſame tree remaining after the flowers and ſeeds are fallen, are wholeſome as food, people in time of famine having lived upon them, boiled in water.

The wood of the willow, though in itſelf very light and ſpongy, is yet of a nature to bear the injuries of wet better than almoſt any other kind. It is uſed by the Chineſe on this occaſion, in the making of their wells, and on all other occaſions where wood is to ſtand under water, and ſucceeds perfectly well. Obſerv. ſur les Coutumes de l'Aſie. For the uſes to which willow-bark and wood are applied, ſee Salix, and Gunpowder.

Willow, in *Agriculture*, a well-known tree, of which there are ſeveral different ſpecies or kinds; but thoſe moſtly cultivated for farm purpoſes are, the common white willow, the purple or red willow, the ſallow, and the broad-leaved or Huntingdon willow.

The firſt is a tall-growing tree, of the deciduous kind. It has a fine ſilvery appearance in the leaves; is quick of growth, and the wood is very uſeful where lightneſs and cleanneſs of the grain is beneficial, as for hurdles, gates, hop-poles, &c.

The ſecond is a free-ſhooting willow; but its wood is inferior for many uſes, eſpecially thoſe of the farmer.

The third ſort delights in a rather dry ſoil, being a tree below the middle growth. It has numerous branches, of a ſmooth appearance, and dark green colour. Its wood is very uſeful for hurdles and other ſimilar purpoſes of the farmer.

It has two varieties, the long-leaved, and the ſtriped ſallow, both which are very uſeful.

The fourth ſort, or red-hearted willow, is ſuppoſed by ſome as the beſt ſort for planting, for the uſe of the farmer, as growing quickly; but the great uſe to which they are applied is that of making hurdles, ſtakes, gates, and farming implements, being a wood uncommonly tough and light, owing, as is conceived, to a new method uſed in planting them cloſe to the ground. If it is the deſign of the planter to let them grow into timber, (which would be far ſuperior to deal for the purpoſe of flooring, or other light work, particularly as it will neither ſplinter nor fire; and if ſuffered to remain for twenty or twenty-five years, would make good maſts for ſmall craft, as they ſhoot up perfectly ſtraight, and without any collateral branches,) it is neceſſary, at the firſt or ſecond year's growth, to obſerve which pole is the ſtrongeſt, as the remaining poles muſt be cut away. In about fifteen years' time it is ſuppoſed they will want thinning; of courſe the inferior muſt be taken out and the ſuperior be ſuffered to remain.

In cultivating them on waſte moiſt lands, laying out the ground into lands, like hop-lands, as from three to four yards wide, with a ditch on each ſide; three feet wide at the top, one foot at the bottom, and two and a half deep, is adviſed by a late writer as the beſt mode from much experience. The earth that comes out of the ditch ſhould be thrown on the land. But if there is not fully ſufficient fall for the water to get off, the ditch ſhould be deeper and wider, till there is near a yard of earth above the level of the water. As ſoon as this is done, the ground muſt be double dug, that is, trenched two ſpades' depth, except it be very boggy, which will afford room for the plants to ſhoot, and will ſave the expence of weeding, which otherwiſe muſt be incurred in the firſt ſummer after the plants are ſet; for if they are not kept clear of weeds the firſt year, the hopes of the planter will certainly be deſtroyed.

In reſpect to the times of planting, they muſt be from January to the end of March; but the ſets for that purpoſe ſhould be cut from December to the end of February, when the ſap is down. And the reaſon is, that if poles are cut in the ſpring (the ſap being up), the ſtool will at leaſt be weakened by bleeding, if not killed; and of courſe prevented from ſhooting ſo vigorouſly as if cut at the preceding time.

In regard to the ſets or truncheons, they may be cut from twenty inches to two feet long; particular care ſhould be taken in the cutting, that the bark be not fridged or bruiſed, or in any other reſpect injured; for in that caſe the plant will be weak and puny.

The poles have been ſold at eight years' growth for 214*l.* *per* acre, net-money; the kids or bruſhwood pay for the felling. Had they been ſuffered to have ſtood two years longer, they would, it is ſaid, have produced 300*l.* *per* acre.

The plantation of the baſket and cooper's willow is an object of importance in thoſe waſte and neglected corners which are to be found upon every eſtate and farm.

The refuſe dwarf willows or offal, as it is termed, are uſed in the fiſheries and baſket-work, and will pay, *communibus annis*, for the labour. The cooper's-willow differs from the common or baſket-willow; the former is known by a ſingle bud or eye throughout the rod, which ſimply throws out a leaf; the latter by a double or flattened eye, which produces a branch or ſprig. The former is applicable to every purpoſe; the latter the cooper rejects: of courſe the former ſhould be propagated.

Plantations of the willow kind have been vaſtly increaſed, indeed, in many parts of the country within theſe few years.

Willow-*Galls*, in *Natural Hiſtory*, the name given by authors to certain protuberances found very frequently on the leaves of the ſeveral ſpecies of willow, which are properly galls, each containing the worm of a fly, and owing its exiſtence to that inſect.

The galls are uſually of a roundiſh or oblong figure, and are equally protuberant on each ſide of the leaf: they are of a pale green at firſt; but they afterwards become yellowiſh, and finally reddiſh. The ſurface of theſe is ſeldom perfectly even, but uſually has ſeveral little prominences and cavities in it. When this gall is opened, there is found in it a worm reſembling a caterpillar in figure, having a ſmooth annulated body, a hard brown head, and twenty legs; and by Reaumur called falſe or baſtard caterpillar. This creature, when the gall is young, is blue; it afterwards becomes greeniſh; and finally, when the gall becomes red, it is white. This inſect ſeems to eat in its priſon more voraciouſly than any

any other gall-infect whatever; for while the gall grows in fize, it becomes alfo thinner in every part; fo that the creature, at the proper time, has but little difficulty to get out. Reaum. Hift. Infect. vol. vi. p. 211.

When the time of the laft change of this infect draws nigh, it leaves the tree, and defcending to the earth makes its way into it in a proper place, and then becomes a nymph, out of which at a proper time iffues a four-winged fly.

The flies which are produced in April copulate almoft as foon as freed from their exuviæ of the chryfalis ftate, and the females foon after lodge their eggs in the leaves of the willows. This is all done before the end of April, and the young ones hatched of thefe eggs live but a fhort time before they pafs into the chryfalis ftate, and living flies are hatched from thefe in June. The young ones of this brood pafs their chryfalis ftate in the earth, and appear not during the whole winter, till the fpring fun enlivens them again. There is, befide thefe, another kind of galls of the willow-leaves, which are of the clafs of thofe, each of which contains feveral cells; in each cell of thefe there is found a fmall white maggot, the offspring of the egg of a two-winged fly, which, after paffing the chryfalis ftate in the earth, alfo comes out in the form of its winged parent. The cells in the galls are different in number in the feveral galls, and are from four or five to twenty: they have no communication with one another, but each worm lives in its own cell.

Befide thefe there is alfo fometimes found in thefe galls a worm of a brownifh-white colour, having two hooks in its head, and no legs at all. This has all the appearance of a carnivorous animal, and probably was depofited there in the egg-ftate by its parent, not to feed on the gall, but on its defencelefs inhabitant. This worm finally becomes a fmall blueifh beetle, and is often found alone in the cavity of the gall, often in company with its proper inhabitant, fucking its juices as it feeds on thofe of the plant. There feem to be feveral fpecies of thefe devourers common to thefe galls; fince Vallifnieri obferved, in the boxes where he kept thefe galls to produce the animals from thence, many fpecies of fmall beetles, and feveral diftinct kinds of flies, which were probably the laft ftate of feveral kinds of carnivorous worms, which had preyed upon the proper inhabitant of the galls. Vallifnieri, Dialog. des Infect.

Willow-*Herb*, or *French* Willow, in *Botany*. See Epilobium.

Willow-*Herb* is a name fometimes given to the *lythrum* or purple loofe-ftrife. See Lythrum.

Willow, *Sweet*, *Dutch* Willow, Gale, or *Candle-Berry* Myrtle, in *Botany*. See Candle-*Berry-Tree*, and *Candle-Berry* Myrtle.

Willow-*Weed*, in *Agriculture*, a term provincially applied to fmart-weed, or perficaria, which is a troublefome weed on many places in the corn-fields and other tillage-lands. See Weed.

WILLS, in *Geography*, a town of Ohio, in the county of Guernfey, with 659 inhabitants.

WILLSBOROUGH, a poft-townfhip of Effex county, in New York, with a poft-office, 530 miles from Wafhington, erected in 1788, then in Clinton county, and very extenfive; from which feveral towns have been fince erected. It is bounded N. by Chefterfield, E. by lake Champlain, in the ftate of Vermont, S. by Effex, and W. by Lewis. Along the lake the land is level and tolerably productive. A fmall well-drain affords many fcites for water-works; and iron-ore of the beft quality is found in great abundance. The population confifts of 668 perfons, and the fenatorial electors are 57. Here are, one diftillery, a forge for making bar-iron, an anchor-fhop, a carding-machine, and a clothiery, befides a confiderable number of grain and faw mills.

Willsborough, a townfhip of New York, near Crown Point.

WILLSTADT, a town of Sweden, in the province of Smaland; 50 miles W. of Wexio.—Alfo, a town of Germany, in the county of Hanau Lichtenberg; 7 miles S.E. of Strafburg.

WILLUGHBEIA, in *Botany*, was fo named by Schreber, in memory of our great Englifh naturalift, Francis Willughby, efq. of Middleton-hall, Warwickfhire, the friend of Ray, in our biographical account of whom the reader will find many particulars relating to Mr. Willughby and his family. This gentleman may well claim botanical diftinction, on account of his enquiries into the philofophy of vegetation, in conjunction with his illuftrious affociate, during the fpring of 1669.—Schreb. Gen. 162. Willd. Sp. Pl. v. 1. 1231. Mart. Mill. Dict. v. 4. (Ambelania; Aubl. Guian. 265. Juff. 148. Lamarck Dict. v. 1. 125. Illuftr. t. 169. Pacouria; Aubl. Guian. 268. Juff. 148. Lamarck Dict. v. 4. 691. Illuftr. t. 169.)—Clafs and order, *Pentandria Monogynia*. Nat. Ord. *Contortæ*, Linn. *Apocineæ*, Juff.

Gen. Ch. *Cal.* Perianth inferior, of one leaf, flefhy, in five deep acute fegments, very fmall. *Cor.* of one petal, falver-fhaped: tube cylindrical, enlarged at the bottom: limb horizontal, in five deep, oblique, acute, wavy fegments, more dilated at one fide than the other, lying over each other at the bafe. *Stam.* Filaments five, very fhort, inferted into the tube juft above the bafe; anthers arrow-fhaped. *Pift.* Germen fuperior, roundifh; ftyle quadrangular; ftigma capitate, ovate, thick, ftriated, double-pointed, fubtended by a flat orbicular difk. *Peric.* Berry ovate, coated, of one or two cells. *Seeds* numerous, angular, compreffed, imbedded in pulp.

Eff. Ch. Corolla falver-fhaped, contorted. Stigma capitate. Berry coated, with many angular feeds.

1. W. *acida*. Acid Willughbeia. Willd. n. 1. (Ambelania acida; Aubl. Guian. 266. t. 104.)—Stem erect. Flower-ftalks the length of the footftalks.—Native of extenfive forefts in Guiana and Cayenne, bearing flowers and fruit in September. The *trunk* of this tree is feven or eight feet high, and feven or eight inches in diameter, with a greyifh bark, and foft white wood. The *head* confifts of very numerous, ftraight, knotty *branches*, fubdivided in an oppofite manner. *Leaves* oppofite, on fhort ftalks, elliptical, fomewhat pointed, entire, wavy, fmooth and fhining, with one rib, and many tranfverfe parallel veins; their greateft length feven inches, by three in breadth. *Flowers* axillary, three or four together on one common ftalk, which is hardly fo long as the adjoining footftalk. *Bracteas* fcaly, folitary at the bafe of each general as well as partial ftalk. *Corolla* whitifh, fcarcely fo large as that of *Vinca minor*. *Fruit* lemon-coloured, oval, corrugated or warty, two inches long, feparated by a longitudinal flefhy partition, into two cells, filled with acid vifcid pulp, and containing many brown rough *feeds*. This *fruit*, though milky, is wholefome. After the rind is taken off, the remainder is foaked for a while in water. The flavour is agreeably acid, notwithftanding a great degree of vifcidity, by which the pulp adheres to the lips and teeth. This *fruit*, with or without its rind, is preferved in fugar. In the latter ftate it is cooling, flightly acid; in the former moderately purgative, and efteemed ufeful in dyfenteries. The whole plant when wounded difcharges a milky, very tenacious, juice.

2. W. *fcandens*. Climbing Willughbeia. Willd. n. 2. (Pacouria guianenfis; Aubl. Guian. 269. t. 105.)—Stem twining. Flower-ftalks branched, as long as the leaves.—Native

Native of woods about the mouth of the creek of the Galibis in Guiana, bearing flowers, as well as fruit, in May. The *trunk* is about three inches in diameter, fending off long, knotty, trailing *branches*, which twine round the neighbouring trees to their very fummits, from whence the extremities hang down, clothed with oppofite, oval, fmooth, entire *leaves*, not unlike the foregoing, and about as large, on fhort ftalks; their rib, as well as lateral veins, are prominent and reddifh. The *flower-ftalks* are axillary, folitary, wavy, alternately branched, refembling tendrils, terminating in feveral little tufts, or umbels, of yellow *flowers*, rather fmaller than the firft fpecies. *Fruit* roundifh or obovate, the fize and colour of a quince, of an agreeable fcent when ripe, pulpy, yielding but a fmall quantity of milky juice if cut, though all the other parts of the plant contain a great quantity of the fame kind of glutinous milk as the preceding. Aublet does not mention any ufe to which this fpecies, or its *fruit*, is applied.

WILLUGHBY, Francis, in *Biography*, was born in 1635 of a good family in Lincolnfhire, and educated in Trinity college, Cambridge, under the tuition and in habits of friendly intercourfe with the excellent philofopher and natural hiftorian, John Ray. They were intimate affociates, and made a foreign tour together in the years 1663 and 1664. To birds and fifhes Willughby paid particular attention, and he formed a rich mufeum of animal and foffile productions. In 1668 he married the daughter of fir Henry Bernard, and his family refidence at Middleton, in Warwickfhire, was the place of Ray's frequent refort, where he and his hoft profecuted their philofophical experiments and obfervations, the refult of which they communicated to the Royal Society, of which they were both members. This inftructive and pleafant intercourfe was, however, prematurely interrupted by the death of Willughby in 1672, at the age of 37. His confidence in Mr. Ray was manifefted by appointing him one of his executors, and committing to him the charge of educating his two infant fons, bequeathing to him an annuity for life as a compenfation. Ray afcribes to him, without any trace of adulation, fingular moral excellence and high mental endowments. His pofthumous work, publifhed under the infpection of Mr. Ray, was entitled "Francifci Willughbeii Arm. Ornithologiæ Libri tres; in quibus Aves omnes hactenus cognitæ, in methodum naturis fuis convenientem reductæ, accuraté defcribuntur. Defcriptiones iconibus elegantiffimis et vivarum avium fimillimis æri incifis illuftrantur. Totum Opus recognovit, digeffit, fupplevit Johannes Raius," Lond. fol. This work was alfo tranflated into Englifh by Ray, and publifhed in 1671 with large additions. Mr. Ray alfo collected and arranged Willughby's papers on Ichthyology. He added the two firft books, and with the affiftance of the Royal Society publifhed them in 1686 under the following title: "Fran. Willughbeii Arm. de Hiftoria Pifcium, Libr. quatuor, juffu et fumptu Soc. Regiæ Lond. editi. Totum Opus recognovit, coaptavit, fupplevit librum etiam primum et fecundum integros adjecit J. Raius." Oxon. fol. The papers of Willughby in the Phil. Tranf. relate to vegetation, plants, and infects. The collection of Ray contains fome of his letters. Biog. Brit. Pulteney's Sketches of Botany.

WILLY, in *Geography*, a river of England, which runs into the Avon, near Salifbury.

WILLYKA, a town of Lithuania, in the palatinate of Wilna; 60 miles E. of Wilna.

WILMANSTRAND. See Vilmanstrand.

WILMANTON, a town of New York; 50 miles N. of New York.

WILMINGTON, a fea-port town of the ftate of Delaware, on Brandy-wine Creek; 22 miles S.W. of Philadelphia. N. lat. 39° 45′. W. long. 75° 34′.—Alfo, a fea-port town of North Carolina, with about 250 houfes, on a branch of Cape Fear river. In January 1781, this town was taken by the Britifh troops; 76 miles S.S.W. of Newbern. N. lat. 34° 11′. W. long. 78° 5′.—Alfo, an ifland near the coaft of Georgia, at the mouth of the Savanna. N. lat. 32°. W. long. 81° 6′.—Alfo, a poft-town of Vermont, on Deerfield river, in Windham county, with 1193 inhabitants; 10 miles E.S.E. of Bennington.—Alfo, a town of Maffachufetts, in the county of Middlefex, with 716 inhabitants; 16 miles N. of Bofton.—Alfo, a town of New York; 53 miles N. of New York.

WILMOT, John, in *Biography*, earl of Rochefter, was the fon of Henry, earl of Rochefter, an eminent loyalift in the reign of Charles I., and was born in 1647, at Ditchley, in Oxfordfhire. In 1659 he was entered at Wadham college, Oxford, and afterwards travelled into France and Italy under a tutor, who is faid to have reclaimed him from his early licentioufnefs; but upon his return to the profligate court of Charles II., in which he was a gentleman of the bed-chamber, he relapfed into his former intemperance. In 1665 he went to fea, and, as it is faid, behaved with great intrepidity in the attack of a caftle at Bergen, in Norway, which character for courage he alfo maintained when he afterwards ferved under fir Edward Spragge. In fome of his domeftic adventures, however, he forfeited this kind of reputation. Welcomed in all companies on account of his wit and vivacity, he became habitually intemperate, infomuch that, on a fubfequent review of his conduct, he acknowledged that for five fucceffive years he was never free from the inflaming effects of wine. His various adventures, in his real, or in a difguifed character, have furnifhed many anecdotes, that have been circulated in converfation, or in books of mere amufement, but which are not worth recording in graver publications. His wit furnifhed in the focieties which he frequented a kind of apology for his profanenefs and licentioufnefs; and as for his poetical compofitions, they were for the moft part lampoons or amatory effufions, the titles of which would ftain the page of biography. "In all his works, (fays Dr. Johnfon, meaning probably thofe which *can be read*,) there is fprightlinefs and vigour, and every where may be found tokens of a mind which ftudy might have carried to excellence." The juftice of Walpole's fentence, in his "Catalogue of Noble Authors," will be generally allowed: "Lord Rochefter's poems have much more obfcenity than wit, more wit than poetry, more poetry than politenefs." His courfe of debauchery was of no long duration; for foon after the age of 30 he funk into a ftate of debility and difeafe, which induced him to ftudy phyfic, and this ftudy permitted him to reflect on the courfe of his paft life, the irremediable effects of which he learnt from experience. Towards the clofe of his fhort life, he became acquainted with bifhop Burnet, who convinced him of the truth both of natural and revealed religion, and his mind was then impreffed to fuch a degree, that he is faid to have became a fincere, penitent. His life terminated in July, 1680, foon after he had commenced his 33d year. He left a fon and two daughters. Biog. Brit. Johnfon. Burnet.

Wilmot, in *Geography*, a town of Nova Scotia, near Annapolis.—Alfo, a town of New Hampfhire, in the county of Hillfborough, with 298 inhabitants.

WILNA, a city and capital of the duchy of Lithuania, on the Wilia, founded in the year 1305. This city lies in a mountainous country, on feveral little eminences. It is very

very large, and has two confiderable fuburbs, called Antokolla and Rudaifzka. In the old ruinous royal palace is the arfenal, and the hall where the court of juftice is held; and over-againft it is the magnificent church belonging to the caftle, which was built in the year 1386. The treafury belonging to this church is very rich; and it is alfo remarkable for the elegant marble chapel of St. Cafimir, whofe filver fhrine is faid to weigh thirty quintals. There are upwards of forty churches in this city, and among thefe are, one Lutheran and one Calvinift church, a Jewifh fynagogue, a Tartarian church, and a Greek church; but all the reft are Popifh churches. Not to mention the devaftation which Wilna formerly fuffered from the Ruffians in the years 1610 and 1655, and from fire in 1737, it was deftroyed by a dreadful conflagration in the year 1748, when 13 churches, the Jewifh fynagogue, 25 palaces, 469 ftone edifices, confifting of private houfes, hofpitals, inns, baths, convents, and mills, with 146 tradefmen's fhops, and difpenfaries, befides a great number of granaries and warehoufes, were confumed to afhes. In 1749 another fire happened by lightning, which confumed 6 churches, the council-houfe, 8 palaces, and 277 other ftone buildings. The chapel of St. Cafimir was alfo burned, and the lofs fuftained by the deftruction of this edifice only amounted to a vaft fum. The churches have been fince rebuilt at a very great expence, and fome of them in a more elegant manner than before; but the city has not recovered its former grandeur. Wilna is the fee of a bifhop, founded in 1387. The univerfity was founded in 1570. It gives name to a palatinate. In 1794 it was taken by the Ruffians, and with its territory annexed to that empire; 168 miles E. of Königfberg. N. lat. 54° 36'. E. long. 25° 18'.

WILRE, a town of France, in the department of the Ourthe; 4 miles E. of Fauquemont.

WILS, a town of the county of Tyrol, on the borders of Bavaria; 5 miles N.N.W. of Reutten.

WILSCOW, a river of Brandenburg, which empties itfelf into a large lake, communicating with the Rega, 4 miles S. of Treptow.

WILSDEN, a townfhip of England, in the Weft Riding of Yorkfhire, near Halifax.

WILSDRUF, or Wilsdorf, a town of Saxony, in the margravate of Meiffen; 9 miles W. of Drefden. N. lat. 51°. E. long. 13° 8'.

WILSELMAUR, a town of Auftria; 3 miles W. of Brugg.

WILSNACH, a town of Brandenburg, in the Mark of Prignitz. This town was anciently famous, there being no lefs than three hofts worfhipped at this place, which hofts they fay, in 1383, remained untouched in the church when it was burned down, and upon each of them was feen a drop of blood. To thefe hofts numerous pilgrimages were made from the remoteft countries; by which means this place rofe from a village to a fmall town. At length the hofts were burned in the year 1552, by the Lutheran preacher, Joachim Ellefeldt; 8 miles S. of Perleberg.

WILSON, Richard, in *Biography*, the moft eminent landfcape-painter of the Englifh fchool, was the fon of a clergyman, and was born at Pineges, in Montgomeryfhire, in 1714.

Having received from his father a good claffical education, in the courfe of which he had evinced a decided difpofition for drawing, he was fent to London at the age of 15, and placed as a difciple with an obfcure portrait-painter, named Wright. After a lapfe of fix years, he commenced profeffor, and under the patronage of Dr. Hayter, bifhop of Norwich, he foon afterwards had the honour to paint portraits of his prefent majefty and his brother, the late duke of York; both at that time under the tuition of the bifhop. He continued to practife portrait-painting fome time in London, but with no great fuccefs, and at length went to Italy to cultivate his tafte. Even there he continued to practife it, ftill unacquainted with the genuine bias of his genius, although occafionally exercifing his talents and employing his time in ftudies of landfcape. At Venice Wilfon painted a portrait of the late Mr. Lock, of Norbury-park, one of the moft creditable of his performances in that branch of the art; and it was there that accident opened his eyes to his own peculiar gratifications, and led him into that path, by purfuing which he has obtained a name among the worthieft in art.

As a matter of relaxation and amufement, he had painted a landfcape, which being feen by Zuccarelli, fo warmly excited that eminent artift's admiration, that he advifed Wilfon to purfue that line of art exclufively. From this time it is believed that he abandoned portraiture, and followed the judicious advice of a rival artift; and foon after he left Venice in company with Mr. Lock, and travelling flowly to Rome, made numerous ftudies on the way, which are ftill preferved at Norbury-park. On his arrival at Rome, the advice of Zuccarelli was confirmed by Vernet and Mengs, both then in high repute. So much were they delighted with Wilfon's landfcapes, that they each offered to exchange a picture with him; a propofal far too flattering for refufal. This liberality, as commendable as it is unufual, was followed by Vernet in the handfomeft manner, as he hung the picture by the Englifhman in his exhibition-room, and recommended him to the particular attention of the cognofcenti.

His progrefs in landfcape-painting muft have been very rapid; indeed it muft have had the character of being almoft intuitive, fince he obtained a very great degree of reputation during his ftay in Italy, and painted many pictures there of known celebrity. He travelled with the late earl of Dartmouth to Naples, and made a number of very fine drawings for that nobleman, now preferved by his grandfon; and for him alfo he painted two pictures, one a very fine one, a view of Rome, which has been beautifully engraved by Middiman. He was alfo employed by the late duke of Bridgewater to paint a landfcape with the ftory of Niobe; but his grace had the bad tafte to employ Placido Conftanza to repaint the figures. To preferve his reputation, Wilfon painted another of the fame fubject, and both are now in England. He returned from Italy in 1755, and occupied apartments over the north piazza of Covent-Garden. He had merited, and here he alfo obtained celebrity, and for a while employment. Many of his principal performances appear to have been painted about this time, moft of which are known by the fine prints engraved from them by Woollett and others; in which the grandeur, breadth, and purity of compofition in mafs and in line, contend for admiration with the talents confpicuous in the engravings.

Hitherto the life of Wilfon was honoured as his talents deferved; the remainder of it exhibited a gradual declenfion, not fo much of power as of patronage. 'Tis true he was often too free in his pencil, and too much mannered in his ftyle; repeating himfelf, perhaps, till it became irkfome: 'tis faid, alfo, that he was not of the moft tractable humour, and was low in his purfuits and affociations. Whencefoever it arofe, he was doomed to undergo indifference and neglect, and confequently the inconveniences of lownefs of purfe. Sometimes he was employed to paint views of gentlemen's feats, but probably the occupation fuited the artift as little as the refult gratified the patron. Wilfon's view of nature was far too broad for fuitable adaptation to ſuch a purpoſe, and conſequently there are not many pictures of this claſs to be met with which have proceeded from his pencil. The great characteriſtic of his works is grandeur, reſulting from breadth, purity, and ſimplicity, united in fullneſs of colour and mellowneſs of touch. He was perfectly original in feeling and execution, more grand in general conception than Claude, though infinitely leſs perfect in detail; and far from travelling through his career in art, with ſo even a pace as his great predeceſſor and only rival in the more exalted ſtyle of landſcape-painting before our time. Now a third ſhines in the ſame hemiſphere, and Claude and Wilſon find no ill-ſuited aſſociate in the name of Turner.

At the inſtitution of the Royal Academy, Wilſon was choſen one of the founders; and after the death of Hayman he was made librarian. That ſtation he retained till his death, which happened in May 1782, in the 68th year of his age.

Wilson, Thomas, an Engliſh prelate, was born in 1663, at Burton-in-Wirral, Cheſhire, and finiſhed his education in Dublin college, where he took his degree of arts. In 1689 he was ordained prieſt, and in 1692 became domeſtic chaplain to the earl of Derby, and attended his ſon, lord Strange, who was his pupil, on a tour to the continent. Upon the death of the young gentleman, he returned to England, and in recompence of his faithful ſervices, was nominated to the biſhopric of the Iſle of Man, by the earl of Derby, who then poſſeſſed the ſovereignty of the iſland. The nomination was approved by king William, and he was conſecrated in January 1697-8, having received at Lambeth the degree of LL.D. The revenue of the biſhopric did not amount to more than 300*l.* a year; but by ſome collateral advantages the biſhop was enabled to exerciſe hoſpitality and charity, to repair his ruined palace, and to found a new chapel at Caſtletown. He alſo eſtabliſhed parochial libraries, which he furniſhed with religious books, among which was a ſmall tract, the firſt that was ever printed in the Manks language. He improved the agriculture of the iſland by introducing into it corn, horſes, cattle, and ſheep, from England; and he ſtudied phyſic with a view of adminiſtering to the relief and comfort of the iſlanders. He publiſhed eccleſiaſtical conſtitutions, which were ſo much approved, that lord chancellor King ſaid of them, that "if the ancient diſcipline of the church were loſt, it might be found in all its purity in the Iſle of Man." Biſhop Wilſon, chiefly with a view to the intereſt of religion and morality, was anxious to maintain a due regard to epiſcopal authority, and this anxiety led him in two inſtances to exceed the bounds of prudence and propriety. When ſome copies of the "Independent Whig" had found their way into the iſland, he ordered them to be ſeized, apprehending that they inculcated ſentiments hoſtile to Chriſtianity and the eſtabliſhed church. He alſo involved himſelf in difficulties and incurred reproach by excluding from the communion the wife of the governor, on account of an act of defamation, for which ſhe refuſed to aſk pardon of the injured party. This led to a ſerious altercation with the governor, who fined both the biſhop and his two vicars-general, for ſuſpending his chaplain for diſobedience in admitting the wife to communion, and who arreſted them for refuſing to pay the fine. Accordingly they were kept cloſe priſoners in the caſtle for nine weeks, till the biſhop, by application to the council in England, obtained their releaſe. The pious and mild-tempered biſhop afterwards declined proſecuting the governor for damages. From his piety and attachment to the church, he was honoured in 1707 with the degree of D.D. from the univerſity of Oxford, in full convocation, and in which he was afterwards aggregated at Cambridge.

Such was the biſhop's zeal for doing good, that he would not quit the ſphere aſſigned him for this purpoſe, though he was offered an Engliſh biſhopric; in reference to which circumſtance queen Caroline, directing her attention to Wilſon, among a number of other prelates who happened to be at court at the ſame time with him, ſaid to them, "Here, my lords, comes a biſhop whoſe errand is not to apply for a tranſlation, nor would he part with his ſpouſe becauſe ſhe is poor." His character was in ſuch eſtimation with the French miniſter, that he procured an order that no French privateer ſhould commit ravages on the Iſle of Man. In this retired ſituation his life was prolonged to his 93d year, when he calmly expired in March, 1755, leaving one ſurviving ſon, known in the political world as rector of St. Stephen's, Walbrook, and patron of the celebrated hiſtorian Mrs. Macaulay. After his death a collection of his works was publiſhed in two vols. 4to. 1781. His notes to Crutwell's Bible, which was publiſhed under the biſhop's name in three vols. 4to. 1785, are of little value. The tranſlation of the New Teſtament into the Manks language, which he had undertaken, was completed by his ſucceſſor, Dr. Mark Hilleſley. Biog. Brit. Life prefixed to his Works. Gen. Biog.

Wilson, Dr. John, a native of Feverſham, in Kent, was a gentleman of Charles the Firſt's chapel, and ſervant in ordinary to his majeſty, in the character of chamber-muſician. His inſtrument was the lute, upon which he is ſaid to have excelled all the Engliſhmen of his time; and, according to Ant. Wood, his royal maſter was ſo pleaſed with his talents, and had even ſuch a perſonal regard for him, that he not only liſtened to him with the greateſt attention, but frequently condeſcended to lean or lay his hand on his ſhoulder, while he was playing.

For the excellence of his performance we muſt now wholly depend on tradition, as the compoſitions he has left behind him for the lute are but feeble teſtimonies of a great hand. Nor will his vocal productions, or Fantaſias, either in print or manuſcript, generate very exalted ideas of his genius or abilities as a compoſer. That he was admired by his majeſty, and by the lovers of muſic at Oxford, where he was honoured with the degree of doctor in muſic, 1644, and where he long reſided, proves more the low ſtate of the art at this time, before the ears of the public were rendered diſcriminative, by a variety of great and rival talents, than his own perfections. Little had been heard, and but little was expected. Swift ſays, "we admire a little wit in a woman, as we do a few words ſpoke plain by a parrot:" and it might more ſeriouſly be ſaid, that the beſt muſic, during times of ignorance and inexperience, is perhaps more admired than the moſt exquiſite productions and performance of a more enlightened period. Nothing can prove this more clearly than the unbounded and hyperbolical praiſes beſtowed in France on the operas of Lulli, of which, at preſent, the whole nation is aſhamed.

Dr. Wilſon, indeed, ſeems to have ſet words to muſic more clumſily than any compoſer of equal rank in the profeſſion; but as he was reſpected by his contemporaries, and held an exalted rank in his art, a liſt ſhall here be inſerted of his works; not ſo much for their intrinſic worth, as to enable curious enquirers to judge for themſelves of the progreſs which muſic had made in this kingdom, when ſuch productions were in high favour, not only with the greateſt perſonages but principal profeſſors of the times.

"Pſalterium Carolinum, the devotions of his ſacred majeſty

jeſty in his ſolitude and ſufferings, rendered in verſe, ſet to muſic for three voices and an organ or theorbo." Folio, 1657.

"Cheerful Aires or Ballads, firſt compoſed for one ſingle voice, and ſince ſet for three voices." Oxon. 1660.

"Aires to a voice alone, to a theorbo or baſs viol;" theſe are printed in a collection entitled "Select Aires and Dialogues." Folio, 1653.

"Divine Services and Anthems," the words of which are in Clifford's Collection. Lond. 1663.

He alſo compoſed muſic to ſeveral of the odes of Horace, and to ſome ſelect paſſages in Auſonius, Claudian, Petronius Arbiter, and Statius; theſe were never publiſhed, but are preſerved in a manuſcript volume curiouſly bound in blue Turkey leather, with ſilver claſps, which the doctor preſented to the univerſity, with an injunction that no perſon ſhould be permitted to peruſe it till after his deceaſe. It is ſtill among the archives of the Bodleian library.

The compoſitions of Dr. Wilſon will certainly not bear a ſevere ſcrutiny either as to genius or knowledge. It is, however, not eaſy to account for the ignorance in counterpoint which is diſcoverable in many luteniſts of theſe times; for having harmony under their fingers, as much as the performers on keyed inſtruments, it facilitates their ſtudy, and ſhould render them deeper contrapuntiſts than the generality of flute-players, whoſe flimſy compoſitions are proverbial.

On the ſurrender of the garriſon of the city of Oxford, 1646, Dr. Wilſon left the univerſity, and was received into the family of ſir William Walter, of Sarſden, in Oxfordſhire; but, in 1656, he was conſtituted muſic-profeſſor, and had lodging aſſigned him in Baliol college, where, being aſſiſted by ſome of the royaliſts, he lived very comfortably, exciting in the univerſity, according to A. Wood, ſuch a love of muſic, as in a great meaſure accounts for that flouriſhing ſtate in which it has long ſubſiſted there, and for thoſe numerous private muſic-meetings, of which this writer, in his own life, has given ſuch an amuſing relation. At the Reſtoration, Dr. Wilſon was appointed chamber-muſician to Charles II.; and, on the death of Henry Lawes, 1662, was again received into the chapel-royal, when, quitting the univerſity, he reſided conſtantly in London, till the time of his deceaſe, at near 78 years of age, in 1673. Burney.

Wilson, in *Geography*, a town of South Carolina; 15 miles S.W. of Queenborough.—Alſo, a town of Scotland, in the county of Lanerk, founded in the latter end of the 18th century, by Meſſrs. Wilſon of London, to accommodate the workmen employed in an iron foundery there; 5 miles E. of Lanerk.—Alſo, a county of Weſt Tenneſſee, with 11,952 inhabitants, including 2297 ſlaves.

WILSONIA, in *Botany*, received that appellation from Mr. R. Brown, who commemorates by it the remarkable zeal and perſeverance of Mr. John Wilſon, an inhabitant of Kendal, Weſtmoreland, author of a "Synopſis of Britiſh Plants in Mr. Ray's Method," publiſhed at Newcaſtle-upon-Tyne in 1744. This work, however, is incomplete, the graſſes, trees, ſhrubs, and all the cryptogamic tribe, except Ferns, being omitted. The author, whom Dr. Pulteney ſuppoſes to have died about the year 1750, is ſaid to have left theſe claſſes finiſhed in MS.; but they were never publiſhed. His performance indeed is now altogether obſolete, being chiefly tranſlated from Ray and Tournefort; though with ſome alterations of the ſyſtem of the former, and much additional matter, reſpecting the ſtations of rare plants; all which evinces a conſiderable portion of practical knowledge. Copious medical information is interſperſed, and a botanical dictionary is prefixed. But the botaniſt of whom we are ſpeaking is principally worthy of memory, for that indefatigable love of ſcience, which even the moſt humble ſituation, and the moſt limited circumſtances, could not counteract. Whether he was employed in the manufacture of knitted ſtockings, formerly very extenſive in his native town, or whether he made ſhoes, his biographers are not agreed; but he contrived to attain more knowledge, and cultivation of mind, than perhaps a great majority of the gentry around him. He muſt have had a competent acquaintance with Latin, and he may rank as an Engliſh writer among the moſt reſpectable, upon ſcientific ſubjects, in his time. We cannot commend his prudence, if we compaſſionate his difficulties, when he would have ſold his only cow, the ſupport of his wife and family, to buy a copy of Moriſon's work. But we may be allowed to regret that his mental application did not tend to ſo ample a pecuniary reward, as that of the famous ſir Richard Arkwright, who repeatedly incurred the cenſure of many a prudent friend, for neglect of buſineſs, while he was planning a ſcheme of unbounded profit for himſelf and family. We rejoice to read that the book ſo much deſired, was preſented to Wilſon by a benevolent lady, who lived near him, and who by this act has afforded a laſting teſtimony to the worth of his character. An honeſt man may always hope for indulgence and aſſiſtance, if he ſmooths the path of hard duty with a little mental excurſion, inſtead of mere unprofitable recreation or diſſipation, whatever may be his ſituation in life. Many a cow has been ſold in conſequence of evil propenſities; few have been ſacrificed to procure food for the mind. — Brown Prodr. Nov. Holl. v. 1. 490. Claſs and order, *Pentandria Monogynia*. Nat. Ord. *Convolvuli*, Juſſ. *Convolvulaceæ*, Brown.

Eſſ. Ch. Calyx pitcher-ſhaped, five-ſided, five-toothed. Corolla funnel-ſhaped, of one petal; imbricated in the bud. Germen with two ſeeds. Style cloven. Stigmas capitate. Capſule . . . .

1. W. *humilis*. Humble Wilſonia. Br. n. 1.—Diſcovered by Mr. Brown, in the ſouth part of New Holland. A little, dwarf, ſhrubby, proſtrate, much branched, downy plant. *Leaves* ſmall, ſeſſile, thickiſh, imbricated in two ranks. *Flowers* axillary, ſolitary, ſeſſile, without *bracteas*. Mr. Brown remarks, that the natural affinity of this genus muſt be uncertain while its *fruit* continues unknown. He met with the plant after the *flowers* were faded, before the *ſeed-veſſel* was formed, nor is he certain whether the *germen* conſiſted of one cell, or of two. He ranges *Wilſonia* next after *Creſſa*, of whoſe place in the natural ſyſtem Linnæus had formed no opinion, but which Juſſieu well refers to his *Convolvuli*, notwithſtanding the ſolitary *ſeed*.

WILSONVILLE, in *Geography*, a town of Pennſylvania; 120 miles N. of Philadelphia.

WILSTER, a town of the duchy of Holſtein, on the river of the ſame name; 8 miles N. of Gluckſtadt.

WILSUM, a town of Germany, in the county of Bentheim; 11 miles W.N.W. of Nienhuus.

WILTER, a town of the Tyroleſe, on the Inn; 3 miles above Inſpruck.

WILTON, an ancient market, borough, and county-town of Wiltſhire, England, derives its name from the river on which it was originally built. By old writers, it was called Wile, or Wily-Vilodunum and Ellandunum; and according to Baxter it was a chief ſeat of the Britiſh prince, Carvilius, and thence denominated Caer-Guilou. Henry of Huntingdon ſays, it afterwards became the capital of the Weſt-Saxon dominions; but Leland and Dr. Milner contend,

tend, that Winchefter was the chief town of that monarchy. It is not improbable that both places were at different periods poffeffed and occupied by the Weft-Saxon kings.

Antecedent to the Norman Conqueft, Wilton was certainly a place of diftinguifhed confequence. It contained feveral religious eftablifhments; and was the principal town of the county, as appears from its having given name to the fhire. Leland ftates, that it poffeffed twelve parifh-churches at the period of Henry III.; a ftatement, if fully authenticated, would afford decided proof both of its great extent and population. The Weft-Saxon monarchs moft probably had a palace here, and conferred on this place many marks of their royal favour. During their dynafty, Wilton was a royal borough, and appears to have been the fcene of feveral important hiftorical events. In 823, Egbert gave battle to and defeated the Mercian army near this town, which army was commanded by their king, Beornwulf. Several other engagements between the Saxons and Danes took place at and near Wilton. One of thefe occurred in 871, when the valiant Alfred commanded the Saxon army againft a vaft horde of the Danifh marauders, who having plundered and laid wafte feveral other places, were checked in their fanguinary career near this town, and after a defperate battle were compelled to petition for mercy and peace. Again in 1003, Wilton was vifited by the Danes, when part of the town was confumed. During the civil warfare between king Stephen and the emprefs Maud, this place was the fcene of much flaughter.

Wilton continued for many centuries after the Conqueft celebrated for its monaftic inftitutions, and particularly for its abbey. This was inftituted in 773 by Wulftan, earl of Wiltfhire, who, having defeated Ethelmund, king of the Mercians, repaired "a certain old church of St. Mary, at Wilton, which had been deftroyed by the Danes, and placed in it a college of fecular priefts." After the Conqueft, king William and feveral of his fucceffors added greatly to the opulence of this abbey, which was diffolved in the thirty-fifth year of Henry VIII. The other monaftic inftitutions in this town were, a houfe of black friars, an hofpital dedicated to St. Mary Magdalen, a collegiate church, and an hofpital dedicated to St. John.

Wilton, though much decayed, ftill retains many of its ancient privileges. It is a borough both by prefcription and by charter, and is governed by a corporation of its own, confifting of a mayor, recorder, five aldermen, three capital burgeffes, and eleven common-councilmen, with a town-clerk, and other officers, as fixed by the laft charter granted in the reign of Henry VIII. The town fends two members to parliament, and has regularly done fo fince the twenty-third year of Edward I. In 1710, it was agreed that the elective franchife was vefted "in the mayor and burgeffes, who are to do all corporate acts and receive the facrament." The number of voters is ftated at twenty-four in the Hiftory of Boroughs, where it is alfo obferved, that "the election of any perfon to be a burgefs of Wilton, who has not taken the facrament of the Lord's fupper, according to the rites of the church of England, within one year before fuch election, is a void election." The mayor is the returning officer; and the patron of the borough is the earl of Pembroke, whofe feat is in the vicinity of the town.

The county courts of juftice are fometimes held here; as are likewife the elections for the county members. The precife fpot where the electors meet to choofe their reprefentatives, is marked by a large ftone in the Warren, at a fhort diftance fouth of the town. The market-days here were formerly Wednefday and Friday in every week; but a fmall one on the former day is now only continued. The fairs are held on the 4th of May and the 12th of September.

The principal public buildings in this town are the parifh-church and the town-hall. The other buildings here appropriated to public purpofes are two chapels, one belonging to the Methodifts, and another to the Independents, a free-fchool, and eight alms-houfes. Wilton, including the borough and parifh, contains, according to the parliamentary returns of 1811, 393 houfes, and a population of 1963 perfons. It was formerly celebrated for its carpet manufactories, which gave employment to a large proportion of its inhabitants. The firft carpet made in England was manufactured at Wilton. Fancy woollens and flannels are now the only articles of manufacture. At the eaftern end of the town is,

Wilton-houfe, feated in a fine park. This edifice is a large, extenfive pile, erected at different periods, and difplays different ftyles of architecture. It was formerly an abbey, but the alteration of Mr. James Wyatt has deftroyed every monaftic part of the building. This architect (now no more) was employed by the prefent noble proprietor, to enlarge the manfion and adapt it for the better difplay of its rich ftores of ancient fculpture and paintings. A principal feature in this alteration is the formation of a glazed cloifter, round a central court, which contains nearly the whole collection of ftatues, bufts, baffo-relievos, &c. Another confiderable novelty is a large court-yard on the north, furrounded by offices, a lodge, and a new fide to the houfe. The approach is through a triumphal arch, which is furmounted by a bold equeftrian ftatue of Marcus Aurelius. A veftibule leads to the cloifter, both of which are filled with ancient marbles.

The collection of works of art at Wilton-houfe has long been highly celebrated, and different publications have been given to the world, with catalogues and accounts of the various fubjects. Thefe are, the "Ædes Pembrochianæ," by Mr. Richardfon, 12mo. 1774; an eleventh edition of which was publifhed in 1788. Gambarini of Lucca publifhed a "Defcription of the Earl of Pembroke's Pictures," in 1731. Kennedy alfo produced a "New Defcription of the Pictures, &c." in 1764. Another volume in 4to., with feveral engravings of the fculpture, was publifhed in 1786. Wilton-houfe was formerly exhibited to ftrangers, but the prefent nobleman has fhut it up. Several perfons of the Pembroke family have been particularly diftinguifhed in the annals of the country; particularly in Clarendon's hiftory. Philip Maffinger, an eminent dramatic poet, was probably born at Wilton-houfe, as his father lived in the fervice of the earl of Pembroke. See Giffard's Life and Works of Maffinger.

About a mile eaft of Wilton is Bemerton, the living of which is poffeffed by the Rev. William Coxe, author of feveral valuable works of Hiftory, Travels, and Topography. It is rather fingular that the rectory of Bemerton has been enjoyed by feveral eminent literary characters, among whom we find the names of Walter Curle, bifhop of Winchefter, &c. George Herbert, (commonly called the divine Herbert,) and John Norris.—Beauties of England, Wiltfhire, 8vo. 1814; by John Britton, F.S.A.

Wilton, a town of the diftrict of Maine, in the county of Kennebeck, containing 770 inhabitants; 60 miles N.N.E. of Portland.—Alfo, a town of New Hampfhire, in Hillfborough county, with 1017 inhabitants; 30 miles E. of Chefterfield.—Alfo, a town of Connecticut, in the county of Fairfield, with 1728 inhabitants.—Alfo, a town of South Carolina; 27 miles S.W. of Charleftown.

WILTOWN, a town of South Carolina; 21 miles W.S.W. of Dorchefter.

WILTPERG, a town of Auftria; 8 miles S.W. of Freyftadt.

WILTSHIRE, an inland county, fituated towards the fouth-weftern divifion of England, derives its name from the town of Wilton, which, according to fome ancient hiftorians, was the metropolis of the Anglo-Saxon kingdom of Weffex. On the north and north-weft it is bounded by Gloucefterfhire, on the fouth-weft by Dorfetfhire, on the fouth and eaft by Hampfhire, and on the north-eaft by the county of Berks. Thefe boundaries are in general artificial, and form a figure approaching that of an ellifpe. Concerning the extent and fuperficial area of this county, various are the ftatements of different writers. In the Magna Britannia it is faid to be thirty-nine miles in length from north to fouth, and thirty in breadth from eaft to weft. Gough, in his additions to Camden's Britannia, eftimates its length at forty-nine miles, and its breadth at thirty-feven. Its circumference, according to the fame author, is one hundred and fifty miles, and the number of acres it contains 876,000. Mr. Davis, whofe authority on this fubject is highly refpectable, in his Agricultural Report on the County, ftates it to be in length fifty-four miles, and in breadth thirty-four. The fame writer computes the fuperficial area to be 1372 fquare miles, or 878,000 acres.

The county of Wilts is a diftrict peculiarly interefting to the topographer and antiquary. To the latter, indeed, it offers a wider and more varied field for refearch than perhaps any other county in England. The grand and myfterious monuments of Stonehenge and at Avebury, and the numerous barrows which cover its plains, are relics of an age anterior to hiftorical record, and of which the annals of the world do not furnifh a parallel example. Like the proud pyramids of Egypt, the former were calculated by their conftruction to have remained entire to almoft endlefs futurity, if the agency of the elements had not been affifted by the deftructive influence of man. In the Wanfdyke, Bokerly-ditch, and Grimfditch, and in the fimpler intrenchments with which the county abounds, we behold the remains of Britifh towns, and perceive the mode adopted by the Britons to mark boundaries and form communications. The caftles of Old Sarum, Scratchbury, Battlefbury, and Bratton, difplay the efforts of a more advanced period; and many other of the Wiltfhire intrenched works bear marks of fucceffive occupation by the Romans, the romanized Britons, the Saxons, and the Danes. This part of the kingdom, indeed, feems to have been the principal theatre of the military and civil events which were confequent on the Saxon and Danifh invafions. Here the far-famed Arthur and the ftill more illuftrious Alfred contended at different periods for the liberties of their country, and checked for a time the tide of invading conqueft. At Ludgerfhall, Devizes, Malmfbury, and Marlborough, the veftiges of Norman fortreffes may yet be traced; and in Clarendon-park ftood a fumptuous palace, erected by king John. Malmfbury yet preferves the ruins of a magnificent abbey; and in the cathedral of Salifbury, we behold an edifice furpaffing every fimilar ancient ftructure in uniformity of ftyle and fymmetry of parts. Many of the parochial churches in the county are alfo objects worthy the examination of the antiquary, as fpecimens of architectural fkill and fcience; and in Wilton-houfe, Longford-caftle, Font-hill, Corfham-houfe, Bowood, Tottenham-park, Charlton-park, Stourhead, and Longleat, we are prefented with manfions alike celebrated for magnificence and beauty of fcenery, and for popular attractions to the connoiffeurs and artifts of the country.

At the period of the invafion of our ifland by Julius Cæfar, a people called the Belgæ inhabited a portion of this county. The Hedui are faid to have occupied its north-weftern divifion, near the fource of the Avon and about Cricklade. Another diftrict is mentioned by Carte, in his Hiftory of England, as being fubfequently poffeffed by the Carvilii, fo named from their prince Carvilius; but whether thefe people were fome of the Belgæ, or a diftinct tribe, does not appear. Other authors fuppofe that the Cangi inhabited the northern parts, if not at this era, at leaft foon after it.

When the Romans, after the lapfe of nearly a century, from the final departure of Cæfar, again invaded Britain in the reign of Claudius (A.D. 44.), they found the political condition and relations of its feveral tribes very materially altered. The opinion of Camden, in his Britannia, is, that the Belgæ had fubdued the whole of Wiltfhire, and alfo had poffeffed themfelves of all the territories of the Hedui.

It is very generally admitted, that the Belgæ were the moft powerful people in the fouth-weftern divifion of England at the era of which we are now fpeaking; and no doubt is entertained of their having occupied all the fouthern diftrict of this county, as far as the Wanfdyke, which is therefore defignated by the appellation of 'The great Belgic Boundary.'

Under the Romans, Wiltfhire formed part of Britannia-Prima, and many ftations, encampments, and other military veftigia of that people can be traced in different parts of it.

Subfequent to the departure of the Romans, the earlieft event of political importance which occurs in hiftory relating to Wiltfhire is the maffacre of three hundred Britifh nobles, on the fpot where Stonehenge is fituated, by the orders of Hengift (leader of the firft Saxon expedition to England), who had invited them here to a banquet under the pretence of effecting a reconciliation between the Britons and himfelf. The truth of this dreadful cataftrophe, however, is extremely doubtful, as it does not appear to be mentioned by any of the Saxon writers, and feems to reft folely upon the authority of Nennius, and a few of the Britifh or Welfh bards, who were evidently interefted in the propagation of ftories calculated to excite feelings of enmity and revenge in the breafts of their countrymen, againft a people, once their allies, but afterwards their inveterate and barbarous enemies. Carte fays, that this "ftory was borrowed from Witikind, who relates it of the Thuringians, who were murdered by the Saxons on a like occafion, and upon a fignal given in the fame words made ufe of by the Britifh writers." Turner, in his Hiftory of the Anglo-Saxons, regards it as an incident which can neither be authenticated nor difproved; and Whitaker, in his Hiftory of Manchefter, afferts, that the conquefts of Hengift never extended beyond the limits of Kent; a circumftance which, if fully eftablifhed, would no doubt tend to invalidate our belief of the tranfaction. Hume, in his Hiftory of England, calls it a ftory "invented by the Welfh authors, in order to palliate the weak refiftance made at firft by their countrymen, and to account for the rapid progrefs and licentious devaftations of the Saxons." About the year 520, Cerdic, founder of Weffex, having received confiderable reinforcements from Saxony, and cut off a body of Britons which had been difpatched to intercept them, collected all his difpofable forces, and advanced to Mount Badon, Badbury-caftle, a Britifh poft then

then confidered of great ftrength and importance, on account of its commanding fituation, and its proximity to the concurrence of the Roman roads, which interfect the northeaftern divifion of this county. The diftinguifhed Arthur, who fo long upheld the falling fortunes of his country, relieved the garrifon with a large army formed under his own infpection: Cerdic, apprized of his intention, abandoned the fiege, and waited the approach of the enemy. The conflict was fevere; the genius of Arthur, however, ultimately prevailed over the fuperior fcience of the Saxon general, and the more fteady conduct of his veteran troops. The fubjugation of Wiltfhire was not again attempted till the year 552, when warfare was once more renewed. Kenric, the fon of Cerdic, and his fucceffor in the Weft-Saxon monarchy, again paffed the frontiers of his dominions, and threatened Sorbiodunum or Old Sarum.

The Britifh army took a pofition to fecure its fafety, and fought with their ufual intrepidity, but were defeated by the fuperior difcipline of the Saxons. At "Beranbyrig," Barbury-caftle, in the vicinity of Marlborough, another decifive battle was fought, in which the invaders were again the conquerors; and Wiltfhire in confequence became incorporated in the kingdom of Weffex.

After feveral fkirmifhes, a decifive battle was fought at Wodnefbury, in which the ufurper of Weffex was defeated. The Danes made a defcent on the ifland in the thirty-fecond year of Egbert's reign, and effected great ravages in Wiltfhire. King Alfred afterwards attacked the Danes near Wilton, and routed them; but elated by fuccefs, he incautioufly fuffered them to rally when they gained a victory.

Alfred engaged them in feveral battles with varied fuccefs, and ultimately compelled them to fue for peace, which was granted; yet in the following year, regardlefs of their recent engagements, they fuddenly advanced to Chippenham, then a royal refidence, and eftablifhed themfelves in that town. They had gained fuch confiderable reinforcements, that the king, with a part of his army, retired into Somerfetfhire. Here he remained feveral months, occafionally fallying out upon the enemy, deftroying their magazines, and carrying off their provifions. Having muftered a confiderable army, Alfred quitted his retirement, and advanced to Æthandune, where the Danifh forces lay encamped, attacked them by furprife, and gained a complete victory. No other particular event occurred in Wiltfhire until 976, when a fynod was held at Calne, in which the refpective rights of the regular and fecular clergy underwent a folemn difcuffion: the fecular clergy would not relinquifh their pretenfions; another council was, therefore, convened the fame year at Amefbury, in which it appears the canons were unfuccefsful.

The next hiftorical occurrence in Wiltfhire happened in 1003, when the towns of Wilton and Sarum were plundered and nearly burned to the ground by the Danifh monarch.

In 1006 another army of Danes vifited Weffex, and retiring to the coaft through Wiltfhire, when fome of its natives attacked it in the vicinity of Kennet; the Saxons were, however, defeated, and purchafed peace by fubmitting to the tribute called Danegelt.

England now remained tranquil five years, when in 1011 king Swein and his fon Canute again landed on the fouth coaft, and entering this county, levied heavy contributions on the inhabitants. King Edward at this time being indifpofed at Corfham, his fon Edmund took the field, and put the invaders to flight. An obftinate battle was fought, about this time, at "Scearftan," or Sherfton, on the northweftern verge of the county, by Edmund (who had juft fucceeded his father, Edward) againft the Danes; the decifion of the battle turned in favour of king Edmund by the unexpected flight of Canute. Subfequent to the Norman Conqueft, Wiltfhire retained a confiderable fhare of political intereft.

In the year 1086, the conqueror held a great council at Sarum; "where," fays Blackftone, "all the principal landholders fubmitted their lands to the yoke of military tenure, became the king's vaffals, and did homage and fealty to his perfon." Thus was the feudal fyftem formally introduced into this country.

Clarendon, in this county, is remarkable for the laws paffed there in the reign of Henry II.; "whereby," fays Blackftone, "the king checked the power of the pope and the clergy, and greatly narrowed the total exemption they claimed from the fecular jurifdiction;" though the completion of his wifhes was prevented by the murder of the proud and arrogant prelate, archbifhop Becket. Thefe laws are ftill familiar to the antiquary, by the appellation of the 'Conftitutions of Clarendon.' At Marlborough, in 1267, Henry III. held a parliament, or a general affembly of the 'Eftates of England,' to provide for "the better ftate of the realm, and the more fpeedy adminiftration of juftice;" and here were confequently enacted thofe ftatutes for the fuppreffion of tumults, which have ever fince been denominated, 'The Statutes of Marlbridge.' In the contefts between the houfes of York and Lancafter, the inhabitants of Wiltfhire were confpicuous for their attachment to the fortunes of the Henries. Many of them were prefent at the battle of Tewkfbury, an event which tended to fix the crown on the brows of Edward.

In the deplorable events of the 17th century, this county was equally diftinguifhed. Many actions between the parliamentary and royal forces were decided within its boundaries; particularly at Malmfbury, at Ludgerfhall, and at Round-a-way-hill, in the neighbourhood of Devizes. Wardour and Longford caftles were alternately befieged and taken by both parties within one year.

The remains of antiquity in Wiltfhire, firft entitled to notice in a collective view, are the ftupendous monuments at Avebury and Stonehenge, both of which are regarded as druidical temples. In thefe ftructures we are prefented with the moft wonderful works of a rude but powerful people; works in which the bodily ftrength of affociated numbers, with the fcience and cuftoms of their age, are ftrongly manifefted, and which are calculated not only to excite the aftonifhed gaze and amazement of the multitude, but alfo to roufe curiofity and awaken inquiry in the minds of antiquaries and hiftorians. See Avebury, and Stonehenge.

Next to thefe immenfe temples, becaufe refembling them in relative magnitude, though totally diffimilar in kind, the Wanfdyke may properly claim attention. This vaft earthwork, which is fuppofed to have originally interfected the whole country, is now only diftinctly vifible in detached places, throughout the range of hills to the fouth and weft of Marlborough, where it ftill remains tolerably entire, and in one place is feen in a bold and connected line for the fpace of ten or twelve miles.

Barrows, or Tumuli.—Of correfponding antiquity to the monuments already named, are the artificial hillocks or mounds of earth which abound in this county, and which appear to have an intimate connection with thofe temples, as they are more numerous around Stonehenge and Avebury than in any other places. Thefe memorials were undoubtedly appropriated to fepulchral purpofes. By the refearches of Mr. Cunnington, fir Richard C. Hoare's "Ancient Wiltfhire," the Rev. James Douglas's "Nennia Britannia," and a few other enlightened antiquaries, we are made

made familiar with the contents of thefe facred depofitories. See BARROW, and TUMULI.

The Roman ftations mentioned in the Itinerary of Antoninus, as being fituated within the county, are three in number, *Sorbiodunum*, *Verlucio*, and *Cunetio*. The firft of thefe is placed by all antiquaries at Old Sarum; but the fituation of the other two has been much difputed. Camden fixes Verlucio at Weftbury; Horfley, at Lackham; and Stukeley, whofe opinion is the moft probable, in the neighbourhood of Heddington. Cunetio was formerly fuppofed by fome writers to be at the village of Kennet, and by others at the prefent town of Marlborough; but it is now generally allowed to have been fituated at a fhort diftance eaft from the latter place, near the north-eaftern boundary of Savernake foreft. Befides thefe, the Romans had feveral other fettlements in this county; particularly at Eafton-Grey, at Wanborough, at Pitmead near Heytefbury, and at Littlecot, at each of which places teffellated pavements and other Roman remains have been found. Of the Roman roads which paffed through Wiltfhire, the principal was a continuation of the Julia Strata, which entering the county from Bath, left it near Hungerford on the eaft. The Foffe road branched off from the Julia Strata at Bathford, at the north-weft córner of the county, where in many places it is ftill confpicuous. Several other roads connected Sorbiodunum with neighbouring ftations; and of thefe, three are traced with confiderable certainty: firft, one which led to *Durnovaria*, or Dorchefter; fecondly, that to *Venta-Belgarum*, Winchefter; and thirdly, another to *Vindonum*, or Silchefter.

The numerous encampments and other intrenched earthen works with which Wiltfhire abounds vary not only in fize and fhape, but in method of conftruction and peculiarity of fituation. Some of thefe are doubtlefs the works of the Britons, others of the Belgæ, of the Romans, of the Saxons, the Danes, and the Normans. Many of them, however, have been in all probability fucceffively occupied and altered by the armies of one or more of thefe nations, at different periods fubfequent to their original formation. The immenfe fortifications of Old Sarum, Chidbury-hill, near Warminfter, and Vefpafian's camp, near Amefbury, conftitute the moft diftinguifhed monuments in this clafs of antiquities.

Caftles.—That this county, at an early period, contained a number of thofe baronial fortified ftructures, which are ufually defignated by the term caftles, and which are fuppofed by feveral writers to have been firft introduced by the Normans, is undoubted. Moft of them, however, are now totally demolifhed, fo that it is even difficult to afcertain their actual fcites; and the reft have been fo much altered in later times, as almoft to efface every veftige of the original building. The more celebrated of thefe edifices, and thofe which moft frequently occur in the ancient hiftorians, are the caftles of Marlborough, Devizes, Ludgerfhall, Wardour, Combe, and Malmfbury.

General Afpect.—In a geographical arrangement, Wiltfhire may be faid to be naturally divided into two portions, by an irregular range of hills, which extends tranfverfely through the greater part of the county in a direction inclining from the north-eaft to the fouth-weft. Thefe diftricts are ufually denominated South and North Wiltfhire, and differ very materially from each other, not only in appearance, but in almoft every diftinguifhing quality.

South Wiltfhire, which claims priority of notice on account of its fuperior extent, forms the weftern divifion of a vaft tract of chalk-hills, which extends into Hampfhire, and having for its boundaries the rich lands of Berkfhire, and the extreme verge of the Marlborough hills on the north; the broken ground of Somerfetfhire on the weft; the new foreft of Hampfhire on the fouth; and the heaths of Surrey and Suffex, together with the Weft Downs of the latter county, on the eaft. The furface of the higher downs, to ufe the words of Gilpin, is "fpread out like the ocean, but it is like the ocean after a ftorm; it is continually heaving in large fwells." In fome parts, the hills affume the form of rotund knolls, and are feparated by fmoothly-fided hollows, which vary confiderably both in depth and extent. At other places they range along for a fhort diftance in connected ridges, fhewing on one fide of the range rather a rapid declivity, from the top of which, on the other fide, the hills fink in irregular gradation, till at length they frequently fhelve into a perfect flat. This effect, fays Marfhall in his "Obfervations on" what he terms "the Weftern Diftrict" of chalk hills, is of courfe more particularly diftinguifhable, "where the range of hills is narrow, *fingle*, than where a congeries of fuch ranges are crowded together diforderly." The whole of this diftrict, generally fpeaking, is feparated into two divifions, the one called Marlborough-Downs, and the other Salifbury-Downs or Plain.

The principal valleys in this divifion of the county lie along the banks of the rivers, the moft remarkable of which diverge like irregular radii from the country around Salifbury and Wilton. Thefe difplay rich meadow and corn lands, interfperfed with feats and villages, and finely covered in various parts with plantations of wood.

North Wiltfhire differs entirely from the fouthern divifion of the county in its general appearance. Inftead of a conftant feries of "chalky waves," the afpect of this diftrict, which extends from the verge of the Downs to the hills of Gloucefterfhire, is nearly that of a perfect flat; the few deviations from the ordinary level being fo gradual as fcarcely to be perceptible, on a curfory view. The country here is fo clofe and well wooded, that when viewed from any of the furrounding hills, it appears like one vaft plantation of trees. If examined in detail, however, it is found alfo to contain many extenfive tracts of rich pafture land, fituated on the banks of the Lower Avon and the Thames, and of fmaller ftreams which flow into both of thofe rivers.

Rivers.—Wiltfhire abounds with rivers, which either take their rife within the county, or on its immediate confines. Two of thefe, the Thames and the Lower Avon, are unqueftionably important ftreams. All the others are much inferior both in extent and confequence; but feveral of them deferve to be particularly noticed, *viz.* the Upper or Salifbury Avon, the Nadder, the Willey, the Bourne, and the Kennet. See THAMES.

The Lower Avon rifes in the hilly diftrict of North Wiltfhire, at a fhort diftance from the town of Wootton-Baffet.

The Upper Avon is formed by the confluence of feveral fmaller ftreams, which take their rife among the hills near the centre of the county. The Kennet rifes near Avebury, and running in an eafterly direction, unites with the Thames at Reading. The Willey and the Nadder join their ftreams at Wilton, and unite with the Avon at Salifbury.

The *cheefe* of North Wiltfhire has long been defervedly celebrated; though for fome time after it became the ftaple commodity here, it was fold in the London market as the manufacture of Gloucefterfhire. See CHEESE.

Wafte Lands.—It is a common idea that the Wiltfhire downs confift entirely of "wafte land." This notion, however, is completely erroneous; for if the correct appropriation of land is to be eftimated by its comparative utility in in different conditions, the application of the grounds in the chalk diftrict cannot be very eafily improved, or materially altered for the better.

In North Wiltfhire the number of common fields is very great, but none of them are of any confiderable extent. It is fubject of regret, however, that they fhould exift at all, as many of them are difperfed over the richeft foil in the diftrict; and if brought under regular cultivation would be extremely productive.

The chaces within Wiltfhire are fuppofed to have been numerous formerly, but only three woodland diftricts now retain that peculiar appellation: thefe are Cranbourn-chace, Vernditch-chace, and Albourn-chace. The firft and fecond join each other, and occupy a long narrow tract of country on the fouthern confines of Wiltfhire. There are three canals which interfect parts of this county: firft, the Thames and Severn; fecondly, the Kennet and Avon; and thirdly, the Wiltfhire and Berkfhire. See CANALS.

The *manufactures* of Wiltfhire are various, and of great extent. Salifbury is noted for its flannels and fancy woollens; and befides carries on a confiderable manufactory of cutlery and fteel goods, which are probably fuperior in workmanfhip to any in the kingdom. Wilton was celebrated for a large manufactory of carpets, and Mere for another of fancy woollens; and in its neighbourhood a great quantity of linen is made, chiefly dowlas and bed-ticks. Broad cloths, kerfeymeres, and fancy cloths, are the principal produce of the towns of Bradford, Trowbridge, Warminfter, Weftbury, Melkfham, Chippenham, and all the adjacent towns and villages from Chippenham to Heytefbury. At Albourn is an excellent manufactory of cotton goods, of which fuftians and thickfets form the moft valuable portion. Swindon and its vicinity has been long famed for its manufactory of gloves.

Ecclefiaftical and Civil Divifion and Government.—The whole of this county is fituated in the province of Canterbury; and, with exception of the parifh of Kingfwood, is in the diocefe of Salifbury. It comprehends two archdeaconries, Sarum and Wilts; the former comprifing the deaneries of Salifbury, Amefbury, Chalk, Pottern, Wilton, and Wily; and the latter, with the annexed rectory of Minety, thofe of Avebury, Cricklade, Malmfbury, and Marlborough.

As in the other counties of England, the chief civil magiftrates of Wiltfhire are, the lord-lieutenant, the cuftos rotulorum, and the high fheriff; which laft is elected annually, and whofe official bufinefs is chiefly conducted by a deputy-fheriff. The other local members of government are, juftices of the peace, mayors and bailiffs of boroughs, and a variety of fubordinate officers. The acting magiftrates are feventy-three, and the petty feffions for the county thirteen.

Wiltfhire is comprehended in the weftern circuit, and fends thirty-four members to parliament, *viz.* two knights of the fhire, two citizens for Salifbury, and two burgeffes for each of the following boroughs; Chippenham, Calne, Cricklade, Devizes, Heytefbury, Hindon, Downton, Great Bedwin, Marlborough, Malmfbury, Ludgerfhall, Weftbury, Wilton, Wootton-Baffet, and Old Sarum. At an early period the whole county was divided into twenty-nine portions, called *hundreds;* and thefe are again fubdivided into two hundred and ninety-five fmaller diftricts, called parifhes; with parts of fourteen others. In the county is one city, Salifbury; and twenty-three market-towns, *viz.* Amefbury, Bradford, Calne, Chippenham, Cricklade, Devizes, Downton, Great Bedwin, Heytefbury, Hindon, Ludgerfhall, Malmfbury, Marlborough, Market-Lavington, Melkfham, Mere, Swindon, Trowbridge, Warminfter, Weftbury, Wilton, and Wootton-Baffet.

The government, provincial management, number, and ftate of the poor in this county, as laid before parliament in the year 1804, and publifhed by authority of the houfe of commons, are detailed in the following particulars. It is ftated, "that returns were received from three hundred and thirty-fix parifhes, or places, in the county of Wilts, in the year 1803; in 1785, the returns were from three hundred and thirty-fix; and from three hundred and twenty-five, in 1776." It is then further ftated, "that forty-one parifhes, or places, maintain all or part of their poor in workhoufes; the number of perfons fo maintained, during the year ending Eafter 1803, was one thoufand fix hundred and feven; and the expence incurred therein amounted to 14,547*l.* 2*s.* 0½*d.*, being at the rate of 8*l.* 19*s.* 8*d.* for each perfon maintained in that manner. By the returns of 1776, there were forty workhoufes capable of accommodating two thoufand and feventy-nine perfons. The number of perfons relieved out of workhoufes was forty thoufand five hundred and eleven, befides four thoufand five hundred and thirty-fix, who were not parifhioners. The expence incurred in the relief of the poor, not in workhoufes, amounted to 113,888*l.* 17*s.* 9½*d.* A large proportion of thofe who were not parifhioners appear to have been vagrants; and, therefore, it is probable the relief given to this clafs could not exceed 2*s.* each, amounting to 453*l.* 12*s.* 0*d.* This fum being deducted from the above 113,888*l.* 17*s.* 9½*d.*, leaves 113,435*l.* 5*s.* 9¼*d.*; being at the rate of 2*l.* 16*s.* 0*d.* for each parifhioner relieved out of any workhoufe. The number of perfons relieved *in* and *out* of workhoufes was forty-two thoufand one hundred and twenty-eight, befides thofe who were not parifhioners. Excluding the expence fuppofed to be incurred in the relief of this clafs of poor, all other expences relative to the maintenance of the poor amounted to 131,864*l.* 19*s.* 9¾*d.*, being at the rate of 3*l.* 2*s.* 7*d.* for each parifhioner relieved. The refident population of the county of Wilts, in the year 1801, appears from the population abftract to have been one hundred eighty-five thoufand one hundred and feven; fo that the number of parifhioners relieved from the poor's rate appears to be twenty-three in a hundred of the refident population. The number of perfons belonging to Friendly Societies appears to be fix in a hundred of the refident population. The amount of the whole total money raifed by rates is 16*s.* 0¾*d.* *per* head on the population. The amount of the whole expenditure on account of the poor appears to average at 14*s.* 3½*d.* *per* head on the population. The expenditure in fuits of law, removal of paupers, and expences of overfeers, and other officers, according to the prefent abftract, amounts to 3682*l.* 15*s.* 0*d.* The amount of fuch expenditure, according to the returns of 1785, was then 2501*l.* 13*s.* 9*d.* The expenditure in purchafing materials for employing the poor, according to the prefent abftract, amounts to 849*l.* 8*s.* 7½*d.* The amount of fuch expenditure, according to the returns of 1785, was 434*l.* 11*s.* 9*d.* It does not appear from the returns received, that the poor of any parifh or place in this county are farmed or maintained under contract. The poor of fix parifhes are maintained and employed under the regulations of fpecial acts of parliament. Thirty-fix Friendly Societies have been enrolled at the quarter-feffions of this county, purfuant to the act of 33 & 35 Geo. III."—Beauties of England and Wales, Wiltfhire, by J. Britton, F.S.A. 8vo. 1814. Ancient Wiltfhire, by fir Richard C. Hoare, bart., folio, 1815.

after which the ſpun-yarn is wound round the body of the winch.

WINCHCOMBE, in *Geography*, a market-town in the lower diviſion of the hundred of Kiftſgate, Glouceſterſhire, England, is ſituated on the Cotſwold-hills, 15 miles N.E. by E. from the city of Glouceſter, and 95 miles W.N.W. from London. It was anciently a town of conſiderable importance, was written Wincelcumbe in Domeſday-Book, and was there ſtyled a borough when only Glouceſter and Briſtol, in the ſame county, were dignified with that title. It was the ſcite of a caſtle, and of a mitred abbey ſufficiently capacious for the reception of 300 monks; but every veſtige of theſe buildings has long been levelled with the duſt, and the places where they ſtood are only conjectured. By whom the caſtle was erected is unknown; but the abbey was founded in 798, by Kenulph, king of Mercia, and was conſecrated with great ſolemnity in the preſence of three kings, and a great number of prelates and nobles. Being deſtroyed by the Danes, it was rebuilt in 981 by Oſwald, biſhop of Worceſter, who converted it into a college of ſeculars, and reſtored it to great ſplendour. It was largely endowed; and in the reign of the Conqueror nineteen manors in this county were annexed to it, independently of Winchcombe itſelf. In 1265 its abbot was ſummoned to parliament, and the privilege was continued to all the ſucceeding abbots. The twenty-eighth abbot, Richard Ancelme, ſurrendered his abbey and its poſſeſſions to Henry VIII. in 1539. The edifice was ſoon after totally deſtroyed. Tradition reports it as very magnificent; but no deſcription of it is now extant. Winchcombe, with a ſmall territory adjoining, is ſaid to have been, in the Anglo-Saxon time, a ſheriffdom or county of itſelf; but in the reign of Canute, it was diveſted of its independence, and annexed to Glouceſterſhire. The town now conſiſts chiefly of two ſtreets, interſecting each other; the houſes are low, and principally of ſtone. The difficulty of approaching it, through the badneſs of the roads, has prevented it from being much viſited; but the new turnpike-roads have now opened a ſhort and eaſy communication. The church is a ſpacious ſtructure, with a nave, chancel, two aiſles, and an embattled tower: the body of the church is alſo ornamented with battlements and pinnacles. The old church ſtood at the weſt end of the town; but having fallen to decay, the preſent fabric was begun in the reign of Henry VI. by the abbot, William Winchcombe, who completed the eaſt part: the remainder was finiſhed by the pariſhioners, aſſiſted by the munificence of Ralph Boteler, lord Sudeley. The government of the town, which is a borough by preſcription, is veſted in two bailiffs and ten aſſiſtants; from the latter, the bailiffs are annually choſen. A weekly market is held on Saturdays, and here are three annual fairs, which are well attended; but from the recluſe ſituation of the town very little trade is carried on, a paper-mill and a tan-yard being the chief ſources of employ. The workhouſe is an ancient irregular building, in which the poor are employed in ſpinning and weaving linen. Here are alſo an alms-houſe for twelve poor women, and three charity-ſchools. The population of the town in the year 1811, according to the return to parliament, was 1256, occupying 299 houſes: the pariſh extends twelve miles in circumference, and includes nine hamlets; the enumeration of the whole was 461 houſes, and 1936 inhabitants.

About a quarter of a mile to the ſouth-eaſt of the town are the ruins of Sudeley-caſtle, erected by Ralph, lord Boteler, an eminent ſtateſman in the reign of Henry VI., on the ſcite of a more ancient caſtle which appears to have been the reſidence of Herald, ſon to Radulf, earl of Hereford, in the time of the Norman conqueror. In this family, which aſſumed the name of Sudeley, the manor continued till the 41ſt of Edward III., when it was conveyed by marriage. Sudeley was attached to the crown till the reign of Edward VI. when it was granted to ſir Thomas Seymour, who ſettled here with Catharine Parr, the queen-dowager, whom he had married, and who died here in child-bed, not without ſuſpicion of poiſon. Seymour being afterwards attainted, Sudeley was granted to William Parr, marquis of Northampton, who forfeited it ſoon afterwards. It now belongs to the marquis of Buckingham. Of this once-famed fortreſs, very little remains: parts of towers, the hall, and the chapel, ſerve to ſhew the ſtyle of architecture and character of the buildings.—See Williams's Hiſtory, &c. of Sudeley Caſtle, folio. Alſo Beauties of England and Wales, vol. v. by J. Britton and E.W. Brayley.

WINCHELSEA, a borough and market-town on the coaſt of Suſſex, England, ſituated about 3 miles W. from Rye, 8 E. from Haſtings, and 67 from London. It is a member of the Cinque Ports, and an incorporated town, the officers of which conſiſt, according to its charters, of a mayor and twelve jurats; but theſe are ſeldom compoſed of more than four or five perſons. Winchelſea is a place of antiquity; but by the ravages of the ſea, the ſcites of its houſes, at different periods, have totally changed. The epoch of the rapid though gradual overthrow of the original town is fixed by Leland between 1280 and 1287. During that time the inhabitants petitioned Edward I. for ground to found another town, who accordingly granted them the ſcite of the preſent town, which he ſurrounded with walls, and to it the inhabitants gradually removed. The new town afterwards fell into decay, from a cauſe juſt the reverſe of that which ruined the old; for the ſea deſerted its neighbourhood, and left in its place a dreary marſh. This began to be ſenſibly felt in the end of the reign of queen Elizabeth. The channel leading to the harbour was choaked, the coaſt was deſerted, and the town, abandoned by the trader, ſoon declined. The houſes and churches fell to ruin, ſo that a town, once covering a ſurface two miles in circuit, is now reduced to comparatively a few houſes in a corner of its ancient ſcite, now a mile and a half from the ſea. Of the ancient church, the lofty and ſpacious chancel, now uſed for divine ſervice, and three aiſles, alone remain entire. In it are two monuments, with effigies of knights templars. Some fragments of the walls and of three gates of the town ſtill exiſt. From the ſituation of Winchelſea, and the ſpacious vaults frequently diſcovered, it is probable that the town was the principal mart for French wines, imported into England before the wine-trade with Portugal was eſtabliſhed. Winchelſea ſends two members to parliament, who are elected by about forty freemen. The houſes in this pariſh, in 1811, were 126, containing 131 families, and 652 perſons.—Beauties of England, vol. xiv. 8vo. 1813, Suſſex, by F. Shoberl.

WINCHELSEA *Iſland*, an iſland in the Pacific ocean; 30 miles S.E. of ſir Charles Hardy's iſland.

WINCHENDON, a town of the ſtate of Maſſachuſetts, in the county of Worceſter, with 1173 inhabitants; 56 miles N.W. of Boſton.

WINCHESTER, an ancient and eminent city in Hampſhire, or the county of Southampton, in England, 11 miles N.N.E. from Southampton, and 62½ W.S.W. from London. The buildings are diſpoſed on the eaſtern declivity of a low hill, which gently ſlopes to the valley of the river Itchen, the chalky cliffs of which, and the chalky ſoil of the ſurrounding heights, in the opinion of Camden, occaſioned the ancient name of the city, *Caer-Gwent*, ſignifying the 'white city.' The latter portion of the name, under

under the Romans, became *Venta*, with the addition of *Belgarum*, from its ſituation in the country occupied by the *Belgæ*, by which it was diſtinguiſhed from *Venta Silurum*, now Caerwent, in Monmouthſhire, and *Venta Icenorum*, now Caſtor, near Norwich, in Norfolk. From *Gwent* or *Venta* we have the firſt part of the name, and *cheſter*, the laſt part, is a corruption of *caſtra*, the Roman term for encampments of different kinds; a frequent name, or appendage of a name, of various places in England, and perhaps invariably an indication that ſuch places owe both their origin and their primitive form to the military ſtations of the earlieſt conquerors of Britain.

Hiſtoric Events.—The origin of Wincheſter, remote as it unqueſtionably is, has been carried back to an epoch far beyond belief, even a century and half anterior to the foundation of Rome. Without referring to ſuch remote and uncertain time, we may ſafely infer that this ſpot was occupied by the Belgæ, a Germanic tribe, who paſſing from Gaul, took poſſeſſion of the country bordering the ſouthern coaſt of England. (Cæſar's Bel. Gal. ii. 4.) Previous to their occupancy, it is conjectured that Wincheſter was the Caer-Gwent, or white city, of the aboriginal Britons. After the Romans had ſubdued the Belgæ and the Britons, they took poſſeſſion of this town, and fortified it with ramparts and walls. Theſe were diſpoſed on the ſloping ſide of a hill, and in the uſual form of a parallelogram. Within this incloſure the town was conſtructed and arranged; and from the importance of this ſtation, and its connection with other ſtations by military roads, there can be little doubt that *Venta Belgarum*, the Roman name, was a place of conſiderable importance. Among the antique relics of the Romans, which have been diſcovered at Wincheſter, are ſeveral coins, urns, &c.; alſo ſome fine coins of Caractacus, called the firſt Britiſh emperor. After the Romans left the iſland in 446, Gortheryn, or Vortigern, was elected chief of the weſtern diſtrict, and he fixed his ſeat of government at Wincheſter. This town, as well as the whole iſland, was ſoon deſtined to experience a total change of polity, cuſtoms, and manners, by the introduction and domination of the Saxons in 519. On this occaſion, the name of the city was changed from the Britiſh Caer-Gwent and the Roman Venta to another of equal import, *Wintan-ceaſter*, from which the modern name, Wincheſter, has gradually been formed. In 635 an important event occurred in Wincheſter, the arrival there of Birinus, deputed by pope Honorius to preach the goſpel in thoſe parts of the country ſtill involved in paganiſm. Favoured by king Kinegils, Birinus's apoſtolic labours were eminently ſucceſsful; for the king founded a new cathedral on the ſcite of that deſtroyed under Diocletian, which was conſecrated under his ſon and ſucceſſor, Kenewalch, in 648. Egbert, king of the Weſt-Saxons, ſucceeding in the ſubjection of all the other Saxon princes, was in 827 crowned king of all England in the cathedral of Wincheſter, thus created or conſidered to be the metropolis of the whole kingdom; and there, about 854, Egbert's ſucceſſor, Ethelwolf, granted his famous charter, eſtabliſhing a general ſyſtem of tythes. About this period the commerce of the city is recorded to have greatly increaſed, and the principal inhabitants are ſtated to have conſtituted a guild, under the royal protection; the earlieſt aſſociation of the kind, by a century, recorded in hiſtory. During the greater part of this and the ſucceeding reign, the ſee of Wincheſter was filled by the celebrated St. Swithun, by whoſe advice king Ethelbald raiſed fortifications for the defence of the cathedral againſt the Danes. Landing at Southampton, they advanced to Wincheſter, where they committed horrible exceſſes; but the cathedral eſcaped their fury. About 871, however, that greatly ſuffered by them, and all the clergy belonging to it were maſſacred. On the ultimate ſucceſs of the great Alfred, Wincheſter reſumed a portion of its former ſplendour; it became again the ſeat of government; there the public records of the kingdom were depoſited, in particular the general ſurvey, called, from this circumſtance, *Codex Wintonienſis*, afterwards imitated by William the Conqueror in 1086, in the famous Roll of Wincheſter, or *Domeſday-book*. (See DOMESDAY.) The ſucceſſion of Edgar the Peaceable increaſed the importance of Wincheſter. Among the judicious laws which he eſtabliſhed was one to prevent frauds ariſing from the diverſity of meaſures uſed in the country, by providing a ſtandard legal meaſure for the whole of his dominions. This was the origin of the eſtabliſhed *Wincheſter meaſures;* the ſtandard veſſels for meaſurement made by Edgar's orders being depoſited in that city, where the original buſhel is ſtill preſerved. In the reign of this prince, in 980, the cathedral, having been partly rebuilt, was ſolemnly re-conſecrated. About the ſame time the married canons of the cathedral were, at the ſuggeſtion of St. Dunſtan, removed, to make room for Benedictine monks. In Wincheſter, in 1002, and in the reign of Ethelred, ſurnamed the Unready, commenced the general maſſacre of the Danes, in mercileſs vengeance for the atrocities they had committed on the inhabitants of the country. Thence aroſe the noted *hock-tide ſports*, of which ſome traces may ſtill be obſerved in remote corners of England. But this vengeance remained not long unrequited by Swayne the Dane, who obtained poſſeſſion of Wincheſter eleven years afterwards. St. Elphage II., then biſhop, is ſaid to have firſt introduced organs into the cathedral. Canute, obtaining the ſovereignty of England by the death of Edmund Ironſide in 1016, choſe Wincheſter for his capital, and, with other rich gifts, beſtowed on the cathedral his crown, which was placed over the crucifix on the high altar: for Canute had vowed never more to wear that enſign of royalty, from the day when, by commanding in vain the flowing tide not to approach his feet, he proved to his flatterers the emptineſs of their adulation, in hailing him lord of the ocean. Wincheſter cathedral is deſcribed to have been the ſcene of a legendary tale relating to queen Emma, mother of Edward the Confeſſor, who is ſaid, but very improbably, there to have eſtabliſhed the purity of her character, by walking unhurt over nine burning plough-ſhares. In the reign of the ſame Edward, the broad ſeal of the chancellor of England was firſt made and kept in Wincheſter.

The Norman invaſion produced many changes in the ſtate of the city: there king William I. founded a caſtle, as he did in many other parts of the kingdom, with the view of overawing, under the pretence of protecting, the inhabitants. It continued, however, to be a principal royal reſidence, although London then began to aſſume the pre-eminence. The politic monarch knew the influence of the clergy over the people; he conſequently aſſigned all or moſt of the chief offices in England to his relatives, dependants, and oſtenſible friends. Councils were held in Wincheſter, in which the new clergy, with the primate Lanfranc at their head, drew up canons or laws levelled at the Saxons, and framed to protect or juſtify themſelves. Wincheſter, the reſidence of the court, was of courſe filled with the prieſts, the officers, and the followers of the king. The curfew (*couvre-feu*), or eight-o'-clock-bell, was firſt rung in Wincheſter. The year 1079 is memorable in the hiſtory of Wincheſter, for then was commenced the preſent ſpacious and magnificent cathedral church. In the reign of Henry I. a ſingular tranſaction is recorded to have taken place in Wincheſter. The current coin of the realm having been greatly debaſed by the different mint-maſters, the king in 1125 aſſembled them in this city, when all, except three who dwelt in Wincheſter, were found guilty and ſeverely puniſhed. The baſe money was cried down, and an entirely new coinage ordered to be made by the three maſters who had preſerved their honeſty. About the ſame period Henry cauſed to be made a ſtandard yard, from the length of his own arm, in order to prevent frauds in the meaſurement of cloth. This ſtandard is ſuppoſed to have been depoſited with other meaſures, &c. in Wincheſter. The city ſuffered greatly in the diſſenſions conſequent on the death of Henry, by the ſtruggle between his nephew Stephen and his daughter, the empreſs Matilda, or Maud. Stephen's party held the biſhop's palace, the cathedral, and adjoining quarters, while Maud's poſſeſſed the caſtle and the remainder of the city. By fire from Stephen's party, the whole north portion, then the moſt populous, the royal palace, the abbey of St. Mary, and twenty churches, the magnificent monaſtery of St. Grimbald, the ſuburb of Hyde, &c. were deſtroyed. Many privileges were conferred on Wincheſter by Henry II., in particular, in 1184, that of being governed by a mayor, with a ſubordinate bailiff. His ſucceſſor, Richard Cœur-de-lion, was ſolemnly re-crowned in the cathedral in 1194, on his return from captivity under the duke of Auſtria. In the end of 1207 was born in Wincheſter Henry III.; and ſoon afterwards his father John, for the ſum of 200 marks paid at once, and 100 marks *per annum*, conferred on the city all the great and unprecedented privileges of a corporation. Thus Wincheſter became the firſt of all the corporate cities or towns in the kingdom, nearly two years before London had even obtained the privilege of being governed by a mayor. The dignity of the city was in ſome meaſure reſtored by the reſidence of Henry III. during his minority; but it again ſeverely ſuffered in the conteſts between the king and the barons. A heavy blow on Wincheſter proceeded from the removal of the royal reſidence, in the reign of Edward I.; who nevertheleſs held ſeveral parliaments there. Under Edward III. it was conſtituted one of the fixed markets, or ſtaples for wool; but by the removal of the ſtaple in 1363, the decline of Wincheſter from commerce and wealth was ſenſible and uniform. In this reign the rebuilding of the nave of the cathedral was begun by biſhop Edington; but the honour of completing it, with material alterations, was reſerved for his celebrated ſucceſſor, William of Wykeham. To Wincheſter Henry VI. was a conſiderable benefactor; for in his reign it was ſo reduced in trade and population, that the inhabitants, in a petition to the king, repreſented 997 houſes to be unoccupied, and 17 churches ſhut up. The ſee of Wincheſter was held for a ſhort time by cardinal Wolſey; but in the time of his ſucceſſor, Gardiner, the final diſſolution of the monaſteries, and the conſequent deſtruction of religious houſes, reduced the city to be little more than the ſkeleton of what it had formerly been. It revived for a ſhort time in the reign of Mary, who there ſolemnized her union with Philip of Spain, and reſtored to the ſee many lands which had been alienated by her father and brother. The city itſelf, however, had, as appears by a charter of Elizabeth, fallen "into great ruin, decay, and poverty." The commencement of 1603 was diſtinguiſhed by the proclamation of James I. in Wincheſter, by the ſole authority of the ſheriff of the county, without waiting for the orders of the privy council in London, who had paſſed ſeveral hours in deliberation on the ſubject. In the civil wars of Charles I.'s time, Wincheſter was ſucceſſively held by the oppoſite parties; but after the fatal battle of Naſeby in 1645, it was finally reduced by Cromwell. The works of the caſtle were blown up, the fortifications of the city were deſtroyed, together with the biſhop's caſtle of Wolveſey, and ſeveral churches, and other public buildings. During the latter part of the reign of Charles II. Wincheſter had a proſpect of recovering ſome portion of its former ſplendour; for he choſe it for his uſual reſidence, when not required by preſence in the capital. In imitation of his example, many of the nobility and gentry likewiſe erected manſions in the city; but by Charles's death in 1685, the project was laid aſide; the palace was left unfiniſhed; and ſo completely has its original deſtination ſince been changed, that, after being frequently uſed as a priſon of war, it is now converted into military barracks for the diſtrict.

Fortifications: Palace.—The ancient walls of Wincheſter form an irregular parallelogram, incloſing a portion of the ſlope of the weſtern hill, and of the level valley watered by the Itchen. But the walls are now nearly deſtroyed, and the foſs in many places filled up. The four gates ſeemed to have been conſtructed where thoſe of the Roman intrenchment were opened. Through two of them, on the north and ſouth ſides, paſſed the great Roman road communicating between *Vindonum*, now Silcheſter, and *Clauſentum*, near Southampton. Through the gate in the weſt ſide of the incloſure, correſponding to the Prætorian gate of the intrenchment, ran the road communicating with *Sorbiodunum*, where now ſtand the remains of Old Sarum. This gate ſtill exiſts, but much altered from its ancient ſtate: part of it is ſuppoſed to be coeval with the city walls, but the whole weſtern face diſplays workmanſhip of much later date. The eaſt or Decuman-gate opened acceſs to the lively and wholeſome waters of the Itchen.

The caſtle, now entirely deſtroyed, overlooking the city from the weſt, owes its origin to the ſyſtem of dominion adopted by William of Normandy. Within its boundary, of an elliptic form, 850 feet from north to ſouth, and in its greateſt breadth 250 feet from weſt to eaſt, ſtands the original chapel dedicated to St. Stephen, and apparently erected by the king of that name. It is in length 110 feet, divided into a nave and ſide-aiſles. At the eaſt end is ſuſpended the antique curioſity called king Arthur's round-table; but with more accuracy attributed to king Stephen, and probably introduced by him to prevent diſputes for precedency, during their entertainments, among the chivalrous champions of that age. It is 18 feet in diameter, compoſed of ſtout oaken planks, painted with the figure of the renowned Arthur, and the names of his twenty-four knights, as collected from the romances of the 14th and 15th centuries. The coſtume is, however, of the time of Henry VIII., when the table was painted. This chapel was, in Cromwell's time, converted into a county-hall, a deſtination to which it continues to be applied. In the year 1792, ſeveral thouſands of French eccleſiaſtics ſought refuge on the Britiſh ſhores. In their deſtitute ſituation, they were generouſly ſuccoured by the ſtate and the people; and at one time one thouſand of them were accommodated with lodgings, and all other neceſſaries, in this deſerted abode of royalty.

Wincheſter poſſeſſed alſo another fortreſs at the oppoſite end of the city: this was Wolveſey caſtle, the epiſcopal reſidence erected by the powerful biſhop Henry de Blois, brother of king Stephen.

Cathedral.—The grand object of attraction in Wincheſter is its cathedral, one of the moſt intereſting ſtructures of its kind in England, whether conſidered with reſpect to the antiquity of its foundation, to the importance of the tranſ-

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actions of which it has been the fcene, or to the characters of the perfonages whofe mortal remains it contains. This magnificent and venerable ftructure has been called, and not without fome propriety, a fchool of ecclefiaftical architecture; for it difplays to the ftudent an interefting and varied feries of examples of the ancient architecture of England, from an early age down to a recent period. If the ftudent fail to fatisfy himfelf as to Roman remains, or genuine Saxon work; if, after careful examination, he retire either doubtful or perfuaded that no fuch architecture is there to be difcovered; ftill he will have ample evidence and examples of Norman works. The plans and magnificent defigns of thofe proud invaders and innovators are in that fabric amply difplayed. There he will fee that the Normans built not for themfelves only, but for pofterity; that their edifices were folid and fubftantial, fimple in their forms, and large in their parts; that as their fyftem of religion was intended to awe, terrify, and foothe the mind, fo its primary temple in England was calculated moft effentially to promote thofe ends.

The cathedral of Winchefter is of great extent, its extreme external length being 556 feet, that of the crofs or tranfepts 230 feet; the external breadth of the whole body and choir 118 feet, and that of the tranfepts 88 feet. The body of the church is divided by ranges of cluftered columns into a nave and two fide-aifles, as are alfo the tranfepts, with the unufual addition of aifles at the extremities. The great central tower refts upon four piers of great folidity, and rifes 140 feet from the pavement. The prefent fabric may be confidered as the foundation of bifhop Walkelyn, a chaplain and relative of William of Normandy, who began it in 1079, conftructing the crypts, the tranfepts, and tower; alfo the internal parts of the piers and walls of the nave. The work was continued under fucceeding prelates, in particular by bifhop de Lucy, who built part of the eaft end; by Edington, who erected the weft front about 1330; and above all by Wykeham, who, between 1370 and 1400, brought the nave to completion. The exterior of the cathedral prefents but few beauties, or attractive features. Its length of nave, plainnefs of mafonry, fhortnefs and folidity of tower, width of eaft end, and boldnefs of tranfepts, furnifh, however, fo many peculiar and fpecific characteriftics. The interior of the cathedral will amply compenfate for any defects or deficiencies of the outfide. While the fine and fublime architecture of Wykeham, in the nave and aifles, produces the moft impreffive effect, and claims general admiration; the large, plain, and fubftantial works of Walkelyn, in the tower and tranfepts, are fimply grand and impofing. The tranfepts and tower are entitled to attention, as unrivalled fpecimens of Norman architecture. The choir and eaftern end are elevated above the nave and aifles, by an afcent of feveral fteps; the choir itfelf occupying the fpace moftly beneath the Norman tower, and fitted up with ftalls of elaborate workmanfhip. On the north fide ftands the pulpit, curioufly carved in the time of Silkftede, who became prior in 1498. On the fame fide of the choir is placed the organ, in an unufual fituation, under one of the lofty arches of the tower. The choir is feparated from the nave by a fcreen of the Compofite or Roman order of architecture, faid to have been defigned by Inigo Jones. The lofty ftone fcreen erected behind the high altar is an elaborate and fumptuous work, covered with niches, canopies, buttreffes, pinnacles, crockets, pediments, &c.; and when in its original colour and condition, with ftatues and coftly ornaments, muft have been peculiarly fplendid and beautiful. On entering the church by the weft door, the attention is firft arrefted by the vaft and lofty columns of the nave, which have been made to affimilate with the pointed ftyle, by furrounding them with cluftered fhafts and other ornaments. Between the fifth and fixth columns, on the fouth fide, ftands the chantry or mortuary chapel, containing the tomb of bifhop William of Wykeham, erected in his life-time, or prior to the clofe of the year 1404. On an altar-tomb within the chapel is the marble effigy of the founder. On the fame fide of the nave is the chantry of bifhop Edington, who died in 1366; within an open fcreen is an altar-tomb fupporting his effigy. Immediately behind the altar-fcreen in the fouth aifle is placed the fumptuous chantry of bifhop Fox, containing neither tomb, ftatue, nor infcription, to commemorate the founder, or to explain his works in the church. In a recefs beneath is the effigy of an emaciated human figure, the head ornamented with a mitre, but the feet refting on a fkull. Oppofite to this chantry in the north aifle ftands that of bifhop Gardiner, who died in 1555. Towards the eaftern extremity of the church are the chantries of cardinal-bifhop Beaufort on the fouth fide, and of bifhop Waynflete, the munificent founder of St. Mary's college, Winchefter, and Magdalen college, Oxford, on the north fide; each containing the tombs and figures of the refpective prelates. The eaftern extremity of the church is terminated by the fpacious Lady-chapel, with a fmaller inclofed on each fide. In the middle of the prefbytery, between the choir and the altar, lies a coffin-tomb, faid to cover the remains of William Rufus, who was killed while hunting in the New Foreft, and buried in this cathedral in 1100. On the top of the fide-fcreens, between the prefent choir and the aifles, are placed fix wooden chefts, the work of bifhop Fox, containing memorials and relics of Saxon monarchs, princes, and other illuftrious perfonages, former protectors and benefactors of the cathedral. Another object of undoubted antiquity is the curious font, now placed between two columns on the north fide of the nave. It is a large fquare block of black marble, charged on each fide with fculptures, the whole fupported by fmall columns at the corners. The fubject of the fculptures is a matter of difpute; and although as productions of art they are beneath criticifm, yet as reprefentations of coftume, manners, implements, &c. they deferve particular attention.

Epifcopal Caftle, or Palace.—Of this ftructure, better known by the name of Wolvefey caftle, the ruins fhew it to have been an imperfect parallelogram of about 250 feet by 160. What ftill remains belonged to the keep. Much was removed to make way for the new palace erected by bifhop Morley, under the fuperintendance of fir Chriftopher Wren, after its deftruction by Cromwell. The front of Morley's palace was pulled down by the prefent bifhop, who never occupies the prefent houfe.

College.—One of the moft celebrated inftitutions of Winchefter is the college, founded by bifhop Wykeham, and completed in 1393, on the fcite of an ancient grammar-fchool; intending it as preparatory for his eftablifhment of New college, Oxford. The eftablifhment in Winchefter confifts of a warden, 70 fcholars, 10 fecular priefts, who are perpetual fellows, 3 priefts' chaplains, 3 clerks, 16 chorifters, and a firft and a fecond mafter. So judicious and complete were the ftatutes drawn up by Wykeham for the government of his college in Winchefter, as to be adopted, with very little alteration, by Henry VI., for his own fplendid inftitutions at Eton and King's college, Cambridge. On the confirmation, by Edward VI., of the general diffolution of colleges, &c. introduced by his father, Winchefter college, with thofe of Eton and the univerfities, were fpecially excepted. The buildings of the college occupy a confiderable extent of ground, and confift principally

cipally of two courts, with a cloifter. The entrance to the firft court is under a fpacious gateway, having the mutilated bufts of a bifhop and a king, to reprefent the founder and his royal patron, Edward III. The fecond court is alfo entered by a tower gateway. The chapel and hall form the fouth wing of the quadrangle, and are enlightened by lofty windows. The interior of the chapel has a fine and lofty vaulting, ornamented with tracery. In the centre of the cloifter is the library, originally conftructed for a chantry in 1430, but converted to its prefent ufe in 1627. In the fouth-weft corner of the fecond court is the hall or refectory, between which and the paffage to the chapel is the fchool, a plain brick building, erected by fubfcription in 1687; over the door is the ftatue of the founder in bronze, by Cibber.

City.—The prefent city of Winchefter confifts chiefly of one main ftreet, extending from the weft to the eaft, with a number of collateral ftreets and lanes branching off on each fide. Towards the middle of the High-ftreet ftands the city crofs, an elegant fpecimen of the ftyle of the age of Henry VI., confifting of three ftories adorned with open arches, niches, pinnacles, and fmall croffes. The ecclefiaftical buildings in Winchefter, and its fuburbs, were once very numerous, and, according to fome writers, amounted to upwards of ninety. Scarcely twelve now remain. St. Laurence's church, near the crofs, is confidered as the mother-church of the city, and by a folemn entry into it the bifhop takes poffeffion of his fee; but the principal parochial church is now that of St. Maurice. The town-hall, or more properly the hall of the guild of merchants of Winchefter, rebuilt in 1713, occupies the place of one erected about 1112. There the city archives, the original Winchefter bufhel of king Edgar, and other meafures of length and capacity fixed as ftandards by fucceeding princes, and various curious memorials of antiquity, are now preferved. The front of the building is ornamented with a ftatue of queen Anne. A neat market-houfe was erected in 1772. The ancient building on the north fide of the High-ftreet, called St. John's Houfe, was originally founded as an hofpital, apparently fo early as in the 10th century; but falling into the poffeffion or the adminiftration of the knights templars, or of St. John of Jerufalem, it was on the fuppreffion of their order granted by Edward II. to a citizen of Winchefter, who refounded the inftitution for the fick and lame foldiers, pilgrims, and wayfaring men, to have their lodging and diet there gratis for one night or longer, as their inability to travel might require. At the general diffolution of hofpitals and monafteries, the revenues and moveable property were feized by Henry VIII.; but the corporation of the city referved the building itfelf to be ufed for municipal bufinefs. In 1554 it again became a charitable foundation, being endowed by Richard Lamb, efq. for the fupport of fix widows. The principal chamber or hall, which is 62 feet in length, 38 in breadth, and 28 in height, has been handfomely fitted up, chiefly by a donation from the late colonel Brydges of Avington. Among the decorations of this hall, in which public feafts, mufic-meetings, and affemblies are held, is a whole-length picture of Charles II. by Lely, prefented to the city by that king himfelf. In the adjoining council-chamber are fufpended the city tables, as they are called, containing a chronological arrangement of the moft remarkable occurrences relating to Winchefter. The ancient chapel of the hofpital is now ufed as a free-fchool. The celebrated monaftery founded by the great Alfred, called the 'Newen Mynftre,' and afterwards Hyde abbey, occupied nearly the whole fpace between the cathedral and the High-ftreet. Completed under his fon Edward, it was firft filled by canons regular, who, in 963, gave place to Benedictine monks. Alwyn, the eighth abbot, with twelve of his monks, fell in the battle of Haftings, in fupporting the caufe of his nephew, Harold, which drew upon the abbey the vengeance of William of Normandy. But the pofition being unhealthy and inconvenient, a new and magnificent church and monaftery were erected juft without the north wall of the city, on the fpot called Hyde-meadow, to which the monks removed in 1110, carrying with them the remains of feveral illuftrious perfonages who had been buried in the former abbey, among which were thofe of Alfred himfelf and fome of his defcendants. The annual revenues of Hyde abbey, of which the abbot fat in parliament, were at the diffolution valued at 865*l.* 18*s.* The church and monaftery were foon afterwards demolifhed, and even the tombs of Alfred and other eminent perfons were defpoiled. What now remains of this inftitution is the fmall and mutilated parifh-church of St. Bartholomew. Precifely on the fpace occupied by the abbey-church was fome time ago erected a bridewell, or houfe of correction, on the plan of the benevolent Howard. In digging the foundations, ftone coffins, rings, and veffels for the fervice of the church, were difcovered, together with fragments of architectural fculpture. But between fifty and fixty years ago, among the remains of the buildings, was found a ftone with this infcription in Saxon characters, 'Alfred Rex DCCCLXXXI.' Another remarkable religious eftablifhment in Winchefter was the Nunna Mynftre, or abbey of St. Mary, founded by Alfred's queen, Alfwitha, and the place of her retirement after his death. Scarcely any veftige of the conventual buildings now remain, excepting in a modern manfion built out of the ancient materials, and the name of the abbey ftill applied to the inclofure where it ftood.

Winchefter, befides the numerous churches of the eftablifhment, contains meeting-houfes for diffenters of various denominations, among which the principal building is the Roman Catholic chapel, rebuilt by Dr. Milner in 1792, on the foundations of one more ancient. A large and commodious county-gaol, from the defigns of Mr. Moneypenny, has been lately erected on the north fide of the city.

Many privileges have at various times been beftowed on Winchefter by Englifh fovereigns. Its chief magiftrate, as was before noticed, received the title of mayor in 1184, fome years before the title was granted to the chief magiftrate of London. The firft charter was conferred by king John; but that under which the city is now governed was the gift of Elizabeth, "in confideration," as it is ftated, "of the city of Winchefter having been moft famous for the celebration of the nativities, coronations, fepulchres, and for the prefervation of other famous monuments of the queen's progenitors." By this charter, the government is vefted in a mayor, recorder, fix aldermen, a town-clerk, two coroners, two conftables, and a council of twenty-four of the "better, difcreeter, and more honeft fort" of inhabitants. The firft return of reprefentatives to parliament for Winchefter took place in the twenty-third year of Edward I. The right of election is vefted in the corporation.

Winchefter poffeffes very little trade but what arifes from its fituation in the centre of an extenfive and populous county. An ancient wool-combing manufactory, however, is ftill in exiftence, and of late years the filk manufacture has been introduced. All the public bufinefs of Hampfhire is tranfacted in Winchefter, which occafions a frequent and ample influx of ftrangers from all quarters. The cathedral and the college fecure to the city the refidence of a number of fuperior clergy. When in the height of its profperity, and poffeffing the benefit of the wool-ftaple, the wealth of the inhabitants was greatly increafed by the multitudes

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tudes reforting to its fairs, the principal of which was held on the neighbouring hills of St. Giles and St. Mary Magdalen. St. Giles's fair was, at one time, by far the greateft in England. By a grant from William the Conqueror, it was originally to be held for one day only; but by Henry II. its duration was enlarged to fixteen days; and in that time no mercantile bufinefs was permitted to be tranfacted in Southampton, nor in any other place within feven leagues of St. Giles's hill. This fair has long become very infignificant; that of St. Mary Magdalen is ftill, however, much frequented. Since the year 1770, various improvements have been made in the general appearance of the city, by paving, repairing, and cleanfing. As early as 1736 was eftablifhed in Winchefter an hofpital or infirmary for the county, a very ufeful inftitution, conducted on a plan judicious in itfelf, and honourable to thofe entrufted with its adminiftration. According to the parliamentary returns of 1811, the number of houfes compofing the city and fuburbs was 1134, and the inhabitants 6705.

Hofpital of St. Crofs.—About a mile fouth from Winchefter, in the valley watered by the Itchen, ftands the venerable hofpital of the holy crofs; an inftitution ftill retaining more of its original character. "The lofty tower," obferves Dr. Milner, "with the grated door and porter's lodge beneath it, the retired ambulatory, the feparate cells, the common refectory, the venerable church, the flowing black drefs, and the filver crofs worn by the members, the conventual appellation 'brother' with which they addrefs one another, the filence, the order, the neatnefs, in fhort, that reign here, feem to recall the idea of a monaftery to thofe who have feen one, and will give no imperfect idea of fuch an eftablifhment to thofe who have not had that advantage." But this eftablifhment was never a monaftery, being only an hofpital originally founded by bifhop Henry de Blois, between 1132 and 1136, for the refidence and maintenance of thirteen poor men, and the relief of a hundred others of the moft indigent of the city, but of creditable character. Each of thefe was to be provided daily with a loaf of bread, three quarts of fmall beer, and two meffes for his dinner, in a hall appointed for the purpofe. In the hofpital was an endowment for a mafter, a fteward, four chaplains, thirteen clerks, and feven chorifters. Before the time of William of Wykeham, bifhop of Winchefter in 1366, the revenues of St. Crofs had been employed in a way very different from the intentions of the founder; but that munificent prelate fucceeded, after long litigation, in reftoring the inftitution to its original ufes, re-eftablifhing it on a fecure and well-ordered foundation. The plan was afterwards refumed and enlarged by cardinal-bifhop Beaufort, for the additional fupport of two priefts and thirty-five refident poor men: he alfo rebuilt a confiderable portion of the hofpital. The prefent eftablifhment of St. Crofs is but the wreck of its ancient inftitutions, having been feverely fleeced, though not quite deftroyed, like many other charitable eftablifhments, at the Reformation. Inftead of feventy refidents, clergy and laity, entirely fupported in the place, and one hundred outpenfioners, the inftitution at prefent confifts of but ten refiding brethren, and three out-penfioners, with one chaplain and the mafter. Certain doles of bread, it is true, continue to be diftributed to the poor of the neighbourhood; and, as perhaps the only veftige remaining in the kingdom of the fimple hofpitality of ancient days, the porter is daily furnifhed with a certain quantity of good bread and beer, of which every traveller, or other perfon whatever, who knocks at the lodge and calls for relief, is entitled to partake gratuitoufly. The buildings of the hofpital once compofed two courts; but the fouth fide of the interior quadrangle has been of late years pulled down. On the eaft fide of the outer court is the 'hundred-menne's hall,' about forty feet long, now converted into a brewhoufe; on the fouth fide is the handfome tower-gateway, with the ftatue of the founder, Beaufort, in the upper part. In the fecond, or inner court, is the church, built in the cathedral form, with a nave and tranfepts, and a low maffive tower at their interfection. The architecture of the edifice is fingularly curious, as it throws fome light on the progrefs, if not on the origin, of the pointed, or Englifh ftyle. The whole edifice feems to be a collection of architectural effays, with refpect to the form and the difpofition, of both the effential parts and the fubordinate ornaments. It prefents the ponderous pillar of a height equal to its circumference, but fupporting an incipient pointed arch. The lower part of the nave contains maffive Norman pillars; and the portal of the weft front is an elegant fpecimen of the time of king John, or beginning of that of Henry III. The weft wing of the remaining buildings contains the apartments of the Brethren, each of whom has for his own ufe three chambers and a feparate garden. Adjoining to the hall on the north fide are the apartments of the mafter, which are fpacious and convenient; and on the eaft fide is the ambulatory or open portico for exercife.

St. Catherine's Hill, or College Hill, feparated from the meadows of St. Crofs by the branches of the Itchen, is remarkable for the intrenchment carried round its fummit: the former name it acquired from an ancient chapel on it, deprived of its endowments by cardinal Wolfey; the latter, becaufe it is a frequent place of refort for the ftudents of the college.

About three miles north-eaft from Winchefter is Avington, anciently Abyngton, a feat and manor of the prefent marquis of Buckingham, in confequence of his marriage with the fole daughter and heirefs of James, the laft duke of Chandos. The manor, originally a royal demefne, was granted, in 961, by king Edgar to the monaftery of St. Swithun, in Winchefter; but in confequence of the diffolution, it became, in the reign of Elizabeth, the property of the ancient family of Bruges, or Brydges, firft fettled in Shropfhire at the Conqueft. Inter-marrying with the family of lord Chandos, renowned in the wars in France under Edward III., the honours of the two families have ever fince continued united. Avington is fituated in a fecluded valley, well planted and nearly inclofed by high downs. The prefent manfion is moftly of brick, and has been greatly improved by the prefent poffeffor, having been previoufly difmantled by the late duke, for the purpofe of adding two wings. Some of the apartments are fitted up with great elegance, and enriched by a felection of excellent paintings. The park formed by the late duke, about three miles in circumference, contains a piece of water fupplied by the river Itchen.—Hiftory, &c. of Winchefter, by the Rev. John Milner, D.D. F.S.A., 2 vols. 4to. 2d edit. 1809. Beauties of England, vol. vii. Hampfhire, by J. Britton and E. W. Brayley. Hiftory, &c. of Winchefter Cathedral, by J. Britton, 1 vol. 4to. with 30 Prints.

WINCHESTER, a town of New Hampfhire, in the county of Chefhire, with 1478 inhabitants; 13 miles S.E. of Chefterfield.—Alfo, a town of the ftate of Connecticut, in Litchfield county, with 1466 inhabitants; 22 miles N.W. of Hartford.—Alfo, a town of the ftate of Kentucky, with 4 churches, and 2000 inhabitants.

WINCHESTER, or *Fredericktown*, a town of Virginia; 56 miles W.N.W. of Wafhington. N. lat. 39° 15′. W. long. 78° 22′.

WINCING, in the *Manege*, is faid of a horfe when he kicks, fpurs, or throws out his hind feet.

WINCKHEIM, in *Geography*, a town of the duchy of Wurzburg; 4 miles N.N.W. of Lauringen.

WINCRANTUM, in *Natural Hiſtory*, a name given by the people of the Eaſt Indies to a foſſile ſubſtance reſembling, in ſome degree, the plated lead ores of Europe, but containing very little of that metal; it is properly a ſpecies of blende, or mock-lead, of a talcky appearance; it is conſiderably hard, and is uſually found in other ſtones. It is given in medicine in the Indies as a provocative to venery, being firſt calcined and beat to powder.

WIND, Ventus, a ſenſible agitation of the air, by which a large quantity of it flows in a current or ſtream out of one place, or region, into another. See Meteorology.

The winds are divided into *perennial*, *ſtated*, and *variable*. They are alſo divided into *general* and *particular*.

Winds, *Perennial* or *Conſtant*, are ſuch as always blow the ſame way.

Of theſe we have a very notable one between the two tropics, blowing conſtantly from eaſt to weſt; called the *general trade-wind*.

Winds, *Stated* or *Periodical*, are ſuch as conſtantly return at certain times. Such are the ſea and land breezes, blowing from ſea to land in the evening; and from land to ſea in the morning.

Such alſo are the *ſhifting* or *particular* trade-winds, which, for certain months of the year, blow one way, and the reſt of the year the contrary way. See Trade-*Winds*.

Winds, *Variable* or *Erratic*, are ſuch as blow now this, now that way; and are now up, now huſhed, without any rule or regularity, either as to time or place.

Such are all the winds obſerved in the inland parts of England, &c. though ſeveral of theſe claim their certain times of the day. Thus, the *weſt* wind is moſt frequent about noon; the *ſouth* wind in the night; the *north* in the morning, &c.

Wind, *General*, is ſuch a one, as at the ſame time blows the ſame way, over a very large tract of ground, almoſt all the year. Such only is the *general* trade-wind.

But even this has its interruption: for, 1. At land it is ſcarcely ſenſible at all, as being broken by the interpoſition of mountains, valleys, &c. 2. At ſea, near the ſhore, it is diſturbed by vapours, exhalations, and particular winds, blowing from landward; ſo that it is chiefly conſidered as *general*, only at mid-ſea: where, 3. It is liable to be diſturbed, by clouds driving from other quarters.

Winds, *Particular*, include all others, excepting the *general trade-winds;* which ſee.

Thoſe peculiar to one little canton, or part, are called *topical* or *provincial* winds. Such is the north wind, on the weſtern ſide of the Alps, which does not blow above one or two leagues lengthwiſe, and much leſs in breadth: ſuch alſo is the pontias in France, &c.

Winds, *Phyſical Cauſe of*. Some philoſophers, as Des Cartes, Rohault, &c. account for the general wind, from the diurnal rotation of the earth, and from this general wind derive all the particular ones. The atmoſphere, ſay they, inveſting the earth, and moving round it; that part will perform its circuit fooneſt which has the ſmalleſt circle to deſcribe: the air, therefore, near the equator, will require a ſomewhat longer time to perform its courſe in, from weſt to eaſt, than that nearer the poles.

Thus, as the earth turns eaſtward, the particles of the air near the equinoctial, being exceedingly light, are left behind; ſo that, in reſpect of the earth's ſurface, they move eaſtwards, and become a conſtant eaſterly wind.

This opinion ſeems confirmed by this, that theſe winds are found only between the tropics, in thoſe parallels of latitude where the diurnal motion is ſwifteſt. But the conſtant calms in the Atlantic ſea near the equator, the weſterly winds near the coaſt of Guinea, and the periodical weſterly monſoons under the equator in the Indian ſeas, declare the inſufficiency of this hypotheſis.

Beſides, the air, being kept cloſe to the earth by the principle of gravity, would, in time, acquire the ſame degree of velocity that the earth's ſurface moves with, as well in reſpect of the diurnal rotation, as of the annual, about the ſun, which is about thirty times ſwifter. See Trade-*Winds*.

Dr. Halley, therefore, ſubſtitutes another cauſe, capable of producing a like conſtant effect, not liable to the ſame objections, but agreeable to the known properties of the elements of water and air, and the laws of the motion of fluid bodies. Such a one is the action of the ſun's beams upon the air and water, as he paſſes every day over the ocean, conſidered together with the quality of the ſoil, and the ſituation of the adjoining continents.

According to the laws of ſtatics, the air, which is leſs rarefied or expanded by heat, and conſequently is more ponderous, muſt have a motion towards thoſe parts of it which are more rarefied, and leſs ponderous, to bring it to an equilibrium; alſo, the preſence of the ſun continually ſhifting to the weſtward, that part towards which the air tends, by reaſon of the rarefaction made by his greateſt meridian heat, is, with him, carried weſtward; and, conſequently, the tendency of the whole body of the lower air is that way.

Thus a general eaſterly wind is formed, which being impreſſed upon the air of a vaſt ocean, the parts impel one the other, and ſo keep moving till the next return of the ſun, by which ſo much of the motion as was loſt is again reſtored; and thus the eaſterly wind is made perpetual.

From the ſame principle it follows, that this eaſterly wind ſhould, on the north ſide of the equator, be to the northward of the eaſt, and in ſouth latitudes to the ſouthward of it; for, near the line, the air is much more rarefied than at a greater diſtance from it; becauſe the ſun is twice in a year vertical there, and at no time diſtant above $23\frac{1}{2}$ degrees; at which diſtance, the heat, being as the ſine of the angle of incidence, is but little ſhort of that of the perpendicular ray; whereas under the tropics, though the ſun ſtay longer vertical, yet he is a long time 47 degrees off, which is a kind of winter, in which the air ſo cools, as that the ſummer heat cannot warm it to the ſame degree with that under the equator. Wherefore, the air towards the north and ſouth being leſs rarefied than that in the middle, it follows, that from both ſides it ought to tend towards the equator.

This motion, compounded with the former eaſterly wind, accounts for all the phenomena of the general trade-winds, which, if the whole ſurface of the globe was ſea, would undoubtedly blow quite round the world, as they are found to do in the Atlantic and the Ethiopic oceans. But ſeeing that ſo great continents do interpoſe, and break the continuity of the ocean, regard muſt be had to the nature of the ſoil, and the poſition of the high mountains, which are the two principal cauſes of the variations of the wind from the former general rule; for if a country lying near the ſun prove to be flat, ſandy, and low land, ſuch as the deſerts of Lybia are uſually reported to be, the heat occaſioned by the reflexions of the ſun's beams, and the retention of it in the ſand, is incredible to thoſe who have not felt it; by which the air being exceedingly rarefied, it is neceſſary that the cooler and more denſe air ſhould run thitherwards, to reſtore the equilibrium. This is ſuppoſed to be the cauſe, why, near the coaſt of Guinea, the wind always ſets in upon the land, blowing weſterly inſtead of eaſterly, there being ſufficient reaſon to believe that the inland parts of Africa are prodigiouſly hot, ſince the northern borders of it were ſo very intemperate, as to give the ancients cauſe to conclude that all beyond the tropics was uninhabitable by exceſs of heat.

Mr. Clare, in his Motion of Fluids, p. 302. mentions a familiar experiment, that ſerves to illuſtrate this matter, as well as the alternate courſe of land and ſea breezes. Fill a large diſh with cold water, and in the middle of it place a water-plate, filled with warm water: the firſt will repreſent the ocean, the other an iſland, rarefying the air above it. Then holding a wax-candle over the cold water, blow it out, and the ſmoke will be ſeen, in a ſtill place, to move toward the warm plate, and riſing over, it will point the courſe of the air (and alſo of vapour) from ſea to land. And if the ambient water be warmed, and the plate filled with cold water, and the ſmoking wick of a candle held over the plate, the contrary will happen. (See Breeze.) For the phenomena of the wind obſerved by Dr. Halley, and explained by his theory, ſee Wind, in *Navigation.*

From the ſame cauſe it happens, that there are ſo conſtant calms in that ſame part of the ocean, called the *rains;* for this tract being placed in the middle, between the weſterly winds blowing on the coaſt of Guinea, and the eaſterly trade-winds blowing to the weſtward of it; the tendency of the air here is indifferent to either, and ſo ſtands in equilibrio between both; and the weight of the incumbent atmoſphere being diminiſhed by the continual contrary winds blowing from hence, is the reaſon that the air here holds not the copious vapour it receives, but lets it fall in ſo frequent rains.

But, as the cold and denſe air, by reaſon of its greater gravity, preſſes upon the hot and rarefied, it is demonſtrable that this latter muſt aſcend in a continued ſtream as faſt as it rarefies; and that, being aſcended, it muſt diſperſe itſelf, to preſerve the equilibrium; that is, by a contrary current, the upper air muſt move from thoſe parts where the greateſt heat is: ſo, by a kind of circulation, the north-eaſt trade-wind below will be attended with a ſouth-weſterly wind above; and the ſouth-eaſt, with a north-weſt wind above.

That this is more than a bare conjecture, the almoſt inſtantaneous change of the wind to the oppoſite point, which is frequently found in paſſing the limits of the trade-winds, ſeems ſtrongly to aſſure us; but that which above all confirms this hypotheſis, is the phenomenon of the monſoons, by this means moſt eaſily ſolved, and without it hardly explicable. See Monsoons.

Suppoſing, therefore, ſuch a circulation as above, it is to be conſidered, that to the northward of the Indian ocean there is every where land, within the uſual limits of the latitude of 30°; *viz.* Arabia, Perſia, India, &c. which, for the ſame reaſon as the Mediterranean parts of Africa, are ſubject to inſufferable heats when the ſun is to the north, paſſing nearly vertical; but yet are temperate enough when the ſun is removed towards the other tropic, becauſe of a ridge of mountains at ſome diſtance within the land, ſaid to be frequently, in winter, covered with ſnow, over which the air, as it paſſes, muſt needs be much chilled. Hence it happens, that the air coming, according to the general rule, out of the north-eaſt, to the Indian ſea, is ſometimes hotter, ſometimes colder, than that which, by this circulation, is returned out of the ſouth-weſt; and, by conſequence, ſometimes the under-current, or wind, is from the north-eaſt, ſometimes from the ſouth-weſt.

That this has no other cauſe is clear from the times in which theſe winds ſet, *viz.* in April; when the ſun begins to warm theſe countries to the north, the ſouth-weſt monſoons begin, and blow, during the heats, till October, when the ſun being retired, and all things growing cooler northward, and the heat increaſing to the ſouth, the north-eaſt winds enter, and blow all the winter till April again. And it is, undoubtedly, from the ſame principle, that to the ſouthward of the equator, in part of the Indian ocean, the north-weſt winds ſucceed the ſouth-eaſt, when the ſun draws near the tropic of Capricorn. Phil. Tranſact. N° 183. or Abridg. vol. ii. p. 139.

Some philoſophers, diſſatisfied with Dr. Halley's theory above recited, or not thinking it ſufficient for explaining the various phenomena of the wind, have had recourſe to another cauſe, *viz.* the gravitation of the earth and its atmoſphere towards the ſun and moon, to which the tides are confeſſedly owing. See Tides.

From the laws of univerſal attraction it has been inferred, that theſe celeſtial bodies muſt act upon the atmoſphere, or that they muſt occaſion a flux and reflux of the atmoſphere, as well as of the ocean. Hence it has been alleged, that though we cannot diſcover aerial tides, of ebb or flow, by means of the barometer, becauſe columns of air of unequal height, but different denſity, may have the ſame preſſure or weight; yet the protuberance in the atmoſphere, which is continually following the moon, muſt, they ſay, of courſe produce a motion in all parts, and ſo produce a wind more or leſs to every place, which, conſpiring with or counteracted by the winds ariſing from other cauſes, makes them greater or leſs. Several diſſertations to this purpoſe were publiſhed, on occaſion of the ſubject propoſed by the Academy of Sciences at Berlin, for the year 1746.

Although the atmoſpherical air is much more variable than water, and the action of the ſun and moon upon it becomes much leſs apparent to us, becauſe they muſt frequently concur with or be counteracted by the much more powerful effects of heat and cold, of dryneſs and moiſture, of winds, &c. ſo that their action upon the barometer has been long diſputed and even denied, (ſee Moon, *Influence of,*) yet that the moon in particular, as well as the ſun, has ſuch an action has been for a conſiderable time ſurmiſed; and of late years it has been in a degree obſerved and rendered ſenſible by means of very accurate and long-continued barometrical obſervations, and perceived only by taking a mean of the obſervations of many years.

Toaldo, the learned aſtronomer of Padua, after a variety of obſervations made in the courſe of ſeveral years, found reaſon to aſſert, that, *cæteris paribus,* at the time of the moon's apogeum, the mercury in the barometer riſes the 0.105 of an inch higher than at the perigeum; that at the time of the quadratures, the mercury ſtands 0.008 of an inch higher than at the time of the ſyzygies; and that it ſtands 0.022 of an inch higher when the moon in each lunation comes neareſt to our zenith, (meaning the zenith of Padua, where the obſervations were made,) than when it goes fartheſt from it. Journal des Sciences Utiles.

In the ſeventh volume of the Philoſophical Magazine, there is a paper of L. Howard, eſq. which contains ſeveral curious obſervations relative to this ſubject. This gentleman found, both from his own obſervations, and from an examination of the Meteorological Journal of the Royal Society, which is publiſhed annually in the Philoſophical Tranſactions, that the moon had a manifeſt action upon the barometer. "It appears," he ſays, "to me evident, that the atmoſphere is ſubject to a periodical change of gravity, by which the barometer, on a mean of ten years, is depreſſed at leaſt one-tenth of an inch while the moon is paſſing from the quarters to the full and new; and elevated, in the fame proportion, during the return to the quarter." A great fall of the barometer generally takes place before high tides, efpecially at the time of new or full moon.

The caufes, it is faid, which render the diurnal tide of the atmofphere infenfible to us, may be the elafticity of the air, and the interference of the much more powerful effects of heat, cold, vapours, &c.

It has been calculated by D'Alembert, from the general theory of gravitation, that the influence of the fun and moon in their daily motions is fufficient to produce a continual eaft wind about the equator. So that, upon the whole, we may reckon three principal daily tides, *viz.* two arifing from the attractions of the fun and moon, and the third from the heat of the fun alone: all which fometimes combine together, and form a prodigious tide.

In corroboration of the opinion of the influence of the fun, and principally of the moon, in the production of wind, we muft likewife mention the obfervations of Bacon, Gaffendi, Dampier, Halley, &c.; namely, that the periods of the year moft likely to have high winds are the two equinoxes; that ftorms are more frequent at the time of new and full moon, efpecially thofe new and full moons which happen about the equinoxes; that, at periods otherwife calm, a fmall breeze takes place at the time of high water; and that a fmall movement in the atmofphere is generally perceived a fhort time after the noon and the midnight of each day.

M. Mufchenbroeck, however, will not allow that the attraction of the moon is the caufe of the general wind; becaufe the eaft wind does not follow the motion of the moon about the earth; for in that cafe there would be more than twenty-four changes, to which it would be fubject in the courfe of a year, inftead of two. Introd. ad Phil. Nat. vol. ii. p. 1102.

Some action in the production of wind may alfo be derived from volcanoes, fermentations, evaporations, and efpecially from the condenfation of vapours: for we find that, in rainy weather, a confiderable wind frequently precedes the approach of every fingle cloud, and that the wind fubfides as foon as the cloud has paffed over our zenith.

Wherever any of the above-mentioned caufes are conftantly more predominant, as the heat of the fun within the tropics, there a certain direction of the wind is more conftant; and where different caufes interfere at different and irregular periods, as in thofe places which are confiderably diftant from the torrid zone, there the winds are more changeable and uncertain.

In fhort, whatever difturbs the equilibrium of the atmofphere, *viz.* the equal denfity or quantity of air at equal diftances from the furface of the earth; whatever accumulates the air in one place, and diminifhes it in other places, muft occafion a wind both in difturbing and in reftoring that equilibrium, as above ftated.

Mr. Henry Eeles, apprehending that the fun's rarefying of the air cannot fimply be the caufe of all the regular and irregular motions which we find in the atmofphere, afcribes them to another caufe, *viz.* the afcent and defcent of vapour and exhalation, attended by the electrical fire or fluid; and on this principle he has endeavoured to explain at large the general phenomena of the weather and barometer. Phil. Tranf. vol. xlix. art. 25. p. 124.

M. Briffon (Principes de Phyfique) alfo is of opinion that electricity is the principal and more general caufe which produces winds; but Mr. Cavallo is of a different opinion.

After making various obfervations on the nature and theory of winds, Dr. Darwin recapitulates his opinions in the following manner. 1. The north-eaft wind confifts of air flowing from the north, where it feems to be occafionally produced; and has an apparent direction from the eaft, owing to its not having acquired in its journey the increafing velocity of the earth's furface. Thefe winds are analogous to the trade-winds between the tropics, and frequently continue in the vernal months for four or fix weeks together, with a high barometer, and fair and frofty weather. They fometimes confift of fouth-weft air, which had paffed by us or over us, driven back by a new accumulation of air in the north; and they continue but a day or two, and are attended with rain.

2. The fouth-weft wind confifts of air flowing from the fouth, and feems occafionally abforbed at its arrival to the more northern latitudes. It has a real direction from the weft, owing to its not having loft in its journey the greater velocity it had acquired from the earth's furface from whence it came. Thefe winds are analogous to the monfoons between the tropics, and frequently continue for four or fix weeks together, with a low barometer, and rainy weather. They fometimes confift of north-eaft air, which had paffed by us, and which becomes retrograde by a commencing deficiency of air in the north. Thefe winds continue but a day or two, attended with fevere froft, with a finking barometer; their cold being increafed by their expanfion as they return into an incipient vacancy.

3. The north-weft wind confifts firft of fouth-weft winds which have been paffed over, been bent down, and driven back towards the fouth by newly-generated northern air. They continue but a day or two, and are attended with rain or clouds. They confift of north-eaft winds bent down from the higher parts of the atmofphere, and having there acquired a greater velocity from the earth's furface are frofty and fair. They confift of north-eaft winds formed into a vertical eddy, not a fpiral one, with froft or fair.

4. The north winds confift firft of air flowing flowly from the north, fo that they acquire the velocity of the earth's furface as they approach it; they are fair or frofty, but feldom occur. They confift of retrograde fouth winds; thefe continue but a day or two, are preceded by fouth-weft winds, and are generally fucceeded by north-eaft winds, cloudy or rainy weather, the barometer rifing.

5. The fouth winds confift firft of air flowly flowing from the fouth, lofing their previous wefterly velocity by the friction of the earth's furface as they approach it; they are moift, but feldom occur. They confift of retrograde north winds; thefe continue but a day or two, and are preceded by north-eaft winds, and are generally fucceeded by fouth-weft winds, colder, and the barometer finking.

6. The eaft winds confift of air brought haftily from the north, and not impelled farther fouthward, owing to a fudden beginning abforption of air in the northern regions; they are very cold, the barometer high, and are generally fucceeded by fouth-weft winds.

7. The weft winds confift of air brought haftily from the fouth, and checked from proceeding farther to the north, by a beginning production of air in the northern regions; they are warm and moift, and generally fucceeded by north-eaft winds. They confift of air bent downwards from the higher regions of the atmofphere; if this air be from the fouth, and brought haftily, it becomes a wind of great velocity, moving perhaps 60 miles in an hour, and is warm and rainy: if it confifts of northern air bent down it is of lefs velocity, and cooler.

Various other interefting remarks and reflections on winds may be feen in the notes to the Botanic Garden, by the fame writer.

The

The induſtry of ſome late writers having brought the theory of the production and motion of winds to ſomewhat of a mathematical demonſtration; we ſhall here give it the reader in that form.

Winds, *Laws of the Production of.* If the ſpring of the air be weakened in any place, more than in the adjoining places; a wind will blow through the place where the diminution is.

For, 1. Since the air endeavours, by its elaſtic force, to expand itſelf every way; if that force be leſs in one place than another, the effort of the more againſt the leſs elaſtic, will be greater than the effort of the latter againſt the former. The leſs elaſtic air, therefore, will reſiſt with leſs force than it is urged by the more elaſtic: conſequently, the leſs elaſtic will be driven out of its place, and the more elaſtic will ſucceed.

If, now, the exceſs of the ſpring of the more elaſtic above that of the leſs elaſtic air, be ſuch as to occaſion a little alteration in the baroſcope; the motion both of the air expelled, and that which ſucceeds it, will become ſenſible, *i. e.* there will be a wind.

2. Hence, ſince the ſpring of the air increaſes, as the compreſſing weight increaſes, and compreſſed air is denſer than air leſs compreſſed; all winds blow into rarer air, out of a place filled with a denſer.

3. Wherefore, ſince a denſer air is ſpecifically heavier than a rarer; an extraordinary lightneſs of the air in any place muſt be attended with extraordinary winds or ſtorms.

Now, an extraordinary fall of the mercury in the barometer, ſhewing an extraordinary lightneſs of the atmoſphere, it is no wonder if that foretels ſtorms. See Barometer.

4. If the air be ſuddenly condenſed in any place, its ſpring will be ſuddenly diminiſhed: hence, if this diminution be great enough to affect the barometer, there will a wind blow through the condenſed air.

5. But ſince the air cannot be ſuddenly condenſed, unleſs it have before been much rarefied, there will a wind blow through the air, as it cools, after having been violently heated.

6. In like manner, if air be ſuddenly rarefied, its ſpring is ſuddenly increaſed: wherefore, it will flow through the contiguous air, not acted on by the rarefying force. A wind, therefore, will blow out of a place, in which the air is ſuddenly rarefied; and on this principle, in all probability, it is, that,

7. Since the ſun's power in rarefying the air is notorious, it muſt neceſſarily have a great influence on the generation of winds.

8. Moſt caves are found to emit wind, either more or leſs. M. Muſchenbroeck has enumerated a variety of cauſes that produce winds, exiſting in the bowels of the earth, on its ſurface, in the atmoſphere, and above it. See Intr. ad Phil. Nat. vol. ii. p. 1116, &c.

The riſing and changing of the wind are determined experimentally, by means of weather-cocks, placed on the tops of houſes, &c. But theſe only indicate what paſſes about their own height, or near the ſurface of the earth: Wolfius aſſures us, from obſervations of ſeveral years, that the higher winds, which drive the clouds, are different from the lower ones, which move the weather-cocks. And Dr. Derham obſerves ſomething not unlike this. Phyſ. Theol. lib. i. cap. 2.

The author laſt-mentioned relates, upon comparing ſeveral ſeries of obſervations made of the winds in divers countries; *viz.* England, Ireland, Switzerland, Italy, France, New England, &c. that the winds in thoſe ſeveral places ſeldom agree; but when they do, it is commonly when they are ſtrong, and of long continuance in the ſame quarter; and more, he thinks, in the northerly and eaſterly than in other points. Alſo, that a ſtrong wind in one place is oftentimes a weak one in another, or moderate, according as the places are nearer, or more remote. Phil. Tranſ. N° 267 and 321.

Wind, *Laws of the Force and Velocity of.* Wind being only air in motion, and air being a fluid ſubject to the laws of other fluids, its force may be regularly brought to a preciſe computation: thus, "The ratio of the ſpecific gravity of any other fluid to that of air, together with the ſpace that fluid, impelled by the preſſure of the air, moves in any given time, being given; we can determine the ſpace through which the air itſelf, acted on by the ſame force, will move in the ſame time." By this rule:

1. As the ſpecific gravity of air is to that of any other fluid; ſo, reciprocally, is the ſquare of the ſpace, which that fluid, impelled by any force, moves in any given time, to the ſquare of the ſpace which the air, by the ſame impulſe, will move in the ſame time.

Suppoſing, therefore, the ratio of the ſpecific gravity of that other fluid to that of air, to be $= \frac{b}{c}$; the ſpace deſcribed by the fluid to be called s; and that which the air will deſcribe by the ſame impulſe, x. The rule gives us $x = \sqrt{\frac{b s^2}{c}}$.

Hence, if we ſuppoſe water impelled by the given force, to move two feet in a ſecond of time, then will $s = 2$; and ſince the ſpecific gravity of water to the air is as 800 to 1, we ſhall have $b = 800$, and $c = 1$; conſequently, $x = \sqrt{800 \times 4} = \sqrt{3200} = 57$ feet nearly. The velocity of the wind, therefore, to that of water, moved by the ſame power, will be as 57 to 2; *i. e.* if water move two feet in a ſecond, the wind will fly 57 feet.

2. Add, that $s = \sqrt{\frac{c x^2}{b}}$; and therefore the ſpace any fluid, impelled by any impreſſion, moves in any time, is determined, by finding a fourth proportional to the two numbers that expreſs the ratio of the ſpecific gravities of the two fluids, and the ſquare of the ſpace the wind moves in, in the given time. The ſquare root of that fourth proportional is the ſpace required.

Mr. Mariotte, *e. gr.* found, by various experiments, that a pretty ſtrong wind moves 24 feet in a ſecond of time, which is at the rate of 1440 in a minute; *i. e.* at the rate of ſomewhat more than 16 miles in an hour: wherefore, if the ſpace which the water, acted on by the ſame force as the air, will deſcribe in the ſame time, be required; then will $c = 1$, $x = 24$, $b = 800$; and we ſhall find $s = \sqrt{\frac{576}{800}} = \frac{24}{28}$ nearly.

Derham eſtimated the velocity of the wind in very great ſtorms at 66 feet *per* ſecond; and de la Condamine at $90\frac{1}{2}$ feet *per* ſecond.

3. "The velocity of wind being given, to determine the preſſure required to produce that velocity;" we have this rule. The ſpace the wind moves in one ſecond of time, is to the height a fluid is to be raiſed in an empty tube, in order to have a preſſure capable of producing that velocity, in a ratio compounded of the ſpecific gravity of the fluid to that of the air, and of quadruple the

 altitude

altitude a body deſcends in the firſt ſecond of time, to the aforeſaid ſpace of the air.

Suppoſe, *e. gr.* the ſpace through which the air moves in a ſecond, $a = 24$ feet, or 288 inches; call the altitude of the fluid x; and the ratio of mercury to air, $\frac{b}{c} = \frac{800 \times 14}{1} = \frac{11200}{1}$; and the altitude through which a body deſcends in the firſt ſecond of time, 16 feet 1 inch; then, by the theorem, we ſhall have $288 : x :: 11200 \times 762 : 288$, and conſequently $x = \frac{288 \times 288}{11200 \times 762} = .01$, &c. of an inch. Hence we ſee why a ſmall but ſudden change in the barometer is followed with violent winds. See an account of the principle upon which theſe calculations are founded under the article WATER.

When the direction of the wind is not perpendicular, but oblique to the ſurface of the ſolid, then the force of the former upon the latter will not be ſo great as when the impulſe is direct, and that for reaſons which are eaſily derived from the theory of the reſolution and compoſition of forces, and from the theory of direct and oblique impulſes. In ſhort, the general propoſition for compound impulſes is, that the effective impulſe is as the ſurface, as the ſquare of the air's velocity, as the ſquare of the ſine of the angle of incidence, and as the ſine of the obliquity of the ſolid's motion to the direction of the impulſe, jointly; for the alteration of every one of thoſe quantities will alter the effect in the ſame proportion. But theſe general rules, as we have already more than once obſerved, are ſubject to great variations; ſo that their reſults ſeldom coincide with thoſe of actual experiments.

Philoſophers have uſed various methods for determining the velocity of the wind, which is very different at different times. The method uſed by Dr. Derham was that of letting light downy feathers fly in the wind, and accurately obſerving the diſtance to which they were carried in any number of half ſeconds. This method he preferred to that of Dr. Hooke's mola alata, or pneumatica. (See Phil. Tranſ. N° 24. and Birch's Hiſt. Roy. Soc. vol. iv. p. 225.) He tells us, that he thus meaſured the velocity of the wind in the great ſtorm of Auguſt, 1705, and by many experiments found, that it moved at the rate of thirty-three feet *per* half-ſecond, or of forty-five miles *per* hour: whence he concludes, that the moſt vehement wind (as that of November, 1703) does not fly at the rate of above fifty or ſixty miles *per* hour, and that at a medium the velocity of wind is at the rate of twelve or fifteen miles *per* hour. Phil. Tranſ. N° 313. or Abr. vol. iv. p. 411.

Mr. Brice obſerves, that experiments with feathers are ſubject to uncertainty: as they ſeldom or ever deſcribe a ſtraight line, but deſcribe a ſort of ſpirals, moving to the right and left, and riſing to very different altitudes in their progreſs. He, therefore, conſiders the motion of a cloud, or its ſhadow, over the ſurface of the earth, as a much more accurate meaſure of the velocity of the wind. In this way he found, that the wind, in a conſiderable ſtorm, moved at the rate of 62.9 miles *per* hour; and that, when it blew a freſh gale, it moved in the ſame time about twenty-one miles; and that in a ſmall breeze, the wind moved at the rate of 9.9 miles *per* hour. Phil. Tranſ. vol. lvi. p. 226.

But it has been obſerved by Cavallo and others, that this method is very fallacious, partly becauſe it is not known whether the clouds do or do not move exactly with the air in which they float; and partly becauſe the velocity of the air in the region where the clouds float is by no means the ſame with that of the air which is nearer to the ſurface of the earth, and is ſometimes quite contrary to it, as indicated by the motion of the clouds themſelves. Others have eſtimated the velocity of the wind by the changes effected by it upon the motion of ſound, which muſt of courſe be very inaccurate. A very ſimple method of determining the velocity of the wind is that which M. Coulomb (Mem. de l'Acad. Roy. 1781, p. 70.) employed in his experiments on wind-mills, becauſe it requires neither the aid of inſtruments nor the trouble of calculation. Two perſons were placed on a ſmall elevation, at the diſtance of 150 feet from one another, in the direction of the wind; and, while the one obſerved, the other meaſured the time which a ſmall and light feather employed in removing through this ſpace. The diſtance between the two perſons, divided by the number of ſeconds, gave the velocity of the wind *per* ſecond. The beſt method, ſays Cavallo, of meaſuring the velocity of the wind, is by obſerving the velocity of the ſmoke of a low chimney, or by eſtimating the effect it produces upon certain bodies, and thus may be determined its force as well as its velocity. We ſhall here obſerve, that from the concurrence of experiments made with various inſtruments, and different modes of calculation, it has been inferred, that in currents of air, of the denomination which are expreſſed in the 4th column of the annexed table, the air moves at the rate of ſo many feet *per* ſecond as are expreſſed in the 2d column, or of ſo many miles *per* hour as are expreſſed in the 1ſt column.

A TABLE of the different velocities and forces of the winds, conſtructed by Mr. Rouſe with great care, from a conſiderable number of facts and experiments, and communicated to Mr. Smeaton, and firſt publiſhed by him in the 51ſt volume of the Philoſophical Tranſactions.

Velocity of the Wind.		Perpendicular Force on one ſquare Foot, in Avoirdupois Pounds.	Common Appellations of the Forces of Winds.
Miles in one Hour.	= Feet in one Second.		
1	1.47	.005	Hardly perceptible.
2	2.93	.020	Juſt perceptible.
3	4.40	.044	
4	5.87	.079	Gentle pleaſant wind.
5	7.33	.123	
10	14.67	.492	Pleaſant briſk gale.
15	22.00	1.107	
20	29.34	1.968	Very briſk.
25	36.67	3.075	
30	44.01	4.429	High wind.
35	51.34	6.027	
40	58.68	7.873	Very high.
45	66.01	9.963	
50	75.35	12.300	A ſtorm or tempeſt.
60	88.02	17.715	A great ſtorm.
80	117.36	31.490	A hurricane.
100	146.70	49.200	A hurricane that tears up trees, and carries buildings, &c. before it.

The force of the wind is as the ſquare of its velocity; as Mr. Ferguſon has ſhewn by experiments on the whirling-table; and in moderate velocities this will hold very nearly.

Upon this principle the numbers in the third column are calculated. The propofition upon which this column has been formed feems to be, that the impulfe of a current of air, ftriking perpendicularly upon a given furface, with a certain velocity, is equal to the weight of a column of air which has that furface for its bafe, and for its height the fpace through which a body muft fall, in order to acquire that velocity of the air.

It is obferved, with regard to this table, that the evidence for thofe numbers, where the velocity of the wind exceeds fifty miles an hour, does not feem of equal authority with that of thofe of fifty miles, or under. Phil. Tranf. vol. li. p. 165.

Dr. Hales found (Statical Eff. vol. ii. p. 326.) that the air rufhed out of a pair of fmith's bellows, at the rate of 68.73 feet in a fecond of time, when compreffed with a force equal to the weight of one inch perpendicular depth of mercury, lying on the whole upper furface of the bellows. The velocity of the air, as it paffed out of the trunk of his ventilators, was found to be at the rate of three thoufand feet in a minute; which is at the rate of thirty-four miles in an hour. Dr. Hales fays, that the velocity with which impelled air paffes out at any orifice may be determined by hanging a light valve over the nofe of a bellows, by pliant leathern hinges, which will be much agitated and lifted up from a perpendicular to a more than horizontal pofition by the force of the rufhing air. There is another more accurate way, he fays, of eftimating the velocity of air, *viz.* by holding the orifice of an inverted glafs fiphon full of water, oppofite to the ftream of air, by which the water will be depreffed in one leg, and raifed in the other, in proportion to the force with which the water is impelled by the air. Defcript. of Ventilators, 1743, p. 12, &c.

The velocity and force of the wind are determined experimentally by a peculiar machine, called an *anemometer* or *wind-meafurer*. Of thefe there have been many, varioufly conftructed. See Anemometer, Anemoscope, and Wind-*Gage*.

Wind, *Qualities and Effects of.* 1. "A wind blowing from the fea is always moift; in fummer, it is cold; and in winter, warm, unlefs the fea be frozen up." This is demonftrated thus: there is a vapour continually rifing out of all water, (as appears even hence, that a quantity of water, being left a little while in an open veffel, is found fenfibly diminifhed,) but efpecially if it be expofed to the fun's rays; in which cafe, the evaporation is beyond all expectation. By this means, the air incumbent on the fea becomes impregnated with a quantity of vapour. But the winds, blowing from off the fea, fweep thefe vapours along with them; and confequently they are always moift.

Again, water in fummer, &c. conceives lefs heat than terreftrial bodies, expofed to the fame rays of the fun, do; but in winter, fea-water is warmer than the earth covered with froft and fnow, &c. Wherefore, as the air contiguous to any body is found to partake of its heat and cold, the air contiguous to fea-water will be warmer in winter, and colder in fummer, than that contiguous to the earth. Or thus: vapours raifed from water by the fun's warmth in winter, are warmer than the air they rife in, (as appears from the vapours condenfing, and becoming vifible, almoft as foon as they are got out into air.) Frefh quantities of vapour, therefore, continually warming the atmofphere over the fea, will raife its heat beyond that of air over the land. Again, the fun's rays reflected from the earth into the air, in fummer, are much more than thofe from the water into air: the air, therefore, over the earth, warmed by the reflection of more rays than that over water, is warmer. Hence, *fea-winds* make thick, cloudy, hazy weather.

2. "Winds, blowing from the continent, are always dry; in fummer, warm; and cold in winter." For there is much lefs vapour arifing from the earth, than from water; and, therefore, the air over the continent will be impregnated with much fewer vapours. Add, that the vapours, or exhalations, raifed by a great degree of heat out of the earth, are much finer, and lefs fenfible, than thofe from water. The wind, therefore, blowing over the continent, carries but little vapour with it, and is therefore dry.

Farther, the earth in fummer is warmer than water expofed to the fame rays of the fun. Hence, as the air partakes of the heat of contiguous bodies, that over the earth in fummer will be warmer than that over the water: therefore, the winds, &c.

After the like manner it is fhewn, that the land-winds are cold in winter. Hence, we fee why land-winds make clear cold weather.

Our northerly and foutherly winds, however, which are commonly efteemed the caufes of cold and warm weather, Dr. Derham obferves, are really rather the effect of the cold or warmth of the atmofphere. Hence it is, that we frequently fee a warm foutherly wind, on a fudden, changed to the north, by the fall of fnow or hail; and that in a cold frofty morning, we fee the wind north, which afterwards wheels about toward the foutherly quarter, when the fun has well warmed the air; and again, in the cold evening, turns northerly, or eafterly. See Darwin's Obfervations *fupra.*

For the manner in which north-eafterly winds contribute to blights, fee Blight. For the effect of winds on the barometer and thermometer, fee Barometer, &c.

The utility of winds has been univerfally acknowledged. The ancient Perfians, Phœnicians, Greeks, and Romans, facrificed and erected temples to the winds; as we learn from Voffius, Theolog. Gentil. lib. iii. part i. cap. 1. Befides their ufe in moving bellows, mills, and other machines, applied in various ways to the fervice of mankind, and the benefits refulting from them to navigation and trade, they ferve to purify and refrefh the air, to convey the heat or cold of one region to another, to produce a regular circulation of vapours from the ocean to countries remote from it, and to fupply, by wafting them in their progrefs againft hills, &c. fprings and rivers.

Wind has been, by many authors, made the bafis of many different difeafes: among others, Dr. Reyn has given it as his opinion, in a Treatife on the Gout (De Arthritid.), that flatufes, or wind inclofed between the periofteum and the bone, are the true caufe of that difeafe; and accordingly, that all the methods of cure ought to tend to the expelling of that wind.

He is alfo of opinion, that head-aches, palpitations of the heart, tooth-ache, pleurify, convulfions, colics, and many other difeafes, are originally owing to the fame caufe, and only differ in regard to the place affected, and to the various motions and determinations of the wind. The moveablenefs of the pain in gouty perfons from one part to another, he looks on as a proof of this, and thinks that the curing of the gout by burning moxa, or the cotton of the mugwort leaves, upon it, is owing to its giving way to the wind in the part to evaporate itfelf.

That thefe winds are cold, appears from the fhivering fits which generally precede a paroxyfm of the gout; and that the fhiverings in the beginning of fevers, and before all fits of agues, are owing to the fame caufe, is fuppofed by this

this author a natural conclufion from the former obfervations.

Their differences, he fays, principally proceed from the various ferments producing in us a variety of humours; which acting upon one another, do in their effervefcences create winds of various effects, and denominate difeafes from the places which are the fcenes of their action. It is on this account that the acupunctura, or pricking with long needles, among the Chinefe, is of ufe: the Japanefe, and other neighbouring nations, having no other cure for moft difeafes than the pricking with the needle, and the burning of the moxa on the part.

The hufbandman often fuffers extremely by high winds in many different refpects. Plantations of trees, at a fmall diftance from the barns and houfes, are the beft fafeguard againft their fuffering by winds; but they muft not be planted fo near as that their fall, if it fhould happen, would endanger them. Yews grow very flowly, otherwife they are the beft of all trees for this defenfive plantation. Trees fuffer by winds, being either broken or blown down by them; but this may be in a great meafure prevented by cutting off great part of the heads and branches of them, in places where they ftand moft expofed.

Hops are the moft fubject to be injured by winds of any crop; but this may be in a great meafure prevented by a high pale, or very thick thorn-hedge; this will both keep off the fpring wind, which nips the young buds, and be a great fafeguard againft other winds that would tear the plants from their poles. The poles fhould always be very firm in the ground; and the beft fecurity to be added to this, is a row of tall trees all round the ground.

Winds, attended with rain, do great injury to the corn, by laying it flat to the ground. The beft method of preventing this, is to keep up good enclofures; and if the accident happens, the corn fhould be cut immediately, for it never grows at all afterwards. It fhould be left on the ground, in this cafe, fome time after the cutting, to harden the grain in the ear. Mortimer's Hufbandry, p. 302.

Wind, in *Navigation*, is the fame agitation of the air, confidered as ferving for the motion of veffels on the water.

If the wind blows gently, it is called a *breeze;* if it blows harder, it is called a *gale*, or a ftiff gale; and if it blows very hard, it is called a *ftorm*.

The following obfervations on the wind have been made by fkilful feamen, and particularly by Dr. Halley.

1. Between the limits of 60°, *viz.* from 30° of north latitude to 30° of fouth latitude, there is a conftant, or almoft conftant, eaft wind through the year, blowing in the Atlantic and Pacific oceans, called the *trade-wind;* which fee.

2. The trade-winds, near their northern limits, blow between the north and eaft; and near their fouthern limits they blow between the fouth and eaft.

The trade-wind feems to depend principally upon the rarefaction of the air, which is occafioned by the heat of the fun progreffively from the eaft towards the weft. The air which is rarefied, and, of courfe, elevated by the heat of the fun immediately over it, is condenfed, and defcends as foon as the fun is gone over another place to the weft of the former; then the air of the latter place is rarefied, and the condenfed air of the former rufhes towards it, &c. From the northern and fouthern parts of the world, the air likewife runs to the place which is immediately under the fun; but thofe directions, combining with the eafterly wind, which blows nearer to the equator, form the above-mentioned north-eafterly and fouth-eafterly winds on the borders of the trade-wind.

3. Thefe general motions of the wind are difturbed on the continents, and near their coafts.

In places that are farther from the equator, the rarefaction which arifes from the heat of the fun, and from the attraction of the fun and moon, is lefs active; and is befides influenced by a variety of local and accidental circumftances, fuch as extenfive continents, mountains, rains, iflands, &c. which difturb, interrupt, or totally change the direction of the wind. Hence, in thofe latitudes north and fouth, which are beyond the limits of the trade-wind, or near the coafts, the winds are very uncertain; nor has any good theory been as yet formed refpecting them.

4. In fome parts of the Indian ocean there are periodical winds, which are called *Monfoons;* which fee.

For the explication of thefe, it is faid, that as the air, which is cool and denfe, will force the warm rarefied air in a continual ftream upwards, there it muft fpread itfelf to preferve the equilibrium. Therefore the upper courfe or current of air muft be contrary to the under current; for the upper air muft move from thofe parts where the greateft heat is; and fo, by a kind of circulation, the N.E. trade-wind below will be attended with a S.W. above; and a S.E. below, with a N.W. above.

5. In the Atlantic ocean, near the coafts of Africa, at about a hundred leagues from the fhore, between the latitudes of 28° and 10° north, feamen conftantly meet with a frefh gale of wind blowing from the N.E.

6. Thofe bound to the Caribbee iflands, acrofs the Atlantic ocean, find, as they approach the American fide, that the faid N.E. wind becomes eafterly; or feldom blows more than a point from the eaft, either to the northward or fouthward. Thefe trade-winds, on the American fide, are extended to 30°, 31°, or even to 32° of N. latitude; which is about 4° farther than they extend on the African fide: alfo to the fouthward of the equator, the trade-winds extend three or four degrees farther toward the coaft of Brafil, on the American fide, than they do near the Cape of Good Hope, on the African fide.

7. Between the latitudes of 4° N. and 4° S., the wind always blows between the fouth and eaft: on the African fide, the winds are neareft the fouth; and on the American fide, neareft the eaft. In thefe feas, Dr. Halley obferved, that when the wind was eaftward, the weather was gloomy, dark, and rainy, with hard gales of wind; but when the wind veered to the fouthward, the weather generally became ferene, with gentle breezes, approaching to a calm. Thefe winds are fomewhat changed by the feafons of the year; for when the fun is far northward, the Brafil S.E. wind turns to the fouth, and the N.E. wind to the eaft; and when the fun is far fouth, the S.E. wind gets to the eaft, and the N.E. winds on this fide of the equator veer more to the north.

8. Along the coaft of Guinea, from Sierra Leone to the ifland of St. Thomas, under the equator, which is above five hundred leagues, the foutherly and fouth-weft winds blow perpetually; for the S.E. trade-wind, having paffed the equator, and approaching the Guinea coaft within eighty or a hundred leagues, inclines toward the fhore, and becomes fouth, then S.E., and by degrees, as it comes near the land, it veers about to fouth, S.S.W., and in with the land it is S.W. and fometimes W.S.W. This tract is fubject to frequent calms, violent fudden gufts of winds, called tornadoes, blowing from all points of the horizon.

The wefterly wind on the coaft of Guinea is probably owing

owing to the nature and ſituation of the land, which, being greatly heated by the ſun, rarefies the air exceedingly; hence the cooler and heavier air from over the ſea will keep ruſhing in to reſtore the equilibrium.

9. Between the fourth and tenth degrees of north latitude, and between the longitudes of Cape Verd, and the eaſternmoſt of the Cape Verd iſles, there is a tract of ſea ſubject to perpetual calms, attended with frequent thunder and lightning, and rains; whence this part of the ſea is called 'The Rains.' Ships in ſailing theſe ſix degrees are ſaid to have been ſometimes detained whole months.

The cauſe of this ſeems to be, that the weſterly winds ſetting in on this coaſt, and meeting the general eaſterly wind in this tract, balance each other, and cauſe the calms; and the vapour carried thither by the hotteſt wind, meeting the cooleſt, is condenſed, and occaſions the very frequent rains.

The three laſt obſervations account for two circumſtances which mariners experience in ſailing from Europe to India, and in the Guinea trade.

The *firſt* is the difficulty which ſhips, in going to the ſouthward, eſpecially in the months of July and Auguſt, find in paſſing between the coaſt of Guinea and Braſil, although the breadth of this ſea is more than five hundred leagues. This happens, becauſe the S.E. winds at that time of the year commonly extend ſome degrees beyond the ordinary limits of four degrees north latitude; and beſides coming ſo much ſoutherly, as to be ſometimes ſouth, ſometimes a point or two to the weſt; it then only remains to ply to windward: and if, on the one ſide, they ſteer W.S.W. they get a wind more and more eaſterly; but then there is a danger of falling in with the Braſilian coaſt, or ſhoals; and if they ſteer E.S.E. they fall into the neighbourhood of the coaſt of Guinea, from whence they cannot depart without running eaſterly as far as the iſland of St. Thomas; and this is the conſtant practice of all the Guinea ſhips.

Secondly, With regard to all ſhips departing from Guinea for Europe, their direct courſe is northward; but on this courſe they cannot go, becauſe the coaſt bending nearly eaſt and weſt the land is to the northward: therefore, as the winds on this coaſt are generally between the S. and W.S.W., they are obliged to ſteer S.S.E. or S., and with theſe courſes they run off the ſhore; but in ſo doing they always find the winds more and more contrary; ſo that when near the ſhore they can lie ſouth, at a greater diſtance they can make no better than S.E., and afterwards E.S.E.; with which courſes they commonly fetch the iſland of St. Thomas and Cape Lopez, where, finding the winds to the eaſtward of the ſouth, they ſail weſterly with it, till coming to the latitude of four degrees ſouth, they there find the S.E. winds blowing perpetually.

On account of theſe general winds, all thoſe that uſe the Weſt India trade, even thoſe bound to Virginia, reckon it their beſt courſe to get as ſoon as they can to the ſouthward, that ſo they may be certain of a fair and freſh gale to run before it to the weſtward; and for the ſame reaſon, thoſe homeward-bound from America endeavour to gain the latitude of thirty degrees, where they firſt find the winds begin to be variable; though the moſt ordinary winds in the North Atlantic ocean come from between the ſouth and weſt.

10. Between the ſouthern latitudes of ten and thirty degrees in the Indian ocean, the general trade-wind about the S.E. by S. is found to blow all the year long in the ſame manner as in the like latitude in the Ethiopic ocean; and during the ſix months from May to December, theſe winds reach to within two degrees of the equator; but during the other ſix months, from November to June, a N.W. wind blows in the tract lying between the third and tenth degrees of ſouthern latitude, in the meridian of the north end of Madagaſcar; and between the ſecond and twelfth degree of ſouth latitude, near the longitude of Sumatra and Java.

11. In the tract between Sumatra and the African coaſt, and from three degrees of ſouth latitude quite northward to the Aſiatic coaſts, including the Arabian ſea and the gulf of Bengal, the monſoons blow from September to April on the N.E., and from March to October on the S.W. In the former half year the wind is more ſteady and gentle, and the weather clearer than in the latter ſix months; and the wind is more ſtrong and ſteady in the Arabian ſea than in the gulf of Bengal.

12. Between the iſland of Madagaſcar and the coaſt of Africa, and thence northward as far as the equator, there is a tract, in which, from April to October, there is a conſtant freſh S.S.W. wind; which to the northward changes into the W.S.W. wind, blowing at that time in the Arabian ſea.

13. To the eaſtward of Sumatra and Malacca on the north of the equator, and along the coaſts of Cambodia and China, quite through the Philippines as far as Japan, the monſoons blow northerly and ſoutherly; the northern ſetting in about October or November, and the ſouthern about May: theſe winds are not quite ſo certain as thoſe in the Arabian ſeas.

14. Between Sumatra and Java to the weſt, and New Guinea to the eaſt, the ſame northerly and ſoutherly winds are obſerved; but the firſt half-year monſoon inclines to the N.W., and the latter to the S.E. Theſe winds begin a month or ſix weeks after thoſe in the Chineſe ſeas ſet in, and are quite as variable.

15. Theſe contrary winds do not ſhift from one point to its oppoſite all at once: in ſome places, the time of the change is attended with calms; in others, by variable winds: and it often happens on the ſhores of Coromandel and China, towards the end of the monſoons, that there are moſt violent ſtorms, greatly reſembling the hurricanes in the Weſt Indies; in which the wind is ſo very ſtrong, that hardly any thing can reſiſt its force.

All navigation in the Indian ocean muſt neceſſarily be regulated by theſe winds; for if mariners ſhould delay their voyages till the contrary monſoon begins, they muſt either ſail back, or go into harbour, and wait for the return of the trade-wind.

16. The irregularities of the wind in countries which are farther from the equator than thoſe which have been mentioned above, or nearer to the poles of the earth, are ſo great that no particular period has as yet been diſcovered, excepting that in particular places certain winds are more likely to blow than others. Thus at Liverpool the winds are ſaid to be weſterly for near two-thirds of the year; in the ſouthern part of Italy, a ſouth-eaſt wind (called the *ſchirocco*) blows more frequently than any other wind, &c.

17. The temperature of a country with reſpect to heat or cold is increaſed or diminiſhed by winds, according as they come from a hotter or colder part of the world. The north and north-eaſterly winds, in this country and all the weſtern parts of Europe, are reckoned cold and drying winds. They are cold, becauſe they come from the frozen region of the north pole, or over a great tract of cold land. Their drying quality is derived from their coming principally over land, and from a well-known property of the air; namely, that warm air can diſſolve, and keep diſſolved, a

greater quantity of water than colder air: hence the air which comes from colder regions, being heated over warmer countries, becomes a better folvent of moifture, and dries up with greater energy the moift bodies it comes in contact with; and, on the other hand, warm air coming into a colder region depofits a quantity of the water it kept in folution, and occafions mifts, fogs, clouds, rains, &c. "In fhort," fays colonel Roy, "the winds feem to be drier, denfer, and colder, in proportion to the extent of land they pafs over from the poles towards the equator; but they appear to be more moift, warm, and light, in proportion to the extent of ocean they pafs over from the equator towards the poles. Hence the humidity, warmth, and lightnefs, of the Atlantic winds to the inhabitants of Europe. On the eaft coafts of North America the feverity of the N.W. wind is univerfally remarked; and there can fcarcely be a doubt, that the inhabitants of California, and other parts on the weft fide of that great continent, will, like thofe on the weft of Europe, feel the ftrong effects of a N.E. wind."

18. In warm countries, fometimes the winds, which blow over a great tract of highly-heated land, become fo very drying, fcorching, and fuffocating, as to produce dreadful effects. Thefe winds, under the names of *Blooms*, *Samiel*, and *Solanos*, are often felt in the deferts of Arabia, in the neighbourhood of the Perfian gulf, in the interior of Africa, and in fome other places. There are likewife in India, part of China, part of Africa, and elfewhere, other winds, which depofit fo much warm moifture as to soften, and actually to diffolve glue, falts, and almoft every article which is foluble in water.

19. It is impoffible to give any adequate account of irregular winds, efpecially of thofe fudden and violent gufts as come on at very irregular periods, and generally continue for a fhort time. They fometimes fpread over an extenfive tract of country, and at other times are confined within a remarkably narrow fpace. Their caufes are by no means rightly underftood, though they have been vaguely attributed to peculiar rarefactions, to the combined attractions of the fun and moon, to earthquakes, to electricity, &c. They are called in general *hurricanes*, or they are the principal phenomenon of a hurricane, that is, of a violent ftorm.

Almoft every one of thofe violent winds is attended with particular phenomena, fuch as droughts, or heavy rains, or hail, or fnow, or thunder and lightning, or feveral of thofe phenomena at once. They frequently fhift fuddenly from one quarter of the horizon to another, and then come again to the former point. In this cafe they are called *tornadoes*.

In mountainous countries, the wind fometimes rages with extreme violence, and the mountains generally exhibit figns of the approaching ftorm. Thus, at the Cape of Good Hope, there are four remarkable mountains, called Table Land, or Mountain; Sugar Loaf, or the Lion's Head; James Mount, or the Lion's Rump; and Charles Mount, called alfo the Devil's Tower, or Devil's Head, from the violent fqualls of wind which come from it. In the fummer feafon Table Mountain is fometimes fuddenly covered with a white cloud, called the *Table-cloth*; when this cloud feems to roll down the fteep face of the mountain, it is a fure indication of an approaching gale of wind from the S.E., which generally blows with great violence, and fometimes continues a day or more, but in common is of fhort duration. On the firft appearance of this cloud, the fhips in Table bay begin to prepare for it, by ftriking yards and top-mafts, and making every thing as fnug as poffible. If, in the morning, the cloud extends from the Table to Mount Charles, or the Devil's Tower, which are almoft contiguous, it is a general faying among feamen, that the old gentleman is going to breakfaft; if in the middle of the day, that he is going to dinner; and if in the evening, that the cloth is fpread for fupper.

There are various other periodical winds: of thefe, however, that generally known by the name of *Limbat*, which is common in the ifland of Cyprus, fhall only be mentioned here. The period of this wind is five days: on the firft day, it begins to blow at eight in the morning, and increafes till noon; from thence it gradually weakens, and ceafes entirely about three P.M. On the fecond day, it arifes at the fame hour; but it does not attain its greateft ftrength till about one in the afternoon, and ceafes at four. On the third day, it begins as before; but it falls an hour later. On the remaining days, it follows the fame progreffion as on the third; but it is remarked, that a little before it ceafes, it becomes extremely violent. Upon the N.W. fide of the above ifland, this wind is confidered as a fea-breeze; and upon the S.E. as a land-breeze. See WIND, *Qualities of*, *fupra*. See alfo HURRICANES, TORNADOES, and WHIRL-*Wind*. See Phil. Tranf. N° 183, or Abr. vol. ii. p. 133, &c. Robertfon's Elem. of Nav. b. vi. f. 6. Cavallo's Philof. vol. ii.

The winds are divided, with refpect to the points of the horizon from which they blow, into *cardinal* and *collateral*.

WINDS, *Cardinal*, are thofe blowing from the four cardinal points; eaft, weft, north, and fouth.

Thus, a wind that blows from the E. towards the W. is called *eaft wind;* when it blows from the W. towards the E., *weft wind;* when it blows from the N. to the S., it is called *north wind;* and when it blows from the S. towards the N., it is called *fouth wind.*

WINDS, *Collateral*, are the intermediate winds between any two cardinal winds. The number of thefe is infinite, as the points from which they blow are; but only a few of them are confidered in practice; *i. e.* only a few of them have their diftinguifhing names.

Thofe winds which deviate a little from the cardinal points are called *northerly*, *eafterly*, *foutherly*, and *wefterly* winds. But for the fake of greater diftinction, the fpace or arch which lies between any two contiguous cardinal points, is fuppofed, by the mariners, to be divided into eight equal parts, or *points*, and each point into four equal parts, called *quarter-points*. So that the horizon is fuppofed to be divided into thirty-two principal points, which are called *rhumbs*, or *winds*, to each of which a particular name is affigned; and thofe names are derived from the names of the adjacent cardinal points. See COMPASS.

The ancient Greeks, at firft, only ufed the four cardinal ones; at length they took in four more. Vitruvius gives us a table of twenty, befides the cardinals, which were in ufe among the Romans.

The moderns, as their navigation is much more perfect than that of the ancients, have given names to twenty-eight collateral winds, which they range into *primary* and *fecondary;* and the fecondary they fubdivide into thofe of the *firft* and *fecond order*.

The Englifh names of the primary collateral winds and points are compounded of the names of the cardinal ones, north and fouth being ftill prefixed.

The names of the fecondary collateral winds of the firft order are compounded of the names of the cardinals, and the adjacent primary one. Thofe of the fecond order are compounded of the names of the cardinal, or the next adjacent primary; and the next cardinal, with the addition of the word *by*. The Latins have diftinct names for each; all which are expreffed in the following Table.

Names of the Winds and Points of the Compaſs. English.	Latin and Greek.	Diſtances of the Points, &c. from the North.	
1. *North.*	*Septentrio*, or *Boreas*.	0°	0′
2. North by eaſt.	Hyperboreas. Hypaquilo. Gallicus.	11	15
3. North-north-eaſt.	Aquilo.	22	30
4. North-eaſt by north.	Meſoboreas. Meſaquilo. Supernas.	33	45
5. *North-eaſt.*	*Arctapeliotes. Borapeliotes. Græcus.*	45	
6. North-eaſt by eaſt.	Hypocæſias.	56	15
7. Eaſt-north-eaſt.	Cæſias, Helleſpontius.	67	30
8. Eaſt by north.	Meſocæſias. Carbas.	78	45
		From the E.	
9. *Eaſt.*	*Solanus, ſubſolanus, apeliotes.*	0°	0′
10. Eaſt by ſouth.	Hypeurus, or hypereurus.	11	15
11. Eaſt-ſouth-eaſt.	Eurus, or volturnus.	22	30
12. South-eaſt by eaſt.	Meſeurus.	33	45
13. *South-eaſt.*	*Notapeliotes, euraſter.*	45	
14. South-eaſt by ſouth.	Hypophœnix.	56	15
15. South-ſouth-eaſt.	Phœnix, phœnicias, leuco-notus, gangeticus.	67	30
16. South by eaſt.	Meſophœnix.	78	45
		From the S.	
17. *South.*	*Auſter, notus, meridies.*	0°	0′
18. South by weſt.	Hypolibonotus, alſanus.	11	15
19. South-ſouth-weſt.	Libonotus, notolibycus, auſtro-africus.	22	30
20. South-weſt by ſouth.	Meſolibonotus.	33	45
21. *South-weſt.*	*Noto-zephyrus. Noto-libycus. Africus.*	45	
22. South-weſt by weſt.	Hypolibs. Hypafricus. Subveſperus.	56	15
23. Weſt-ſouth-weſt.	Libs.	67	30
24. Weſt by ſouth.	Meſolibs. Meſozephyrus.	78	45

Names of the Winds and Points of the Compaſs. English.	Latin and Greek.	Diſtances of the Points, &c. from the Weſt.	
25. *Weſt.*	*Zephyrus, favonius, occidens.*	0°	0′
26. Weſt by north.	Hypargeſtes. Hypocorus.	11	15
27. Weſt-north-weſt.	Argeſtes. Caurus, corus, iapyx.	22	30
28. North-weſt by weſt.	Meſargeſtes. Meſocorus.	33	45
29. *North-weſt.*	*Zephyro-boreas, borolibycus, olympias.*	45	
30. North-weſt by north.	Hypocircius. Hypothraſcias. Scirem.	56	15
31. North-north-weſt.	Circius, thraſcias.	67	30
32. North by weſt.	Meſocircius.	78	45

Note.—The ancient names are here, after Ricciolus, adapted to the modern ones; not that the winds formerly denoted by thoſe were preciſely the ſame with theſe, (for the ancient number and diviſion being different from the modern, the points they refer to will neceſſarily be ſomewhat different,) but theſe are what come the neareſt. Thus, Vitruvius, only reckoning twenty-four winds, diſpoſes the points they refer to in a different order; as in the following Table.

Names of the Winds.	Diſtance from North.	Names of the Winds.	Diſtance from Eaſt.
1. *Septentrio.*	0°	7. *Solanus.*	0°
2. Gallicus.	15	8. Ornithias.	15
3. Supernas.	30	9. Cæſias.	30
4. Aquilo.	45	10. Eurus.	45
5. Boreas.	60	11. Volturnus.	60
6. Carbas.	75	12. Euronotus.	75
Names of the Winds.	**Diſtance from South.**	**Names of the Winds.**	**Diſtance from Weſt.**
13. *Auſter.*	0°	19. *Favonius.*	0°
14. Alſanus.	15	20. Eteſiæ.	15
15. Libonotus.	30	21. Circius.	30
16. Africus.	45	22. Caurus.	45
17. Subveſper.	60	23. Corus.	60
18. Argeſtes.	75	24. Thraſcias.	75

The

The following Table ſhews the angles which every rhumb or point of the compaſs makes with the meridian: by means of which the direction of the wind, &c. may be determined.

North.	South.	Points.	D. M.	North.	South.
		$\frac{1}{4}$	2 49		
		$\frac{1}{2}$	5 $37\frac{1}{2}$		
		$\frac{3}{4}$	8 26		
N. by E.	S. by E.	1	11 15	N. by W.	S. by W.
		$1\frac{1}{4}$	14 4		
		$1\frac{1}{2}$	16 $52\frac{1}{2}$		
		$1\frac{3}{4}$	19 41		
N.N.E.	S.S.E.	2	22 30	N.N.W.	S.S.W.
		$2\frac{1}{4}$	25 19		
		$2\frac{1}{2}$	28 $7\frac{1}{2}$		
		$2\frac{3}{4}$	30 56		
N.E. by N.	S.E. by S.	3	33 45	N.W. by N.	S.W. by S.
		$3\frac{1}{4}$	36 34		
		$3\frac{1}{2}$	39 $22\frac{1}{2}$		
		$3\frac{3}{4}$	42 11		
N.E.	S.E.	4	45 0	N.W.	S.W.
		$4\frac{1}{4}$	47 49		
		$4\frac{1}{2}$	50 $37\frac{1}{2}$		
		$4\frac{3}{4}$	53 26		
N.E. by E.	S.E. by E.	5	56 15	N.W. by W.	S.W. by W.
		$5\frac{1}{4}$	59 4		
		$5\frac{1}{2}$	61 $52\frac{1}{2}$		
		$5\frac{3}{4}$	64 41		
E.N.E.	E.S.E.	6	67 30	W.N.W.	W.S.W.
		$6\frac{1}{4}$	70 19		
		$6\frac{1}{2}$	73 $7\frac{1}{2}$		
		$6\frac{3}{4}$	75 56		
E. by N.	E. by S.	7	78 45	W. by N.	W. by S.
		$7\frac{1}{4}$	81 34		
		$7\frac{1}{2}$	84 $22\frac{1}{2}$		
		$7\frac{3}{4}$	87 11		
East.	East.	8	90 0	West.	West.

For the uſe of the winds in navigation, &c. ſee Sailing.

Wind, a diſeaſe in ſheep of a very dangerous and diſtreſſing kind.

It is obſerved in the Shepherd's Guide, that in this complaint, the ſheep, immediately after being clipped or ſhorn, appear to be in violent pain, their ſides are ſomewhat extended, and their breathing very ſhort, the head is hung down drooping, and they have a great averſion to moving or walking. Theſe ſymptoms continue to increaſe until the ſheep dies, which is in a very few hours, unleſs a violent purging comes on, which generally gives immediate relief. On inquiring for the name of this affection, the writer ſays, he found it was called the wind, but where the ſeat of it lay few could tell him; ſome thought it was in the head, others in the lungs; and the remedies they applied were as various as their opinions of the nature of the diſeaſe.

Not being ſatisfied with theſe accounts, he endeavoured, by inſpecting the carcaſes of ſheep that died of the diſeaſe, to diſcover the cauſe and ſeat of the complaint. On opening four ſheep that died of the diſeaſe, he found all the inteſtines rather diſtended with flatus, but not in any great degree. Their blood-veſſels were very turgid, and of a deep red, particularly thoſe of the large inteſtines, excepting the rectum, or what is called the *bum-gut*, which had a healthy appearance, as likewiſe had the ſtomach, milt, caul, liver, heart, lungs, and in ſhort all the viſcera contained in the cavity of the trunk. From theſe appearances he will venture to ſay, that the diſeaſe in queſtion is a violent inflammation of the inteſtines, perhaps in ſome meaſure ariſing from bruiſes in ſhearing, but more ſo from loſing a warm clothing, and being ſuddenly expoſed to cold air and cold feeding.

He therefore recommends to farmers, that on the firſt appearances of the complaint they put the ſheep into a ſtable or other warm place, and immediately bleed it freely. Then to bruiſe a quarter of an ounce of ſome carminative ſeed, ſuch as carraway, aniſe, cummin, or fennel, and to mix theſe with two ounces of Glauber's purging ſalts, in a pint of water, placing it on a fire, and making it boil for a few minutes, then to ſtrain it off. Then to add a quarter of an ounce

ounce of powdered jalap, and while lukewarm to give the ſheep a quarter of a pint of this liquor, well ſhaken together, every half hour till it dungs. It ſhould have no food or cold water until recovered, but a little warm water might be of ſervice in ſome caſes.

This is a diſorder which is in general ſo ſuddenly fatal, that recourſe ſhould be inſtantly had to any remedy that may have been found beneficial; but bleeding is probably that on which the greateſt dependence may be placed, with calomel in ſome inſtances.

WIND, among *Animals*, is another name for the breath, or rather for the power with which the lungs are endowed in the exerciſe of their functions, which in many caſes is a ſort of morbid affection of them, eſpecially in horſes, ſwine, calves, and ſome others. Horſes are often thick-winded and purſive, which is this ſtate, and require much exerciſe and management, and the other two are ſometimes affected in much the ſame way.

WIND, in *Rural Economy*, a term applied to a winch or wince in ſome places.

WIND, *Freſh*. See FRESH.

WIND, *To haul the*. See HAUL.

WIND, *Large*, in the *Sea Language*. See LARGE.

WIND, *Quarter*, at *Sea*. See QUARTER.

WINDS, *Reigning*. See REIGNING.

WINDS, *Tropic*. See TRADE-*Winds*, and WIND *ſupra*.

WIND, *Side*, at *Sea*, that which blows on the ſide of the ſhip.

To WIND *a Ship* or *Boat*, in *Sea Language*, is to change her poſition, by bringing the ſtern to lie in the ſituation of the head, or directly oppoſite to its former ſituation.

WIND, in the *Manege*. A horſe that carries in the wind, is one that toſſes his noſe as high as his ears, and does not carry handſomely.

The difference between carrying in the wind and beating upon the hand is, that a horſe who beats upon the hand ſhakes his head, and reſiſts the bridle; but he who carries in the wind, puts up his head without ſhaking, and only ſometimes beats upon the hand. The oppoſite to carrying in the wind is arming and carrying low.

WIND, *Whirl*. See WHIRL-*Wind*.

WIND, *Colic*. See COLIC.

WIND-*Dropſy*. See TYMPANITES.

WIND-*Egg*, an addle egg, or an egg that has taken wind. See EGG.

WIND-*Fall* denotes fruit blown off the tree by the wind.

WIND-*Flower*, in *Botany*. See ANEMONE.

WIND-*Furnace*. See FURNACE.

WIND-*Gage*, in *Pneumatics*, an inſtrument ſerving to determine the velocity and force of the wind. See ANEMOMETER, ANEMOSCOPE, and *Laws of the Force, &c. of the* WIND *ſupra*.

Dr. Lind, of Edinburgh, has contrived an apparatus of this kind, which is ſimple and eaſy of conſtruction, and which ſeems to be well adapted for meaſuring the force of the wind with a ſufficient degree of accuracy. This inſtrument conſiſts of two glaſs tubes A B, C D, (*Plate* XV. *Pneumatics*, *fig.* 9.) five or ſix inches in length, and about four-tenths of an inch in bore; which are connected together like a ſiphon, by a ſmall bent glaſs tube *a b*, the bore of which is one-tenth of an inch in diameter. On the upper end of the leg A B there is a tube of latten braſs, which is kneed or bent perpendicularly outwards, and has its mouth open towards F; on the other leg C D is a cover, with a round hole G in the upper part of it, two-tenths of an inch in diameter. This cover and the kneed tube are connected together by a ſlip of braſs, *c d*, which ſtrengthens the whole inſtrument, and ſerves to hold the ſcale H I. The kneed tube and cover are fixed on with hard cement, or ſealing-wax. To the ſame tube is ſoldered a piece of braſs, *e*, with a round hole in it, to receive the ſteel ſpindle K L, and at *f* another ſuch piece of braſs is ſoldered to the braſs hoop *g h*, which ſurrounds both legs of the inſtrument. There is a ſmall ſhoulder on the ſpindle at *f*, upon which the inſtrument reſts, and a ſmall nut *i*, to prevent it from being blown off the ſpindle by the wind. The whole inſtrument is eaſily turned round upon the ſpindle by the wind, ſo as always to preſent the mouth of the kneed tube toward it. At the end of the ſpindle there is a ſcrew, by which it may be ſcrewed to the top of a poſt or ſtand: it has alſo a hole at L, to admit a ſmall lever for ſcrewing it into wood with greater facility. A thin plate of braſs *k* is ſoldered on the kneed tube, about half an inch above the round hole G, ſo as to prevent rain from falling into it. There is alſo a crooked tube A B (*fig.* 10.), to be put occaſionally upon the mouth of the kneed tube F, in order to prevent rain from being blown into the mouth of the wind-gage, when it is left expoſed to the rain.

This inſtrument ſerves to aſcertain the force of the wind, by filling the tube half full of water, and puſhing the ſcale a little up or down, till o upon the ſcale, when the inſtrument is held perpendicularly, be on a line with the ſurface of the water, in both legs of the wind-gage. The inſtrument being thus adjuſted, hold it up perpendicularly, and turning the mouth of the kneed tube toward the wind, obſerve how much the water is depreſſed by it in one leg, and how much it is raiſed in the other. The ſum of the two is the height of a column of water, which the wind is capable of ſuſtaining at that time; and every body that is oppoſed to that wind, will be preſſed upon by a force equal to the weight of a column of water, having its baſe equal to the ſurface that is oppoſed, and its height equal to the altitude of the column of water ſuſtained by the wind in the wind-gage. Hence the force of the wind upon any body, where the ſurface oppoſed to it is known, may be eaſily found; and a ready compariſon may be made betwixt the ſtrength of one gale of wind, and that of another, by knowing the heights of the columns of water which the different winds were capable of ſuſtaining. The heights of the column in each leg will be equal, provided that the legs are of equal bores; but unequal if their bores are unequal. For ſuppoſe the legs equal, and the column of water ſuſtained by the wind to be three inches, the water in the leg which the wind blows into will be depreſſed $1\frac{1}{2}$ inch below o, and raiſed as much in the other leg. But if the bore of the leg which the wind blows into be double that of the other, the water in that leg will be depreſſed only one inch, whilſt it is raiſed twice as much, or two inches, in the other, and *vice verſâ*.

The force of the wind may likewiſe be meaſured with this inſtrument, by filling it till the water runs out at G. For if it be then held up to the wind as before, a quantity of water will be thrown out; and if both legs of the inſtrument are of the ſame bore, the height of the column ſuſtained will be equal to double the column of water in either leg, or the ſum of what is wanting in both legs. But if the legs are of unequal bores, neither of theſe will give the true height of the column of water which the wind ſuſtained. For, obtaining in this caſe the true height, Dr. Lind has ſubjoined the requiſite formulæ. The uſe of the ſmall tube of communication *a b* (*fig.* 9.), is to check the undulation of the water, ſo that the height of it may be read off from the ſcale with eaſe and certainty; and alſo to prevent the water

water from being thrown up to a much greater or lefs altitude than the true height of the column which the wind is able at that time to fuftain. The author has calculated a table, by means of which, having the height of the column of water fuftained in the wind-gage, the force of the wind upon a foot fquare may be determined.

Height of the Water in the Gage.	Force of the Wind on One Foot Square in Pounds Avoirdupois.	Common Defignations of fuch Winds.
Inches.		
12	62.500	
11	57.293	
10	52.083	Moft violent hurricane.
9	46.875	
8	41.667	Very great hurricane.
7	36.548	Great hurricane.
6	31.750	Hurricane.
5	26.041	Very great ftorm.
4	20.833	Great ftorm.
3	15.625	Storm.
2	10.416	Very high wind.
1	5.208	High wind.
0.5	2.604	Brifk gale.
0.1	0.521	Frefh breeze.
0.05	0.260	Pleafant wind.
0.025	0.030	A gentle wind.

When the height of the water is not exactly mentioned in the table, then that height may be feparated into fuch parts as are mentioned in the table, and the fum of the forces anfwering to fuch parts will be the force of the wind correfpondent to the height in queftion: thus, if the height of the water be 4.6 inches; then this height is equal to 4 + 0.5 + 0.1, which parts are all in the table; therefore,

Inches.		Pounds.
4	-	20.833
0.5	-	2.604
0.1	-	0.521

The fum is 23.958, which expreffes the force of the wind when the height of the water in the gage is 4.6 inches.

Any alteration that can ufually take place in the temperature of the water, makes no fenfible difference in this inftrument.

In frofty weather this gage cannot be ufed with common water. At that time fome other liquor muft be ufed, which is not fo fubject to freeze; and, upon the whole, a faturated folution of common falt in water is the moft eligible: but in that cafe, (fince the fpecific gravity of a faturated folution of falt is to that of pure water, as 1.244 to 1,) the forces which are ftated in the preceding table muft be multiplied by 1.244. Thus, if in the preceding example the faturated folution of falt had been ufed inftead of water only, the force of the wind on a fquare foot would have been 29.8 pounds.

When falt-water is ufed, the force of the wind, which is ftated in the table, muft be increafed in the proportion of the fpecific gravity of falt-water to that of common water; thus, ufing the preceding example, we muft fay, as 1 : 1.244 : : 23.958 to a fourth proportional, which muft be found by multiplying the fecond term by the third, and then dividing the product by the firft term; but, the firft term being unity, we need only multiply 23.958 by 1.244.

On the 9th of May, 1775, Dr. Lind obferved, that the wind fupported a column of water in his wind-gage $6\frac{7}{10}$ inches in height; and from his table it appeared, that the force of the wind in this hurricane, which did great damage to the gardens in his neighbourhood, was equal to 34.921 pounds avoirdupois, on every fquare foot.

If the velocity and denfity of the wind in any particular cafe were accurately determined, this inftrument, which gives its force or momentum, would enable us to afcertain the velocity in every other cafe, the denfity being known: for the force of the wind is as the fquare of its velocity. Phil. Tranf. vol. lxv. part ii. art. 34. p. 353, &c.

Mr. Martin, from a hint firft fuggefted by Dr. Burton, contrived an anemofcope, or wind-gage, of the following conftruction. A B C D E F G H I (*fig.* 11.) is an open frame of wood, firmly fupported by the fhaft or poftern I. In the two crofs pieces H K, L M, is moved an horizontal axis Q M, by means of the four fails *a b*, *c d*, *e f*, *g h*, in a proper manner, expofed to the wind. Upon this axis is fixed a cone of wood M N O, upon which, as the fails move round, a weight S is raifed by a ftring on its fuperficies, proceeding from the fmall to the largeft end N O. Upon the great end or bafe of the cone is fixed a ratchet-wheel *i k*, in whofe teeth falls the click X, to prevent any retrograde motion from the depending weight.

From the ftructure of this machine, it is eafy to underftand, that it may be accommodated to eftimate the variable force of the wind, becaufe the force of the weight will continually increafe, as the ftring advances on the conical furface, by acting at a greater diftance from the axis. And, therefore, if fuch a weight be put on, on the fmalleft part at M, as will juft keep the machine in equilibrio with the weakeft wind; then as the wind becomes ftronger, the weight will be raifed in proportion, and the diameter of the bafe of the cone N O may be fo large in comparifon of that of the fmaller end or axis at M, that the ftrongeft wind fhall but juft raife the weight to the great end.

Thus, for example, let the diameter of the axis be to that of the bafe of the cone N O as 1 to 28; then if S be a weight of one pound at M on the axis, it will be equivalent to twenty-eight pounds, or $\frac{1}{4}$ of an hundred, when raifed to the greateft end. If, therefore, when the wind is weakeft, it fupports one pound on the axle, it muft be twenty-eight times as ftrong to raife the weight to the bafe of the cone. Thus may a line or fcale of twenty-eight equal parts be drawn on the fide of the cone, and the ftrength of the wind will be indicated by that number therein from which the ftring fhall at any time hang.

Furthermore, the ftring may be of fuch a fize, and the cone of fuch a length, that there fhall be fixteen revolutions of the ftring between each divifion of the fcale on the cone; fo will the ftrength of the wind be expreffed in pounds and ounces. And if greater exactnefs be required, let the periphery of the cone's bafe be divided into fixteen equal parts; then whenever the equilibrium happens, the ftring will leave the conic furface againft one of thofe divifions, and thus fhew the force of the wind to a drachm avoirdupois weight. Martin's Phil. Brit. vol. ii. p. 211, &c.

M. Bouguer contrived a very fimple inftrument, by means of which we may immediately difcover the force which the wind exerts on a given furface. This is a hollow tube A A B B (*fig.* 12.), in which a fpiral ftring C D is fixed, that may be more or lefs compreffed by a rod F S D, paffing

paffing through a hole within the tube at A A; then having obferved to what degree different forces or given weights are capable of compreffing the fpiral, mark divifions on the rod in fuch a manner, that the mark at S may indicate the weight requifite to force the fpring into the fituation C D; afterwards join at right angles to this rod at F, a plane furface E F E of a given area, either greater or lefs, at pleafure; then let this inftrument be oppofed to the wind, fo that it may ftrike the furface in the directions V E, V E, parallel to that of the rod, and the mark at S will fhew the weight to which the force of the wind is equivalent.

The ingenious profeffor Leflie (Enquiry into the Nature and Propagation of Heat) having found, in the courfe of his experiments on heat, that the refrigerant, or cooling power of a current of air, is exactly proportional to its velocity, derives from this principle the conftruction of a new and fimple anemometer. "It is in reality nothing more," fays he, "than a thermometer, only with its bulb larger than ufual. Holding it in the open ftill air, the temperature is marked: it is then warmed by the application of the hand, and the time is noted which it takes to fink back to the middle point. This I fhall term the fundamental meafure of cooling. The fame obfervation is made on expofing the bulb to the impreffion of the wind, and I fhall call the time required for the bifection of the interval of temperatures, the occafional meafure of cooling. After thefe preliminaries, we have the following eafy rule: Divide the fundamental by the occafional meafure of cooling, and the excefs of the quotient above unit, being multiplied by $4\frac{1}{2}$, will exprefs the velocity of the wind in miles *per* hour. The bulb of the thermometer ought to be more than half an inch in diameter, and may, for the fake of portability, be filled with alcohol, tinged, as ufual, with archil. To fimplify the obfervation, a fliding fcale of equal parts may be applied to the tube. When the bulb has acquired the due temperature, the zero of the flide is fet oppofite to the limit of the coloured liquor in the ftem; and after having been heated, it again ftands at 20° in its defcent, the time which it thence takes until it finks to 10° is meafured by a ftop-watch. Extemporaneous calculation may be avoided, by having a table engraved upon the fcale for the feries of occafional intervals of cooling."

WIND-*Gall*, a difeafe in horfes and fome other animals. It is a puffy kind of fwelling or tumour, which yields to the preffure of the finger, but upon removing the preffure recovers itfelf, and pufhes out as before. Thefe fwellings have been thus named from a falfe notion of their containing nothing but air or wind. Thefe tumours are often feated on both fides of the back-finew of a horfe, above the fetlock on the fore-legs, but moft frequently on the hind-legs. They are quite loofe and detached from the parts on which they grow, and exhibit the fame figns whereever they are met with, whether in the hocks or about the knees; for thefe fwellings are not confined to the lower limbs only, but appear in any of thofe parts of a horfe's body where the cellular membrane can be eafily feparated; and they exift, for the moft part, without occafioning any pain. They are ufually caufed by riding on very hard roads, or on dry hilly grounds. Sometimes travelling horfes, when they are worked too young, before the limbs are grown firm and vigorous, will have them. And Gibfon obferves, that they fometimes proceed from conftitutional weaknefs, efpecially in bulky horfes, that are fomewhat under-limbed and flefhy about the fetlock-joint. Thefe, it is faid, have been known to have wind-galls without any ftrain, hard riding, or other ill ufage of any kind.

It has been obferved too, that when thefe tumours appear upon the hind-legs they never caufe lamenefs, though fuch horfes are often ftiff behind after riding. When on the fore-legs they always make a horfe go lame at firft; but afterwards that tendernefs goes off in a great meafure, and they feldom go lame, but ftiff, and inclinable to ftumble. They generally recover, however, with a day's reft. Thofe flatulent fwellings indeed that come in the ligaments of the hocks are always troublefome, disfigure the animal, and, unlefs fpeedily affifted, will caufe incurable lamenefs. At firft they are but fmall, but in time they grow to the fize of a pullet's egg, perhaps, and pufh out on each fide of the hollow of the hock. Swellings of the fame kind alfo appear before the knee, where they often precede a difeafed joint. Very fmall fimilar fwellings under the fore part of the knee, in the interftices of both fides of the joint, are alfo dangerous; but thefe feldom happen, and are ufually caufed by fome violent ftrain, efpecially when a horfe falls down upon a defcent with his whole weight upon his knees. The other flatulent fwellings which horfes are fubject to feldom caufe lamenefs, but are, for the moft part, eafily cured. We mean thofe that arife in the interftices of the large mufcles of the hips and thighs, which are diftended like little bladders filled with air. Thefe come by ftrains and over-exertion; for draught-horfes are the moft fubject to them.

Wind-galls that proceed from mere weaknefs are feldom curable, unlefs the conftitution can be improved; but we often fee horfes that were fubject to wind-galls when young, get the better of them as they advance in age. The methods of cure in thefe cafes is by means of bliftering, firing, and the ufe of aftringent applications.

As thefe are enlargements of the capfules, or *burfæ mucofæ*, fituated between the tendons, that contain an oily lubricating fluid for the prevention of friction and to facilitate motion, arifing from long exertion producing inflammation of them, and an increafed fecretion of the contained fluid, they are capable of being eafily removed in their beginning ftates, by reft and the ufe of blifters to the parts compofed of cantharides and corrofive fublimate with olive oil; afterwards turning the animals out to grafs or the ftraw-yard. Or where this cannot be permitted, the parts may be ftrengthened by the ufe of a flannel roller, made and continued wet by a wafh compofed of equal parts of ftrong vinegar and Goulard water, or the latter alone in fome cafes. If, however, the difeafe may have been neglected, recourfe muft be had to the hot iron; after which the bliftering fhould be practifed as before advifed.

WIND-*Gun*. See AIR-*Gun*.

WIND-*Hatch*, in *Mining*, a term ufed to exprefs the place at which the ore is taken out of the mines.

The word *hatch* is the general term ufed by the miners to exprefs an opening from the furface into the mine, or in the attempting to find a mine.

Thus the word *effay-hatches* fignifies the openings made in fearch of the trains of fhoad-ftones; and the *tin-hatch* in Cornwall is the name of the opening by which they defcend into a tin-mine.

The word *wind-hatch* feems to be a corruption of *winder-hatch*; for at thefe places they have a winder conveying two buckets, the one conftantly up, the other conftantly down; the man below fills the bucket that defcends; and when that which afcends full is emptied at the mouth of the hatch, the perfon who has the care of that part of the work, delivers it empty to go down again. Phil. Tranf. N° 69.

WIND-*Hover*, in *Ornithology*, the name of a fpecies of hawk,

hawk, called alfo by fome the *ftannel*, but more ufually the *keftrel*, and known among authors by the names of the *tinnunculus* and *cenchris*.

WIND-*Inftruments*, in *Mufic*, are inftruments played by wind, chiefly by the breath; in contradiftinction to ftringed-inftruments, and inftruments of the *pulfative* kind.

The wind-inftruments known to the ancients were, the *tibia*, *fiftula*, or *fyringa* of Pan, confifting of feven reeds, joined fidewife; alfo, *organs*, *tubæ*, *cornua*, and the *lituus*. Thofe of the moderns are, the *flute*, *bagpipe*, *hautboy*, *trumpet*, &c. See INSTRUMENT, and MUSIC.

WIND-*Mill*, in *Mechanics*, a machine which is put in motion by the force of the wind. Wind-mills are in general applied to the purpofe of grinding corn, but are occafionally ufed to give motion to machines for raifing water, fawing-mills, or for other purpofes. We fhall in this article confider the wind-mill as a firft mover, or *primum mobile*, which may be applied to many purpofes.

The invention of wind-mills is not of very remote date. According to fome authors they were firft ufed in France in the fixth century; while others maintain that they were brought to Europe in the time of the crufades, and that they had long been employed in the Eaft, where the fcarcity of water precluded the application of that powerful agent to machinery.

The wind-mill, though a common machine, has fome things in it more ingenious than is ufually imagined. Add, that it is commonly allowed to have a degree of perfection, which few of the popular engines have attained to, and which the makers are but little aware of: though the aid of mathematics has furnifhed ample matter for its improvement.

The vertical wind-mill, which is the kind in moft common ufe, confifts of an axis or fhaft A B, (*fig.* 1. *Plate* II. *Wind-Mill*,) placed in the direction of the wind, and ufually inclining a little upwards from the horizontal line. At one end of this, four long arms or yards, S, T, V, W, are fixed perpendicular to the axis, and crofs each other at right angles; into thefe arms fmall crofs-bars are mortifed at right angles; and other long bars are joined to them, which are parallel to the length of the arms; fo that the bars interfect each other in the manner of lattice-work, and form a furface, on which a cloth can be fpread to receive the action of the wind. Thefe are called the fails; they are in form of a trapezium, and are ufually nine yards long and two wide.

The circular motion is produced by the obliquity of the planes of thefe furfaces, from the plane in which all the four arms are fituated; by thefe means, when the wind blows in the direction of the axis, it does not impinge upon the fails at right angles to their furfaces, but ftrikes obliquely; hence the effort of the fail to recede from the wind, caufes it to turn round with the common axis, and the four fails are all made oblique in the fame direction, fo as to unite their efforts for the common object.

That the wind may act with the greateft efficiency upon the fails, the wind-fhaft muft have the fame direction as the wind. But as this direction is perpetually changing, fome apparatus is neceffary for bringing the wind-fhaft and fails into their proper pofition: this is done by turning the axis and fails round in an horizontal direction. There are two methods of effecting this. In the old mills, like *fig.* 1, the whole of the mill or building which contains the machinery is fuftained upon a vertical poft, firmly fixed as a ftand or foot, upon which the whole machine can be turned by a lever, to prefent the fails to any quarter of the horizon from whence the wind blows; and hence thefe are called poft wind-mills, and are neceffarily made of wood. The other kind, *fig.* 2, is called a fmock-mill, in which only the dome-cap or head, which contains the axis of the fails, and covers the great cog-wheel, turns round horizontally; the other parts of the machinery being contained in a fixed building, which rifes up in form of a conical tower of mafonry, and is furmounted by this moveable cap or dome, which is fupported on rollers, fo as to turn round eafily.

As both the common methods of adjufting the wind-fhaft require human affiftance, it would be very defirable that the fame effect fhould be produced folely by the action of the wind. This may be done by fixing a large wooden vane or weathercock at the extremity of a long horizontal arm, which lies in the fame vertical plane with the wind-fhaft.

By thefe means, when the furface of the vane and its diftance from the centre of motion are fufficiently great, a very gentle breeze will exert a fufficient force upon the vane to turn the machinery, and will always bring the fails and wind-fhaft to their proper pofition. This weathercock, it is evident, may be applied either to machines which have a moveable roof, or to thofe which revolve upon a vertical arbor. This method is practifed in fmall machines; but a vane of fufficient power to turn a large mill about would be unwieldy. A much better method is therefore practifed in the beft mills, as we fhall foon defcribe.

In a *poft-mill* the building muft neceffarily be of fmall fize, and it can only contain one pair of mill-ftones. For this purpofe, a large cog-wheel is fixed upon the main-fhaft or axis of the fails; the cogs are placed in the face or flat furface of the wheel, and act upon the teeth of a pinion, which is fixed upon the vertical axis or fpindle of the mill-ftones. The mill-houfe is of a rectangular figure, but narrow in the direction which is prefented to the wind: it is two ftories high, the main-fhaft and mill-ftones being in the upper chamber, whilft the lower is only ufed to contain facks of flour, and alfo to receive the poft on which the mill turns round horizontally to face the wind. This poft is a very ftrong tree, and is held perpendicularly by fixing it upon the middle of long timbers, which form a large crofs on the ground, and are the bafement of the whole mill. The poft is fixed perpendicularly by means of feveral oblique braces, extending from the ground-crofs to the middle part of the poft; but ten or twelve feet of the upper end of the poft muft be round, and clear from the obftruction of the braces. This part of the poft rifes up through the middle of the lower chamber, in the floor of which a circular collar is formed, to furround the lower part of the poft exactly. At the upper end of the poft is a pivot or gudgeon, which enters into a focket fixed in the middle of the upper floor, and to one of the ftrongeft crofs-beams, becaufe this beam muft fuftain the whole weight of the mill. In this manner, the whole mill can turn about upon the vertical poft, but remains always in equilibrio. To make it firm, and prevent it from turning about at every moment, a ftrong framing is united by joints to the back part of the mill-houfe, and defcends in a floping direction till it touches the ground: this is furnifhed with fteps, fo that it ferves as a broad ladder to afcend to the mill; but another ufe is to fteady the mill, becaufe the end of this frame, which is very heavy, refts on the ground, and fhort pofts are fixed in a circle round the mill at regular intervals, to which the end of the ladder is faftened with cords. In order to turn the mill about, a rope is faftened to the end of the floping ladder, and is carried up to the top of the mill in an inclined direction. By means of a ftrong lever, or a tackle of pulleys, this rope can be fhortened, fo as to lift up the ladder clear of the ground; and then, by pufhing it like a long lever, the whole mill is turned round. To obtain more force, a fmall capftan is often provided to draw

a rope

a rope attached to the end of the ladder. This capſtan is moveable, and is faſtened at pleaſure to any one of the poſts which are fixed in the ground.

The internal mechaniſm of a poſt wind-mill is exhibited in *fig.* 3. *Plate* II. *Wind-Mill.* A H O is the upper room; H *o z* the lower one; A B the axis paſſing through the mill; S, T, V, W, the ſails, covered with canvas, ſet obliquely to the wind, and turning round in the order of the letters in *fig.* 1; C the cog-wheel, having about forty-eight cogs, which carry round the lantern E, having eight or nine rounds, together with its ſpindle G N; K is the upper mill-ſtone, and L the lower one; Q R is the bridge ſupporting the axis or ſpindle G N; this bridge is ſupported by the beams *c* and X Y, wedged up at *c* and Q; *z* Y is the lifting-tree, which ſtands upright; *a b* and *e f* are levers, whoſe centres of motion are *a* and *u*; *f g h i* is a cord, with a ſtone, *i*: it goes about the pins *g* and *h*, to wind up and raiſe the ſtone at pleaſure. The ſpindle *t* N is fixed to the upper mill-ſtone K, by a piece of iron called the rynd, and fixed in the lower ſide of the ſtone, which is the only one that turns about, and its whole weight reſts upon a hard ſtone, fixed in the bridge Q R at N. The trundle E, and axis G *t*, may be taken away; for it reſts by its lower part at *t* by a ſquare ſocket, and the top runs in the edge of the beam *w*. By bearing down the end *f* of the lever *f e*, *b* is raiſed, which raiſes *z* Y, and this raiſes Y X, which lifts up the bridge Q R, with the axis N G, and the upper ſtone K; and thus the ſtones are ſet at any diſtance. The lower immoveable ſtone is fixed upon ſtrong beams, and is broader than the upper one: the flour is conveyed through the tunnel *n o* into a cheſt; P is the hopper, into which is put the corn, which runs along the ſpout *r* into the hole *t*, and ſo falls between the ſtones, where it is ground. The axis G *t* is ſquare, which ſhaking the ſpout *r*, as it goes round, makes the corn run out; *r s* is a ſtring going about the pin *s*, and ſerving to move the ſpout nearer to or farther from the axis, ſo as to make the corn run faſter or ſlower, according to the velocity and force of the wind. And when the wind is great, the ſails S, T, V, W, are only in part or one ſide covered; or perhaps only one half of two oppoſite ſails. Toward the end B of the axis another cog-wheel may be fixed, with a trundle and mill-ſtones, like that already deſcribed; ſo that the ſame axis moves two ſtones at once; and when only one pair is to grind, the trundle E, and axis G *t*, are taken out from the other; *x y l* is a girt or gripe of pliable wood, fixed at the end *x*; and the other end *l* is tied to the lever *k m*, moveable about *k*; and the end *m* being put down, draws the gripe *x y l* cloſe to the cog-wheel; and thus the motion of the mill is ſtopped at pleaſure; *p q* is a ladder for aſcending to the higher part of the mill; and the corn is drawn up by means of a rope, rolled about the axis A B, when the mill is at work.

The ſtructure of the mill-ſtones, or grinding parts, is the ſame as the water-mills. See Mill.

It is plain that this conſtruction confines all the machinery to the two chambers, or that part of the mill which is poiſed upon the vertical poſt; hence this kind of wind-mill is unfit for any other purpoſes than that of grinding corn, and for expreſſing oil, becauſe there is ſo little room for the machinery. The Dutch, who are famous for wind-mills, make them ſometimes with a very large poſt, which has a hole down through the centre of it, like a trunk, and through this, a perpendicular axis paſſes to convey the power of the mill down into a building below, and upon the top of which, as a roof, the foundation-beams of the poſt are fixed. (See *fig.* 4.) In this way, the mill is applied to ſaw wood, or to make paper, or any other purpoſe; but the conſtruction is complicated, and leſs effective than the other kind of mill, in which only the head or top turns round, as we ſhall now deſcribe.

The Smock-Mill.—This is the beſt kind of mill, becauſe the building which contains the machinery may be made of any required dimenſions, the ſails and turning cap being all at the top of the houſe. *Fig.* 3. in *Plate* I. *Wind-Mill*, is a vertical ſection of one of theſe mills. K K are the walls of the houſe, and O O ſtrong timbers forming a roof to it; upon theſe eight principal timbers H are erected, to form an octagonal pyramid of carpentry, the ſides of which are filled up by diagonal bracing, and ſmall uprights to nail the boarding to.

The four ſails are fixed on an iron axis B N, by ſcrewing them to an iron croſs formed at one end of it. Two of theſe ſails are marked A A; but the other two are end-ways, and cannot be ſeen. Upon the axis within the mill the cog-wheel C is fixed; and this turns a trundle or lantern D, fixed on the upper end of a ſtrong vertical ſhaft, E E, extending from the top to the bottom of the mill, to turn the machinery: on the lower end of it is a large wheel, *f f*, which turns two pinions, *g g*, upon the ſpindles of the mill-ſtones *h h*. Theſe are on the ſame conſtruction as thoſe deſcribed in our article Mill, to which we refer. At *l* is a wheel upon the main axis, giving motion to a pinion on a horizontal ſhaft or roller, *k*, which has a rope wrapped upon it, to wind up the ſacks of corn. The wheel *l* alſo turns a ſimilar horizontal axis with ſeveral wheels, to receive endleſs ropes for turning the bolting and dreſſing machines.

We will now enter more fully into the mechaniſm of the upper part of the mill, which is called its head or cap, marked G, and contains the axis B N. This is ſupported upon bearings, one being near its ſails, and the other at its extreme end, as is ſhewn in *fig.* 5. *Plate* II. *Wind-Mill*, which is an horizontal ſection of the head, ſhewing the circular kirb, or wooden ring, K, and the framing which is bolted upon it to ſupport the axis.

The conſtruction of the axis is ſhewn in *fig.* 6. of the ſame plate. It conſiſts of an octagonal iron ſhaft with two cylindrical necks at *c* and *d*, where it reſts upon its bearings. At the end it has a kind of box, which has two mortiſes, *e* and *f*, through it in perpendicular directions to receive the ſails. At the back of one of theſe mortiſes, and the front of the other, a projecting arm is left in the caſting to receive ſcrew-bolts, which hold the ſails faſt in the mortiſes. The cog-wheel is fixed on by bolting its arms againſt a flanch C, caſt on the axis. The ſails are braced by a rope-ſtay to each arm, proceeding from the end of a pole, which is fixed at the end of the caſt-iron axis. Each ſail is formed of a ſail-cloth, ſpread upon a kind of lattice-work or framing, compoſed of rails mortiſed into the arms of the ſails. The plane of this frame is inclined to the plane of the ſails' motion at ſuch an angle, that the wind blowing in the direction of the axis acts upon the ſails as inclined planes, and turns them about with a power proportionate to the ſize of the ſails and force of the wind. It is neceſſary, as the wind changes its direction, to turn the ſails about, that the axis may be always in the direction of the wind. (See *fig.* 3. *Plate* I.) This motion is effected by turning the head of the mill round upon the fixed part, on a circle or kirb at the top of the frame compoſing the houſe of the mill. At the bottom of the frame of the wood-cap is a circular or moveable kirb, between which and the fixed kirb a number of rollers are placed; and the moveable kirb of the cap lies upon theſe rollers, which are kept

equidiſtant

equidistant from each other by their centre-pins being fitted into a circular hoop: by these means, though the head of the mill with the wheels and sails weigh several tons, they can be made to turn round to face the wind by a slight power.

The head is contrived to turn itself about whenever the wind changes in the following manner:—A small pair of sails, or fans, M, are fixed up in a frame L, projecting from the back of the head: it has a pinion of ten leaves upon its axis, engaging in a wheel of 60 teeth upon an inclined axis *b*; and this has a pinion *d* of 12 leaves at the other end of it, turning a bevilled wheel of 72 teeth upon a vertical iron axis, at the lower end of which is a pinion *e* of 11 teeth: this works in a circle of 120 cogs, fixed round on the outside of the fixed kirb. By these means, whenever the fan M is turned, it moves the head of the mill slowly round, and with proportionate power.

Now if ever the wind varies in the least from the direction of the main shaft of the sails, it acts obliquely upon the vanes of the fan, and turns them round, at the same time setting the head right again, so that the axis points to the wind. But when the axis is in this situation, the wind blows in the planes of the vanes of the fan, and has no effect upon them. The head of the mill is kept firmly in its place when it turns about by rollers; the axles of which are bolted to the inside of the framing of the head, and the rollers apply to the inside of the fixed kirb: there are four of these rollers. The pivot at the upper end of the vertical shaft is supported in a bearing bolted to a cross-beam in the framing of the head of the mill; and this is fixed precisely in the centre of the head, that it may not vary in its situation as the head turns round. Many other things are so evident in the drawing as to need little farther explanation; such as the different floors of the building, and the circular gallery, I I, all round the mill, for the miller to go round to take the cloth off the sails in high winds, or when the mill is to stop. This is done by untying the cloth at the extremity of the sail, and twisting it up like a rope; then tying the end of it again to the lattice, in which state it presents no surface to the wind. At *k* is a roller turned round by a wheel *l*, fixed on the middle part of the vertical shaft: it is used to draw up the sacks of corn from the bottom of the mill into the upper part, which is used as a store-house for the corn, being divided into as many compartments as the miller requires. The mill-stones are made the same as those used in water-mills. A pair of regulating balls are attached to the upper part of the mill-stone spindle, to regulate the velocity of the mill. The manner of applying this regulator is explained in *fig.* 5. *Plate* II. *Wind-Mill.* The lower end of the iron spindle F is fitted to a square, formed on the top of the mill-stone axis, and the pinion *g g* is fixed on the upper end, to give motion to the stones: immediately beneath the pinion two rods are jointed, hanging downwards, having a heavy iron ball, *l*, fixed fast on the lower end of each: two links are jointed to the arms at *m*, and suspend a collar, which is capable of sliding freely up and down upon the spindle F. It is evident that when the balls fly out from the spindle by their centrifugal force, that the collar will be elevated, and the contrary when the balls approach the spindle. The sliding collar is embraced by a fork formed at the end of a steelyard, lying horizontal, and suspended by the rod *p* as a fulcrum; an iron rod *q* descends from the extreme end of the steelyard, having its lower end formed to a hook, by which it is connected with a lever, *r*, whose fulcrum is *s*; this, by an iron rod *t*, suspends one end of the beam called the bridge, on which the lower pivot of the mill-stone axis rests, the other end bearing on a fulcrum or centre. Now it follows from this arrangement of levers, that by elevating the forked end of the steelyard, or the sliding collar, that the spindle of the stones will be suffered to descend a very minute quantity. This regulates the velocity of the mill, because when the wind increases, and the motion of the mill is accelerated, the balls fly out by the centrifugal force; this lets the upper stone down nearer to the lower, thereby increasing the resistance to the mill, and counteracting the increased force of the wind. On the other hand, if the wind falls, and the mill moves more slowly in consequence, the balls fall together, and let down the sliding collar; this raises the stone up, and increases the distance between them, thereby diminishing the resistance; for this purpose, a weight *o* (*fig.* 5.) is hung upon the steelyard, sufficient to elevate the stone whenever the closing of the balls and consequent descent of the collar will permit it to do so. There are several notches made in the steelyard for different positions of the fulcrum *p* and rod *q*; by means of these the quantity of the regulation can be adjusted to the following rule. If when the wind blows stronger the mill goes slower, contrary to the effect expected, it shews that the regulation is too active; then increase the leverage of the balls by shortening the distance between the fulcrum *p* of the steelyard and the suspension of the rod *q*, by shifting either of them into different notches. On the contrary, if the mill goes much faster when the wind increases, it shews that the regulation does not act sufficiently; then increase the distance between the rod *q* and the fulcrum *p*. If the whole limits of the notches in the steelyard should not be sufficient to effect this, the acting length of the lever *r s* must be increased or diminished by removing its fulcrum *s* to a greater or lesser distance from the suspending-rod *t*; by means of this contrivance the miller is enabled, without much inconvenience, to regulate the velocity of the stones to that degree which is found best for reducing the greatest quantity of grain to flour, without damaging it by heating, as is the case when the stones move too quick.

Theory of the Motion of a Wind-Mill, with the Position of its Sails or Vanes.—The angle which the surfaces of the sails are to make with their common axis, that the wind may have the greatest effect, or the degree of weathering, as the mill-wrights call it, is a matter of nice inquiry, and has much employed the thoughts of the mathematicians.

To conceive why a wind-mill moves at all, the theory of compound motions must be supposed. A body moving perpendicularly against any surface, strikes it with all its force. If it move parallel to the surface, it does not strike it at all: and if it move obliquely, its motion, being compounded of the perpendicular and parallel motion, only acts on the surface, considered as it is perpendicular, and only drives it in the direction of the perpendicular. So that every oblique direction of a motion is the diagonal of a parallelogram, whose perpendicular and parallel directions are the two sides. Add, that if a surface, which, being struck obliquely, has only received the perpendicular direction, be fastened to some other body, so as that it cannot pursue its perpendicular direction, but must change it for some other; in that case, the perpendicular itself becomes the diagonal of a new parallelogram, one of whose sides is the direction which the surface may follow; and the other, that which it cannot.

Thus, a rudder fastened obliquely to the keel of a vessel, being struck by the current of water parallel to the keel, and, of consequence, obliquely with regard to itself; it will appear, by drawing the line of perpendicular impulse, that it tends to tear the rudder from the keel, and to carry it away: and that this direction, perpendicular to the rudder,

der, is oblique to the keel. The rudder, then, would be carried off in an oblique direction; but as, in reality, it is so secured, that it cannot be torn and carried off, we are only to consider, in this compound motion, that of the two directions wherewith it can move without being torn from the keel; and leave the other, which would tear it off, as useless.

Now, the direction in which it can move without parting from the keel, is that which carries it circularly about its extremity, as about a centre. So that the effect of the oblique impulse of the water on the rudder is reduced, first to a perpendicular impression, which is again reduced to the mere turning of the rudder round; or, if the rudder be immoveable, to the turning of the vessel. Now, in an oblique and compound motion, where only one of the directions is of service; the greater ratio the other has to it, the less effect will the motion have, and *vice versâ*. In examining the compound motions of the rudder, we find, that the more oblique it is to the keel, the ratio of the direction that serves to turn it to the other is the greater. But, on the other hand, the more obliquely it is to the keel, and, of consequence, to the course of the water which is supposed parallel to it, the more weakly it strikes. The obliquity of the rudder, therefore, has, at the same time, both an advantage and a disadvantage; but as those are not equal, and as each of them is still varying with every different position of the rudder, they become complicated variously; so that sometimes the one prevails, and sometimes the other.

It has been a point of inquiry to find the position of the rudder, in which the advantage should be the greatest. M. Renau, in his famous theory of the working of ships, has found, that the best situation of the rudder is, when it makes an angle of fifty-five degrees with the keel. See Rudder.

If, now, a wind-mill, exposed directly to the wind, should have its four sails perpendicular to the common axis in which they are fitted, they would receive the wind perpendicularly; and it is visible that impulse would only tend to overturn them. There is a necessity, therefore, to have them oblique to the common axis, that they may receive the wind obliquely.

For the greater ease, let us only consider one vertical sail. The oblique impulse of the wind on this sail is reducible to a perpendicular impulse; and that direction, as the sail cannot absolutely keep to it, is compounded of two; one of which tends to make it turn on its axis, and the other to fall backwards. But it is only the first of these directions that can be obeyed. Of consequence, the whole impulse of the wind on the sail has no other effect but to make it turn from right to left, or from left to right, as its acute angle turns this way or that. And the structure of the machine is so well contrived, that the three other sails are determined, from the same causes, to move the same way.

The obliquity of the sails, with regard to their axis, has precisely the same advantage and disadvantage with the obliquity of the rudder to the keel. And M. Parent, seeking, by the new analysis, the most advantageous situation of the sails on the axis, finds it precisely the same angle of fifty-five degrees.

For the farther illustration of this point, let A B (*Plate* II. *Wind-Mill*, *fig*. 7.) be the axis of the mill, C D a sail, and its angle of obliquity (*viz*. that which it makes with the axis) be E C G; then if G C be the force of the wind in the direct position of the sail, G E (the sine of the angle of incidence G C E) will be the force of the wind in its oblique position; but the force of G E is resolvable into two others, E F and G F; of which the latter, being parallel to the axis, avails nothing in turning the sails about it; but the other, E F, being perpendicular to it, is wholly spent in compelling the sail to turn round. The force of the wind on the sail will be as the square of the sine of incidence, or as GE^2; and if the area of the sail, and the velocity of the wind, be supposed constant, the force of the wind in the direct position will be to that in the oblique one, as G C to GE^2; but when G E is the whole force, that part which turns the sail is represented by E F; and $GE : EF \; (:: GC : CE) :: GE^2 : \frac{CE \times GE^2}{GC}$ = to the force which turns the sail, when the whole force is represented by GE^2. This expression $\frac{CE \times GE^2}{GC}$ begins from nothing, when the angle of incidence begins to be oblique, and increases with the obliquity of the said angle to a certain number of degrees; because that part of the force which is parallel to the axis, becomes less in proportion to that which is perpendicular to it; but after it has passed this limit, it again decreases, and becomes nothing, when the angle of incidence vanishes. There is, therefore, one certain position of the sail, in which the force of the wind upon it is a *maximum*. In order to find this, put radius $GC = a$, $EC = x$; and we have $GE^2 = aa - xx$, and consequently the force $\frac{CE \times GE^2}{GC} = \frac{aax - xxx}{a}$, which must be a *maximum*: therefore its fluxion $aa\dot{x} - 3x^2\dot{x} = 0$: whence $a\,a = 3\,x\,x$, and so $x = \sqrt{\frac{aa}{3}}$ = (in logarithms) $\frac{20.000000 - 0.477121}{2} = 9.761439$, which is the logarithmic sine of the angle $35° \; 16' = CGE$; and therefore the angle $ECG = 54° \; 44'$, when the force of the wind is a *maximum*. Thus, also, if lm (*fig*. 7.) parallel to the axis Q M, be equal to a, and represent the whole force of the wind on the sail; this force is reduced to ln, and this again to no, which acts perpendicularly to the axis, and turns the sail. This force, putting $mn = x$, is expressed by $\frac{aax - x^3}{a}$, and thus, as before, when it is a *maximum*, $x = \sqrt{\frac{aa}{3}} = a\sqrt{\frac{1}{3}}$; and the angle $lmn = 54° \; 44'$. Martin's Phil. Brit. vol. i. p. 220, vol. ii. p. 212.

This angle, however, is only that which gives the wind the greatest force to put the sail in motion, but not the angle which gives the force of the wind a *maximum* upon the sail when in motion: for when the sail has a certain degree of motion, it yields to the wind; and then that angle must be increased, to give the wind its full effect. Mr. Maclaurin, in his Fluxions, vol. ii. p. 734. has shewn how to determine this angle.

It may be observed, that the increase of this angle should be different, according to the different velocities from the axis to the extremity of the vane or sail. At the axis it should be $54° \; 44'$, and thence continually increase, giving the

the vane a twift, and fo caufing each rib of the vane to lie in a different plane.

It is obferved, that the ribs of the vane or fail ought to decreafe in length from the axis to the extremity, giving the vane a curvilineal form; fo that no part of the force of any one rib be fpent upon the reft, but all move on independent of each other. The twift above-mentioned, and the diminution of the ribs, are exemplified in the wings of birds. As the end of the fail neareft the axis cannot move with the fame velocity which the tips or fartheft ends have, although the wind acts equally ftrong upon them, Mr. Ferguson (Lect. on Mechanics, p. 52.) fuggefts, that perhaps a better pofition than that of ftretching them along the arms directly from the centre of motion, might be to have them fet perpendicularly acrofs the farther ends of the arms, and there adjufted lengthwife to the proper angle. For, in that cafe, both ends of the fails would move with nearly the fame velocity; and being farther from the centre of motion, they would have fo much the more power, and then there would be no occafion for having them fo large as they are generally made; which would render them lighter, and, confequently, there would be fo much the lefs friction on the thick neck of the axle, when it turns in the wall.

M. Parent confidered what figure the fails of a wind-mill fhould have, to receive the greateft impulfe from the wind; and he determined it to be a fector of an ellipfis, whofe centre is that of the axis, or arbor, of the mill; and the little femi-axis the height of thirty-two feet: as for the greater, it follows neceffarily from the rule that directs the fail to be inclined to the axis, in an angle of 55 degrees.

On this foundation he affumes four fuch fails, each of which is one-fourth of an ellipfis; which, he fhews, will receive all the wind, and lofe none, as the common ones do. Thefe four furfaces, multiplied by the lever with which the wind acts on one of them, exprefs the whole power the wind has to move the machine, or the whole power the machine has when in motion.

The fame manner of reafoning, applied to a common wind-mill, whofe fails are rectangular, and their length about five times their breadth, fhews, that the elliptic wind-mill has about feven times the power of the common one.

A wind-mill with fix elliptic fails, he fhews, would ftill have more power than one with only four. It would only have the fame furface with the four, fince the four contain the whole fpace of the ellipfis as well as the fix. But the force of the fix would be greater than that of the four, in the ratio of 245 to 231. If it were defired to have only two fails, each being a femi-ellipfis, the furface would be ftill the fame; but the power would be diminifhed by near one-third of that with fix fails, becaufe the greateft of the fectors would much fhorten the lever with which the wind acts.

Beft Form and Proportion of rectangular Wind-Mills.—As elliptical fails would be fomething fo new, that there is little room to expect they will come into common ufe, the fame author has confidered which form, among the rectangular ones, will be the moft advantageous. And by the method *de maximis et minimis*, he finds it very different from the common ones.

The refult of this inquiry is, that the width of the rectangular fail fhould be nearly double its length; whereas the length is ufually made almoft five times the width. Add, that as we call length the dimenfion which is taken from the centre of the axis, the greateft dimenfion of the new rectangular fail will be turned toward the axis, and the fmalleft from it; quite coutrary to the pofition of the common fails.

The power of a wind-mill with four of thefe new rectangular fails, M. Parent fhews, will be to the power of four elliptic fails, nearly as 13 to 23; which leaves a confiderable advantage on the fide of the elliptic ones; yet will the force of the new rectangular fails be confiderably greater than that of the common ones.

M. Parent likewife confiders what number of the new fails will be moft advantageous; and finds, that the fewer the fails, the more furface there will be, but the lefs power. The ratio of the power of a wind-mill with fix fails will be to another with four, nearly as 14 to 13. And the power of another with four will be to that with two, nearly as 13 to 9.

For a variety of curious experiments and obfervations concerning the conftruction and effects of wind-mill fails, by the ingenious Mr. Smeaton, fee Phil. Tranf. vol. ii. p. 138, &c.

Mr. Smeaton's experiments did not realize M. Parent's theory; for he found the fails fixed at the angle of 55 degrees with the axis, to be the leaft advantageous of any which he tried; but if the fails are included from 72 to 75 degrees from the axis, or 15 to 18 degrees to the place of their motion, the greateft effect will be produced that can be when the fails are plane furfaces.

He alfo found, that the elliptical fails, which intercept the whole cylinder of wind, do not produce the greateft effect, for want of proper interftices for the wind to efcape.

The following maxims, deduced by Mr. Smeaton from his experiments, contain the moft accurate information upon the fubject.

Maxim 1.—The velocity of wind-mill fails, whether unloaded or loaded, fo as to produce a maximum effect, is nearly as the velocity of the wind, their fhape and pofition being the fame.

Maxim 2.—The load at the maximum is nearly, but fomewhat lefs than, as the fquare of the velocity of the wind, the fhape and pofition of the fails being the fame.

Maxim 3.—The effects of the fame fails at a maximum are nearly, but fomewhat lefs than, as the cubes of the velocity of the wind.

Maxim 4.—The load of the fame fails at the maximum is nearly as the fquares, and their effects as the cubes of their number of turns in a given time.

Maxim 5.—When fails are loaded, fo as to produce a maximum at a given velocity, and the velocity of the wind increafes, the load continuing the fame: 1ft, The increafe of effect, when the increafe of the velocity of the wind is fmall, will be nearly as the fquares of thofe velocities. 2dly, When the velocity of the wind is double, the effects will be nearly as 10 to $27\frac{1}{2}$. But, 3dly, When the velocities compared are more than double of that where the given load produces a maximum, the effects increafe nearly in the fimple ratio of the velocity of the wind.

Maxim 6.—In fails where the figure and pofitions are fimilar, and the velocity of the wind the fame, the number of turns in a given time will be reciprocally as the radius or length of the fail.

Maxim 7.—The load at a maximum that fails of a fimilar figure and pofition will overcome, at a given diftance from the centre of motion, will be as the cube of the radius.

Maxim 8.—The effects of fails of fimilar figure and pofition are as the fquare of the radius.

Maxim 9.—The velocities of the extremities of the fails, in all their ufual pofitions, when unloaded, or even loaded

loaded to a maximum, are confiderably quicker than the velocity of the wind.

Rules for modelling the Sails of Wind-Mills.—Fig. 4. *Plate* II. *Wind-Mill,* is a front view of one of the four fails of a wind-mill. The letters of reference will ferve to explain the terms made ufe of in the following defcription.

1. The length of the arm or whip A A, reckoned from the centre of the great fhaft B, to the outermoft bar 19, governs all the reft.

2. The breadth of the face of the whip A, next the centre, is one-thirtieth of the length of the whip; its thicknefs at the fame end is three-fourths of the breadth; and the back-fide is made parallel to the face for half the length of the whip, or to the tenth bar; the fmall end of the whip is fquare, and as its end is one-fixtieth of the length of the whip, or half the breadth at the great end.

3. From the centre of the fhaft B, to the neareft bar 1 of the lattice, is one-feventh of the whip; the remaining fpace of fix-fevenths of the whip is equally divided into nineteen fpaces, fo as to make nineteen bars; one-ninth of one of thefe fpaces is equal to the mortifes for the bars, the tenons of which are made fquare where they enter and go through the whip, and confequently the mortifes muft be fquare alfo.

4. To prepare the whip for mortifing, ftrike a gage-fcore at about three-fourths of an inch from the face on each fide, and the gage-fcore, on the leading fide 4, 5, will give the face of all the bars on that fide; but on the other fide, the faces of all the bars will fall deeper than the gage-fcore, according to a certain rule. To find the fpace to be fet off for this purpofe for each bar, conftruct a fcale in the following manner.

5. Extend the compaffes to any diftance at pleafure, fo that fix times that extent may be greater than the breadth of the whip at the feventh bar; fet thofe fix fpaces off upon a ftraight line for a bafe, at the end of which raife a perpendicular; fet off three fpaces upon the perpendicular, and divide the two fpaces that are fartheft from the bafe line into fix equal parts each, fo that this quantity of two fpaces may be equally divided into twelve fpaces marked out by thirteen points; from each of thefe points draw a line to the oppofite end of the bafe, as fo many rays to a centre, and the fcale is finifhed.

6. To apply this fcale to any given cafe, fet off the breadth of the whip at the laft bar, (that is, the bar at the extremity of the fail,) from the centre of the fcale along the bafe towards the perpendicular; and at this point raife a perpendicular to cut the ray neareft to the bafe; alfo fet off the breadth of the whip at the feventh bar in the fame manner, and at this point erect another perpendicular to cut the thirteenth radius. From the interfection of the perpendicular (drawn upon the breadth of the laft bar) with the firft of the thirteen radii, to the interfection of the other perpendicular with the thirteenth radius, draw an oblique line cutting all the reft, and the diftances of each of thefe laft-mentioned points of interfection from the bafe line is the fpace which the face of each bar is diftant from the gage-line on the driving fide.

7. Thefe diftances give a different fet-off for each bar till the feventh, which fame muft be fet off for all the reft to the firft.

8. The mortifes muft be fquare to the leading fide of the whip.

9. When the mortifes are cut, let the face of the whip be floped off fo as to agree with the face of the bars in every part.

10. Two-fifths of the whip are the length of the laft or longeft bar.

11. Five-eighths of the longeft bar muft be on the driving fide of the whip, and three-eighths on the leading fide, each being reckoned from the middle of the whip.

12. The proportion of the mortifes already given determines the fize of the bars at the mortifes, but their thicknefs muft be diminifhed each way, fo as to be only one-half at the ends; but the face muft be kept of equal breadth all the way.

13. The leading fide goes no farther than the fourth bar, and there only projects one-third of the projection of the laft bar.

14. All the bars on the driving fide are made hollowing in the arch of a circle, which begins to fpring one-third of the length of the bars on the driving fide from the whip; and the fweep is fuch, that if a ftraight line is applied to the face of the bar from the whip to the end, the face of the bar fhould leave the ftraight line about the breadth of the bar.

15. There ought to be three uplongs, as 3, 2, 10, *fig.* 4, to the driving, and two to the leading fide, as at 5, 4, to ftrengthen the lattice.

Self-regulating wind-mills are thofe which adapt themfelves to the irregularities of the wind, by diminifhing or increafing the furface on which the wind can act to turn them round. If the wind increafes in force, the furface expofed to its action is diminifhed; on the contrary, if it decreafes in force, the furface will be increafed in the fame proportion, fo as in fome meafure to render their motion uniform.

The following felf-regulating wind-mill is ftated as the invention of Mr. Andrew Mickle in 1772, the inventor of the threfhing-machine. The length of the fail was divided into eleven compartments, by the bars forming a number of oblong openings, which were each filled up by a fquare frame of wood covered with canvas, and mounted on pivots at their ends; one pivot turning in a hole in the whip, and the other in the bar which lies parallel to it, in the manner of a Venetian blind: the pivots were not placed in the middle of the breadth of the frames, but at one-third from that edge, towards the fhaft or axis of the fails. On the end of each pivot which enters the whip a fmall roller is fixed, round which a chain paffes, and its end is attached to a fteel fpring, placed at right angles to the whip, and in the direction of the length of the canvaffed frames. Now, if the wind blows too hard, it acts to turn the frames edgeways, in which cafe the wind paffes through the fails, and exerts lefs force to turn them round; but as foon as the wind becomes moderate, the fteel fpring brings up the frames into a plane, prefenting their whole furface to its action. A rod of iron extends the whole length of the whip, and is connected with the feveral fprings, to afford the means of ftrengthening or diminifhing their action, according to the feafon of the year. This rod was formed into a fcrew at its outer extremity, and a nut put on to enable the miller to adjuft the ftrength of the fprings conveniently, from the circular gallery furrounding the outfide of the mill.

Mr. William Cubit of North Walfham, in the county of Norfolk, took out a patent, in 1807, for a method of equalizing the motion of wind-mill fails. It is fimilar to Mr. Mickle's, in the fails being made like a Venetian blind; but inftead of the fprings, he applied racks and pinions on the ends of the blind pivots, and a fliding rod, which paffed in a fmall hole made through the length of the axis of the fails; the end of this rod within the mill was

 made

made into a rack, working in a wheel upon which a weight was hung. By this means, when the wind blows too hard, the blinds turn upon their pivots, and by the racks draw out the rod which paffes through the axis, and raife the weight; but as foon as the wind abates, the weight brings the blinds to their former pofition.

A patent was granted in 1804 to Mr. John Bywater of Nottingham, for a method of clothing and unclothing the fails of wind-mills while in motion. The invention confifts in a manner of rolling or folding up, and unfolding again, the cloths of common wind-mill fails while in motion. It is effected by placing a long roller in the direction of the length of the whip round which the cloth is rolled; the inner end of the roller is furnifhed with a pinion, which engages in the teeth of a circular ring of cogs fixed to the fhaft-head, clofe behind the back-ftocks, with the liberty of turning round independent of the fhaft. Another roller is placed at the back-fide of the fail, round which feveral cords pafs, and are conveyed over pulleys at the edge of the fail, and then made faft to the cloth at different diftances along its length. The object of this fecond roller is to clothe the fail, in the fame manner as the firft-mentioned roller unclothed it. The inner end of the back roller is furnifhed with a bevelled pinion, which acts in the teeth of a ring of cogs placed concentric with the one before defcribed, which has alfo the liberty of turning round independent of the fhaft. Suppofe the fails to be completely clothed, and turning round by the wind, the two rings of cogs revolve with the axis, and therefore produce no effect on the pinions; but if the wind blows too violent, and it becomes neceffary to partly unclothe the fails, the miller pulls a cord which is connected with a lever in the head of the mill. This lever comes in contact with a projection on the ring of cogs belonging to the rollers, upon which the cloth winds. Now it is evident, that if the ring of cogs is held faft, and the fails continue to revolve, it will caufe the pinions to turn round and roll up the cloth upon the rollers; on the contrary, if the wind falls, the fails will require to be more clothed, which is effected by the fame lever being moved farther, fo as to quit the ring of cogs it held before, and hold the other faft, which will put the rollers at the back of the fails in motion, and by winding the cords upon them, draw the cloth off the fail-roller, which increafes the furface for the wind to act upon. We have not entered into the minute details of this invention, as given in the patent, for it would have exceeded our limits, but only given a fufficient defcription to enable a perfon to underftand the means of effecting the regulation.

Horizontal Wind-Mills.—Thefe are of various kinds; but only one kind that we know of has been put to any valuable ufe.

Horizontal wind-mills were a favourite fpeculation a century ago; and the Theatrum of the celebrated Leopold contain a great variety, but they are all upon one or other of two principles. In one of thefe, a very large wheel, like a water-wheel, is mounted with its axis in a perpendicular direction. It confifts of feveral circular wheels fixed upon the axis; and it has large boards or vanes fixed parallel to its axis, and arranged at equal diftances round the circular wheels. Upon thefe vanes the wind can act to blow the wheel round; but if the wind were to act upon the vanes at both fides of the wheel at once, it would have no tendency to turn the wheel round; hence one fide of the wheel muft be fheltered from the wind, whilft the other is fubmitted to its full action. For this purpofe, the whole wheel is inclofed within a large cylindrical framing of wood, which is furnifhed with doors or fhutters on all fides to open at pleafure, and admit the wind, or to fhut and ftop it. If all the fhutters on one fide are open, whilft all thofe on the oppofite fide are fhut, the wind, acting with undiminifhed force on the vanes at one fide, whilft the oppofite vanes are under fhelter, turns the mill round; but whenever the wind changes, the difpofition of the open vanes muft be altered, to admit the wind to ftrike upon the vanes of the wheel in the direction of a tangent to the circle in which the vanes move. A horizontal wind-mill is thus defcribed in Leopold's Theatrum Machinarum for grinding corn with one pair of ftones. A ftrong upright axis is fo poifed on a pivot at the lower ends, and fuftained in a collar or bearing, as to turn round. Into this feveral long arms are fixed, in the manner of radii, and at the extreme ends of each arm a vane is fixed, to receive the action of the wind. Thefe vanes are made of two or more moveable leaves, which clofe up flat like a book, when they are at that fide of the circle which moves in a direction to advance towards the wind; fo that only the edges of the boards are oppofed to the wind; but when thefe vanes arrive at the oppofite fide of the wheel, fo that the wind blows upon them, the leaves fly open, and expofe their full furfaces to the wind, and receive the impulfe thereof.

A horizontal wind-mill is defcribed by Dr. Hooke in the Philofophical Collections for 1681. It confifted of four vanes mounted upon vertical axes, and arranged round in a circle by the upper and lower pivots of the vanes being received into holes in the rims of two horizontal wheels fixed upon the fame vertical fhaft. The vanes were difpofed in fuch a manner, that on one fide of the wheel each vane prefented its furface to the wind, whilft the one on the oppofite ftood edgeways, fo as to move through the air without much refiftance. This was effected by cog-wheels placed on the lower pivots of the vanes, and fo arranged, that as one vane turned round upon its pivots, the whole number moved together, and the motion was given to them by a cog-wheel fixed faft to the framing over the wheel, but concentric with it. This wheel communicated, by means of an intermediate wheel, with the wheels on the axes of the vanes.

The action of this machine is as follows:—Suppofe the wind blowing at the wheel; it acts againft that vane which is at right angles to its motion, to turn the wheel round upon its axis. The oppofite vane prefenting its edge to the wind oppofes very little refiftance. The motion of the wheel upon its axis turns the vanes round upon their pivots, by means of the fixed cog-wheel before defcribed; fo that by the time that one has paffed out of the direction of the wind, another arrives in the fame perpendicular pofition; and when the wheel has made half a revolution, the vane which ftood edgeways will be perpendicular to the wind, and the one which before ftood perpendicular will be edgeways; thus a continued motion is produced without the wheel being cafed up.

Horizontal wind-mills, which are inclofed in a houfe with blinds on all fides, are very fully defcribed in Jacob Leopold's Theatrum Machinarum, 1724; but we believe they were firft practifed in this country by captain Hooper, who erected one at Margate, and another at Batterfea. The latter is upon a very large fcale, and is ufed for grinding corn; but at prefent it does not work with much advantage, as the repairs are more confiderable in proportion to the power it exerts, than in the mills with fails conftructed in the common manner.

In *Plate Wind-Mill, fig.* 1, is an upright fection, and *fig.* 2. a plan a plan of the horizontal mill erected at Margate by captain Hooper. H H are the fide walls of an octagonal building which contains the machinery. Thefe walls are furmounted by a ftrong timber-framing G G, of the fame form as the building, and connected at top by crofs-framing to fupport the roof, and alfo the upper pivot of the main vertical fhaft A A, which has three fets of arms, B B, C C, and D D, framed upon it at that part which rifes above the height of the walls. The arms are ftrengthened and fupported by diagonal braces, and their extremities are bolted to octagonal wooden frames, round which the vanes or floats E E are fixed, as feen in outline in *fig.* 2, fo as to form a large wheel refembling a water-wheel, which is lefs than the fize of the houfe by about eighteen inches all round. This fpace is occupied by a number of vertical boards or blinds F F, turning on pivots at top and bottom, and placed oblique, fo as to overlap each other, and completely fhut out the wind, and ftop the mill, by forming a clofe cafe furrounding the wheel; but they can be moved all together upon their pivots to allow the wind to blow in the direction of a tangent upon the vanes on one fide of the wheel, at the time the other fide is completely fhaded or defended by the boarding. The pofition of the blinds is clearly fhewn at F F, *fig.* 2. At the lower end of the vertical fhaft A A, a large fpur-wheel *a a* is fixed, which gives motion to a pinion *c*, upon a fmall vertical axis *d*, whofe upper pivot turns in a bearing bolted to a girder of the floor N. Above the pinion *c*, a fpur-wheel *e* is placed, to give motion to two fmall pinions *f*, on the upper ends of the fpindles *g* of the mill-ftones *h*. Another pinion is fituated, at the oppofite fide of the great fpur-wheel *a a*, to give motion to a third pair of mill-ftones, which are ufed when the wind is very ftrong; and then the wheel turns fo quick, as not to need the extra wheel *e* to give the requifite velocity to the ftones. The weight of the main vertical fhaft is borne by a ftrong timber *b*, having a brafs box placed on it to receive the lower pivot of the fhaft. It is fupported at its ends by crofs-beams mortifed into the upright pofts *b b*, as fhewn in the plan, *fig.* 2. A floor, or roof, I I, is thrown acrofs the top of the brick building, to protect the machinery from the weather; and to prevent the rain blowing down the opening through which the fhaft defcends, a broad circular hoop K is fixed to the floor, and is furrounded by another hoop or cafe L, which is fixed to the arms D D of the wheel. This laft is of fuch a fize, as exactly to go over the hoop K, without touching it when the wheel turns round. By this means, the rain is completely excluded from the upper room M, which ferves as a granary, being fitted up with bins *m m*, to contain the different forts of grain which is raifed up by the fack-tackle. A wheel *i* is fixed on the main fhaft, having cogs projecting from both fides. Thofe at the under fide work into a pinion on the end of the roller *k*, which is for the purpofe of drawing up facks. Another pinion is fituated above the wheel *i*, which has a roller projecting out over the flap-doors feen at *p*, in the *fig.* 2, to land the facks upon. The two pinions *m m*, *fig.* 2, are turned by the great wheel *a a*, and are for giving motion to the dreffing and bolting machines, which are placed upon the floor N, but are not fhewn in the drawing, being exactly fimilar to the dreffing-machines ufed in all flour-mills. The cogs upon the great wheel *a* are not fo broad as the rim itfelf, leaving a plain rim about three inches broad. This is encompaffed by a broad iron hoop, which is made faft at one end to the upright poft *b*; the other being jointed to a ftrong lever *n*, to the extreme end of which a purchafe *o* is attached, and the fall is made faft to iron pins on the top of a frame fixed to the ground. This apparatus anfwers the purpofe of the brake or gripe ufed in common wind-mills to ftop their motion. By pulling the fall of the purchafe *o*, it caufes the iron ftrap to embrace the great wheel, and produce a refiftance fufficient to ftop the wheel. The mill can be regulated in its motion, or ftopt entirely, by opening or fhutting the blinds F, which furround the fan-wheel. They are all moved at once by a circular ring of wood fituated juft beneath the lower ends of the blinds upon the floor I I, being connected with each blind by a fhort iron link. The ring is moved round by a rack and fpindle, which defcend into the mill-room below, for the convenience of the miller.

A fort of wind-mill has been long much employed in Portugal, in which, from the difference in the conftruction of the fails, it is fuppofed by fome, as lord Somerville, who has infpected it when working, to poffefs a fuperiority in having the broad part of the fail at the end of the levers or booms; in confequence of which equal refiftance is overcome with lefs length of branches: and that from this fhortnefs a confiderable faving is made in the timber of both the booms and fpindles, as well as in the height, firft coft of the mills, and their future repairs.

The advantages of making ufe of thefe forts of wind-mills in preference to others are, that as there are four booms, as well as four mafts for the fails, they are capable of being more eafily braced out to the wind, and in cafe of a fudden gale or guft of it, are more eafily caft loofe than in thofe of the common conftruction; and that as the fails in thefe mills are placed in the beft poffible direction by the booms, it is prefumed that a wind-mill built on this plan and principle will do more work than any common wind-mill with an equal quantity of canvafs.

Thefe forts of mills have alfo lately been very much improved by conftructing and difpofing thofe furface parts upon which the wind is intended to act, in fuch a particular manner, as that by alternately oppofing a refifting and non-refifting furface, the whole force or impulfe may operate in a direct manner upon the refifting fide of the fail or vane, in proportion to its extent; and that when the non-refifting fide is returning againft thefe powers, the mill being fo contrived that there is very little refiftance, however large the furface. Thefe improvements, when applied to horizontal wind-mills, the power of them, even with the fame quantity of fail, or acting furface, may too be increafed or diminifhed at pleafure, which is a circumftance of very great utility and convenience in many cafes.

WIND-*Pump*, that fort of pump which is fo contrived and formed as to be driven by the wind. Thefe kinds of pumps are very ufeful for draining and lifting water in many cafes, as where the depth of it is too great to admit of cutting drains, or the fuperftrata too loofe for forming them, and when the height to which the water is to be raifed is great. See SPRING-*Draining* and SURFACE-*Draining*.

WIND-*Row*, in *Agriculture*, a term fignifying the green parts or borders of a field, dug up, in order to carry the earth on other land to mend it; fo called becaufe it is laid in rows, and expofed to the wind. It alfo fignifies a row of peats fet up to dry for fuel. Likewife a row of hay expofed to the wind and fun to get dry. And alfo of turfs or fward cut up in paring and burning.

The peats are fet up in thefe rows in an open manner, to the height of two or three feet or more, that the wind may pafs between and dry them. The rows of hay of this kind are either fingle or double, the former for that which is in the more graffy ftate, and the latter for that which has been more made; and the work is performed by different perfons

raking

raking the fpread hay in oppofite directions towards themfelves, and by fuch means forming a row between them of double the extent of that of the fingle wind-row. See HAY-*Making*.

The turf or fods for burning are fet up in thefe rows, in leaning directions againft each other, fo as to let the wind readily pafs among and dry them in a quick manner for burning.

Whins are fometimes, too, formed into wind-rows for being burnt for the afhes. See WHIN-*Afhes*.

WIND-*Sail*, or VENTILATOR, in a *Ship*, is made of canvas, and ufed for circulating frefh air between the decks, and is in the form of a cylinder, or an obtufe-ending cone, and is adapted to the fize of the fhip. Four breadths of canvas are fewed together, and the outer felvages are joined with an inch feam, leaving one cloth four feet fhort of the top. A three-inch tabling goes round the top and bottom. It is kept diftended by circular hoops, made of afh, fewed to the infide, one at top, and one at every interval of fix feet. The upper part, or top, is covered with canvas, and a fmall rope fewed round the edge; into which are fpliced, at the quarters, the ends of two pieces of rope, that are fewed up to the middle, and an eye formed by feizing the bights. The length of a wind-fail is taken nine feet above the deck, to three or four feet below the lower hatchway; the quantity of canvas is obtained by multiplying the number of cloths by the length.

Thefe, of which there are generally three or four in our capital fhips of war, have the advantage of taking little room, of requiring no labour in working, and of a fimple contrivance, fo that they can fail in no hands. But their powers are faid to be fmall in comparifon with thofe of Dr. Hales's ventilators: they cannot be put up in hard gales of wind, and are of no efficacy in dead calms, when a refrefhment of air is moft wanted. See VENTILATOR.

WIND-*Seed*, in *Botany*. See ARCTOTIS.

WIND-*Shock*, a name given by our farmers to a diftemperature to which fruit-trees, and fometimes timber-trees, are fubject.

It is a fort of bruife and fhiver throughout the whole fubftance of the tree; but the bark being often not affected by it, it is not feen on the outfide, while the infide is twifted round and greatly injured.

It is by fome fuppofed to be occafioned by high winds; but others attribute it to lightning. Thofe trees are moft ufually affected by it, whofe boughs grow more out on one fide than on the other.

The beft way of preventing this in valuable trees, is to take care in the plantation that they are fheltered well, and to cut them frequently in a regular manner while young.

The winds not only twift trees in this manner, but they often throw them wholly down: in this cafe, the common method is to cut up the tree for firing, or other ufes; but if it be a tree that is worth preferving, and it be not broken but only torn up by the roots, it may be proper to raife it again by the following method:—Let a hole be dug deep enough to receive its roots, in the place where they before were; let the ftraggling roots be cut off, and fome of the branches, and part of the head of the tree; then let it be raifed, and when the turn-up roots are replaced in the earth in their natural fituation, let them be well covered, and the hole filled up with rammed earth; the tree will, in this cafe, grow as well, and perhaps better, than before. If nature be left to herfelf, and the tree be not very large, the pulling off the roots will raife it. Mortimer's Hufbandry, vol. ii. p. 79.

WIND-*Tackle Blocks*, in a *Ship*. See WINDING-*Tackle*.

WIND-*Taught*, in *Sea Language*, denotes the fame as ftiff in the wind. Too much rigging, high mafts, or any thing catching or holding wind aloft, is faid to hold a fhip wind-taught; by which they mean, that fhe ftoops too much in her failing in a ftiff gale of wind.

Again, when a fhip rides in a main ftrefs of wind and weather, they ftrike down her top-mafts, and bring her yards down, which elfe would hold too much wind, or be too much diftended and wind-taught.

WIND-*Thrufh*, in *Ornithology*, a name given by fome to the red-wing, and fuppofed to be given from their generally firft appearing with us in windy feafons; but it appears more probably to be derived from the German name *wint-troffel*, or vine-thrufh, from its doing great mifchief there in the vineyards, by eating and deftroying the grapes. Ray.

WIND-*Tumours*. See TUMOUR.

WIND-*Ward*, in *Sea Language*, denotes any thing towards that point from whence the wind blows, in refpect of a fhip.

WIND-*Ward*, *Sailing to*. See SAILING.

WIND-*Ward Tide* denotes a tide which runs againft the wind.

WIND, in *Geography*, a river of America, which runs into the Connecticut at Windfor.

WIND *Gap*, a pafs in the Blue Mountains of Pennfylvania.

WINDAGE *of a Gun*, is the difference between the diameter of the bore and the diameter of the ball.

The windage is not the fame in England as it is abroad. With us, if the diameter of the fhot is divided into twenty equal parts, then the diameter of the bore is twenty-one of thefe parts. The French fuppofe the diameter of the fhot divided into twenty-fix parts, and the diameter of the bore to be twenty-feven. Mr. Muller obferves, that the lefs windage there is, the truer the fhot will go, and having lefs room to bounce from one fide to another, the gun will not be fpoiled fo foon. Accordingly, he divides the diameter of the fhot into twenty-four equal parts, and makes the bore twenty-five, which is a medium between the Englifh and French method. Artillery, p. 84.

Dr. Hutton obferves, that if the windage be one-twentieth of the calibre, which is the ufual fize, no lefs than one-third or one-fourth of the powder efcapes, and is loft. As the balls are often fmaller than the regulated fize, it frequently happens, that half the powder is loft by unneceffary windage.

Dr. Hutton alfo recommends the diminifhing of the windage. See GUNNERY.

WINDALA, in *Geography*, a town of Sweden, in Eaft Bothnia; 65 miles E. of Wafa.

WINDALL, a town of the ftate of Vermont; 22 miles S.S.W. of Windfor.

WINDASS, WANDASS, or WANLASS, an ancient term in hunting. Thus, to drive the windafs fignifies the chafing of a deer to a ftand, where one is ready with a bow, gun, or to fhoot. This is one of the cuftomary fervices of fiefs.

"——Omnes illi qui tenuerunt in bondagii tenura, folebant vocari cuftumarii: & quotiefcunque dominus ad venandum venerit, illi cuftumarii folebant fugare windaffum, ad ftabulum, in venatione ferarum beftiarum fecundum quantitatem tenuræ fuæ." MS. de Confuetud. Manerii de Sutton Colfield, an. 3 Ed. II.

WINDAU, in *Geography*, a fea-port town of the duchy of Courland, near the mouth of the Wera, on the Baltic. It was the capital of a palatinate, and has a caftle, once the refidence of the Livonian knights; the ftates of Courland likewife held their affemblies here, which made it populous; but it is now much decayed, and chiefly fupported by fhip-building, and exporting pitch, tar, wax, &c.; 8 miles N.N.E. of Piltyn. N. lat. 57° 10'. E. long. 21° 32'.

WINDAU. See WETA.

WINDECK, a town of France, in the department of the Scheldt; 9 miles S.S.E. of Ghent.—Alfo, a town of the duchy of Berg; 21 miles E. of Bonn.

WINDECKEN, a town of Germany, in the county of Hanau Munzenburg; 4 miles N. of Hanau.

WINDELSBACH, a town of the margravate of Anfpach; 22 miles N.W. of Anfpach.

WINDER, in *Agriculture*, a term ufed provincially to fignify to clean corn with a fan-machine. See FAN-*Machine*.

WINDER-*Meb*, in *Ornithology*, the name of a bird of the larus, or gull-kind, the *larus cinerarius* of Linnæus, moderately large, and defcribed by Aldrovandus under the name of *larus major*.

Its head is remarkably large and thick, and is of a mottled colour of white and grey; its breaft and belly are alfo variegated with the fame colours, but they are fomewhat paler; its beak is thick and ftrong, of a yellow colour, and very fharp, and the opening of its mouth very wide; its wings are variegated with white, grey, and chefnut colour, and both thefe and the tail have much black in them; the feet are webbed and yellow, the claws are fharp, and the hinder toe larger than in moft birds of this kind. Ray's Zoology, p. 267.

WINDERS *of Wool*. See WOOL-*Winders*.

WINDHAM, or WYMONDHAM, in *Geography*, a town of England, in the county of Norfolk, with a weekly market on Friday. The chief trade of the place is making wooden ware. In 1549, William Kett, one of the Norfolk infurgents, was hanged on the fteeple of the church; 9 miles W.S.W. of Norwich. N. lat. 52° 34′. E. long. 1° 7′.

WINDHAM, a large poft-townfhip of Greene county, in New York, comprifing all that part of the county on the S. and W. of the fummit of the Catfbergs or Catfkill mountains; bounded N. by Durham, Cairo and Catfkill, E. by the northern angle of Ulfter county, S. by Ulfter and a part of Delaware counties, and W. by Delaware county. It has a poft-office, and is about 24 miles in length, its medial breadth being about 12 miles.

It is mountainous, with much good pafture-lands that yield excellent dairy. It is watered by the Schoharie creek, which has feveral mill-feats and fmall branches. Along thefe ftreams are fome alluvial lands, which are rich and fertile. The view from the Catfbergs, over which is a road, is very grand and interefting. The W. part of Windham is about 35 miles W. from Catfkill, its principal market. The population confifts of 3965 perfons, and the fenatorial electors are 267.

WINDHAM, a town of the ftate of Connecticut, on the Thames. It is the chief town of a county, to which it gives name. The county contains 28,611 inhabitants, and the town 2416; 63 miles S.W. of Bofton. N. lat. 41° 38′. W. long. 72° 11′.—Alfo, a town of the ftate of Vermont, in the county of Windham, with 782 inhabitants; 20 miles E. of Bennington.—Alfo, a county in the S.E. part of the ftate of Vermont, bordering on the Maffachufetts. It contains 26,760 inhabitants.—Alfo, a poft-town of New Hampfhire, in Rockingham county, with 743 inhabitants; 40 miles S.W. of Portfmouth.

WINDING, twifting from an even furface, or not a direct plane.

WINDING *a Call*, in *Sea Language*, denotes the act of blowing or piping upon a boatfwain's whiftle, fo as to communicate the neceffary orders of hoifting, heaving, belaying, flackening, &c. See CALL.

WINDING-*Engine*, in *Mining*, a machine employed to wind or draw up corves or buckets out of a deep pit or fhaft. There are feveral different machines employed for this purpofe, and each has a different name.

The moft fimple winding-machine is a roller placed horizontally over the pit, to wind up the rope, by which the bucket is fufpended; the roller is turned round by a handle at each end. This fimple machine, which is called a windlafs, wind-up, or roller, is commonly ufed for well-digging, and formerly was the common machine for mines; but for mining on the prefent fyftem more powerful machinery is required. In Derbyfhire it is called a ftowfe, and the conftruction is very minutely directed in the ancient mining-laws of the diftrict, called 'The King's Field.' A fmall model or effigy of a ftowfe, conftructed according to law, and fixed up "in fight of all men," is ftill the fign of legal poffeffion of a lead-mine, and one of thefe muft be conftantly maintained at every thirty-nine yards in length of the vein of ore; for by thofe laws no man may work more than thirty-nine yards, and it is fuppofed that each one of thefe is a feparate working and drawing up of the ore from the mine.

With this fimple machine a man can work continually to draw up a weight of 3750 pounds, at the rate of one foot *per* minute, or any fmaller weight with a proportionably quicker motion. This is a fair average of the ftrength of man, which has been determined by a number of experiments, as fhewn in our article WATER. The radius of a winch or handle fhould not be above fourteen inches, which defcribes a circle of $7\frac{1}{3}$ feet circumference; a man can turn this round twenty times *per* minute with convenience, and the motion of his hands will therefore be $146\frac{2}{3}$ feet *per* minute, at which rate a man can exert a force of $25\frac{1}{2}$ pounds according to our ftandard. To apply a man's force to the greateft advantage, we muft not depart much from thefe proportions; but the load which is drawn up at one time may be varied according to the diameter of the roller or barrel on which the rope winds: for inftance, if this barrel is feven inches diameter, it will draw up the weight only one-fourth as faft as the man moves the handle; and in confequence the weight may be $4 \times 25\frac{1}{2} = 102$ pounds, and this he will be able to wind up at the rate of thirty-feven feet *per* minute. It is beft to employ two men, and make the two handles at right angles to each other; the roller may then be 14 inches diameter, and they can draw up the 102 pounds at the rate of 74 feet *per* minute. The roller fhould have two ropes wrapped upon it in oppofite directions, and a bucket being fufpended from each, one bucket will be drawn up as the other is let down, and no time will be loft.

The next machine is the horfe-gin: it has a large drum or barrel to wind up the rope; the barrel is mounted on a vertical axis, which is provided with one or more long levers, to the extreme ends of which a horfe is harneffed, and by walking round in a circle, the barrel is turned round, and the rope which defcends into the pit or fhaft, is wound up by wrapping round the barrel. The gin is placed at a convenient diftance from the mouth of the pit, and the rope is conducted over a pulley at the top of the pit, to change the direction from horizontal to vertical. The horfe-gin ufually has two ropes wrapping round the barrel in oppofite directions, and one winds up as the other unwinds. The two buckets or corves which are fufpended in the pit at the fame time, go up and down alternately, one full and the other empty, and the weight of the empty corve, which is defcending, tends in fome meafure to balance that which is coming up full.

The barrel muft be turned in a contrary direction every time a bafket is drawn up, and for this purpofe the horfe is turned

turned round every time, ſo as to draw the barrel round in one direction the firſt time, and in a reverſe direction the next time. The horſe turns at the ſame time that the baſkets are unhooked and changed at the top and bottom of the pit, and very little time is loſt. A boy is required to lead and direct the horſe. In ſome large horſe-machines wheel-work is introduced, to communicate the motion of the vertical axis of the horſe-levers to the barrel on which the rope winds; and this work may be ſo contrived as to reverſe the motion of the barrel at pleaſure, although the horſes always walk in the ſame direction.

In very deep pits an inconvenience is experienced from the weight of the great length of rope which muſt be employed; for the whole weight of this rope is added to the weight of the loaded corve when it is at the bottom of the pit; and at the ſame time, the other corve being at the top of the pit, there is no length of rope on that ſide to counterbalance. As the corve is drawn up from the bottom, the other deſcends into the pit; this ſhortens the length of the aſcending rope, and increaſes the deſcending rope, ſo that by the time that the corve is half drawn up, the other is let half down, and the weight of the rope is equally divided, ſo as to be in balance; but after this, the deſcending rope becomes the longeſt, and its weight tends to weigh up the loaded corve, and in very deep pits, the weight of the rope exceeds that of the corve ſo as to draw it up: hence, there is a great inequality in the force required to turn the machine. To remedy this, the barrel is often made of a conical ſhape, being ſmalleſt in the middle, and larger towards the upper and lower ends; the ends of the two ropes are made faſt to it in the middle, or at the ſmalleſt part, and therefore the horſe has greater power when the corve is to be drawn from the bottom, and all the length of rope is added to its weight, becauſe the rope winds on a ſmaller radius; but as the rope coils on the barrel, it winds on a larger part of the cone, and the power or leverage diminiſhes; therefore, the horſe will draw up the corve with a rapidity which increaſes in proportion to the diminution of the load, by the ſhortening of the rope.

A very convenient mode of conſtructing a double conical barrel is to fix two circular wheels upon the axis, one for the top of the barrel, and the other for the bottom of the ſame. Two old cart-wheels are frequently employed for this purpoſe. The barrel on which the rope is wound is formed by a number of ſtraight pieces of wood, which are fixed to the rims of the wheel, and extend from the upper to the lower one. Theſe pieces are not fixed in a direction parallel to the vertical axis of the barrel, but are fixed croſswiſe in an oblique direction, and thus form a barrel, which is ſmall in the middle, and larger at the ends. When a cylindrical drum is fixed upon the main ſhaft to wind up the rope, if the pit is deep, a counterbalance to the weight of the rope muſt be applied to a ſmaller conical drum fixed on the vertical axis above the great drum. The circumference of the conical barrel is grooved with a ſpiral groove, like the fuſee of a watch; upon this fuſee a rope is applied, which deſcends into a ſmall pit made on purpoſe, and has a counter-weight at the end of it: this balances the unequal weight of the great rope, if the rapidity of the cone is properly proportioned. This anſwers very well for ſmall depths; but for a deep pit, the fuſee muſt be placed on a ſeparate barrel. This barrel may be placed horizontally over the pit in which the balance-weight deſcends, and muſt have a wheel upon it to communicate by a rope with a wheel fixed upon the vertical axis of the gin; by this means, the ſame motion is communicated to a ſpiral, as if it was placed immediately on the vertical axis.

A perfect equal motion is not neceſſary for horſe-work, and if it is not ſo much in extremes as to ſtrain the horſe in one part of his journey, whilſt he has nothing to do in another, he will work very well. Gentle aſcents and deſcents in a road are found as advantageous to the action of horſes as a road upon a perfect flat. The following is the conſtruction recommended by Mr. Smeaton for a two-horſe gin for a lead-mine:—The horſe-track 36 feet diameter, and two horſes are employed at once; the diameter of the drum 14 feet; the weight to be drawn at once $5\frac{3}{4}$ cwt. or 644 lbs. excluſive of the bucket, becauſe there are two, and the one ſerves as a balance for the other; depth of the pit 45 fathom, or 270 feet; the girt of the rope $6\frac{1}{2}$ inches. The counterbalance for the unequal weight of the great rope is conſtructed as follows:—Above the drum or rope-wheel, a ſmaller one, or balance-drum of one-fourth the diameter of the great drum, or 3 feet 6 inches, muſt be firmly fixed to the upright axis; alſo a little ſhaft or pit muſt be ſunk at a convenient diſtance from the machine: if this is oppoſite the great pit, it will require leſs bracing to keep the fixed parts of the framing at their proper diſtances. A hole muſt be made in the circumference of the ſmall wheel, or balance-drum, through which the end of a rope is paſſed, and ſecured by a knot. This rope, which is for the counter-weight, is to paſs over a pulley of 3 feet or more diameter, ſuch as is uſed to direct the great ropes down the main ſhaft; but it muſt be ſtrongly and ſubſtantially fixed, becauſe there will be a greater ſtrain upon it. Over this pulley the balance-rope goes down into a little pit ſunk for the purpoſe, and a balance-weight is hung to it, which muſt be double the weight of 45 fathom of the main pit-rope, and it will act as a counter-weight to the great pit-rope. The counter-weight muſt not, however, go down ſo as to touch the bottom of the little pit; and it muſt be ſo regulated as to be at the loweſt point when the two buckets are at their meetings, half way down the main pit. Hence, whichever way the main drum turns round, the counter-weight will be drawn up, and will arrive at the top when either of the buckets arrive there: by this means, whatever be the weight of the rope, though it exceeds the weight of matter in the bucket, yet the horſe will always have ſomething to draw; whereas in the old horſe-gins made at Newcaſtle, they had no other method than turning the horſes at the point of equilibrium; and after that letting them draw the backward way, which obliged them alſo to walk backwards, till the bucket arrived at the top.

As a $6\frac{1}{2}$-inch rope is far more than equivalent to the weight required to be drawn, the ſame ſort of rope will do for the counter-weight alſo; but as there will be a great deal of chafing at the hole where it is fixed to the little drum-wheel, in conſequence of its bending alternately one way and then the other, it will be proper to fortify it there with the white leather made of horſes' ſkins, and the hole itſelf ſhould be rounded off on each ſide, ſo as to make the rope bend eaſily.

In the ſinking of the little ſhaft, if there is any particular advantage or obſtacle, the depth may be greater or leſs than a quarter part of the main ſhaft; but then the ſize of the little drum and counter-weight muſt be proportioned accordingly. If practicable, the pit had better be deeper; and if it was half the depth, then the little drum might be half the diameter of the large one, and the counter-weight would be no more than the weight of the rope in the great pit. On account of the expence of the balance-pit, the double conical drum, which requires no counter-weight, is much preferable to any machine with a counter-weight.

In our article Water we have given the experiments on the ſtrength of horſes; from which it appears that a proper load

load for a horse to work eight hours in a day is 22,000 lbs. avoirdupois, to be raised one foot in a minute, or any smaller weight to be drawn quicker in proportion; hence the weight of 644 lbs. may be drawn by two horses at the rate of 71 feet *per* minute, or the whole depth of 45 fathoms in $3\frac{3}{4}$ minutes. The horses will then walk in their circle rather more than three miles *per* hour; but $2\frac{1}{2}$ miles is the best pace. Horses are frequently loaded much more than this, and indeed one strong horse may work this machine; but as he could only work a short time each day, it is better to employ two.

When mines were sunk to very great depths, the drawing of the ore by horse-gins became too expensive, particularly for coal-mines, and more effective winding-machines were introduced. The water-gin was the first of these. The most simple of these is called a whimsey, and consists of a bucket, which is let down full of water, and by its descending force, draws up a loaded basket or corve from the bottom of the pit. (See WHIMSEY.) This machine requires a very considerable fall of water, and it can rarely be less than one-fourth or sixth of the whole depth from which the coal or ore is to be drawn.

In cases where the fall is smaller, an over-shot water-wheel is employed; and in order to make the wheel turn at pleasure either way round, so as to wind up or let down, the wheel is made double; that is, with two rows of buckets, one row adapted to receive the water from a spout, which will cause it to turn round in one direction, and the other row of buckets is supplied with water from a different spout, and will turn the wheel in the opposite direction. Each spout is provided with valves to stop the stream at pleasure, and when one is open the other must be shut, and thus the wheel may be made to turn either way round. This is a very old invention, and is fully described by Agricola in his De Re Metallica, 1621. It was at one time in very common use in the collieries, and they raised up the supply of water for it by a pump applied to the beam of the great steam-engine, or sometimes by an engine on purpose.

Mr. Smeaton made a machine, in 1774, for drawing coals at Griff, in Warwickshire, by a water-wheel, in which the motion of the wheel is always continued in the same direction; and by a change in the communication of the wheel-work, the barrel is made either to draw up or to let down.

In 1777 Mr. Smeaton made a larger machine for Long Benton colliery, at Newcastle, which is worked by the water raised by a steam-engine on Newcomen's principle. The water-wheel and machinery are represented in *Plate Winding-Engine*, in several different elevations. X is the over-shot water-wheel, which is 30 feet in diameter: it is mounted on a cast-iron axis, which is clearly represented in the drawing. The water is delivered upon the wheel by a spout from a trough or cistern, which is supplied by the pump of the steam-engine. This trough is supported on tall piers of masonry, one of which is shewn in the sketch. Upon the axis of the water-wheel are fixed two cog-wheels, U V, of 88 cogs each, and the cogs are turned towards each other; W is a trundle, which is situated between the two wheels, and is turned round by either of them, according as it is placed; but it is smaller in diameter than the space between the two wheels, so that it cannot engage with both wheels at the same time. The trundle is fixed at the extremity of a long shaft, as shewn in the plan, *fig.* 1; and the opposite end of this shaft is connected with the barrel on which the ropes are wound: this barrel is composed of two cones, joined together at their bases. The ropes from the barrel are conducted over pulleys at the top of the pit, as shewn in the elevation, *fig.* 2, and descend into the same. The baskets, or corves, in which the coals are brought up, are hooked to the ends of the two ropes; so that by the motion of the water-wheel one basket is drawn up whilst another is let down.

To regulate the motion of the machine, two brakes or gripes are applied: one encompasses the great cog-wheel U, which is fixed on the axis of the water-wheel, in the same manner as the brake of a wind-mill; and in like manner, the fixed circle or brake is provided with a lever, as shewn in *fig.* 4, by means of which the brake can be drawn tight round the wheel, and will then cause such a friction as to stop the water-wheel and all the machine.

The other brake-wheel D C (*fig.* 1.) is fixed near the end of the long axis, and has clogs or pieces of wood applied at the top. This piece of wood is supported by a lever A B, as shewn in *fig.* 2, A being the centre; and to the other end, B, a box E is suspended, and contains as much weight as will press the clog upon the wheel, with the force necessary to retain the corve from descending when it is full loaded. To enable the man at the mouth of the pit to lower down the corve, a cord is fastened to the lever A B, and is conducted over the pulleys, *g k* and *l*, to the mouth of the pit, where it hangs down in a knot, which the man can always reach, and by pulling it, he raises up the lever, and releases the wheel from the clog. To prevent accidents, if the clog and lever A should fail to stop the machine, another clog and lever F G are applied beneath the wheel; this lever is drawn upwards by a cord and a block of pulleys O, which are attached to the lower part of the weight for the upper lever. This cord is conducted to the pit's mouth, and hangs down, so that the man can always reach it, and by pulling this, he compresses both the upper and lower clogs upon the wheel at the same time, which will be certain to stop it even if it be in a rapid motion; but he only resorts to this lower clog on occasion, as the curb-rein is used for a horse; the weight of the upper lever, like a horse's bridle, being a sufficient check for common use.

To make the machine wind either up or down, the trundle W must be changed from one of the wheels, U or V, to the opposite one, and this will cause the barrel to turn in an opposite direction. The pivot of the trundle W is supported by the long upright beam shewn in *fig.* 3, which is moveable on a centre at the lower end, so that by inclining it to the right or left, the trundle may be engaged with either of the wheels U or V. The requisite motion is given to the upright beam by two tackles of pulleys applied to the upper end of the beam, as shewn in *fig.* 3.

The ropes of both these tackles are fastened together, and hang down in a loop in reach of a boy, who can pull it either way, and make the trundle engage with either wheel, so as to wind up or let down the corves at pleasure. This boy is always stationed in a small room immediately over the wheels U V, so as to have the brake-lever, as well as the upright lever, always at his command; likewise the shuttle of the water-wheel, which is fixed, as is shewn in *fig.* 3. A lever is made to communicate with it, and from the opposite end of the lever a rod descends into the room, so that the boy, by pulling it, can open or shut the shuttle at pleasure. This he must do whenever the corve comes up, or rather before; and notice of the proper time is given by a large knot in the main rope. The water being then shut off, the wheel will continue to turn by its momentum until the corve comes fully up, but by that time will have diminished its velocity, so that the application of the brake will stop it without any strain: the man at the mouth of the

the pit alſo applies the brake on the wheel C D. Immediately the motion ceaſes, the boy pulls the tackle, which diſengages the trundle W from the wheel, but without engaging it with the oppoſite one, and in conſequence the barrel is detached from the water-wheel. A man now ſeizes the corve with a long hook, like a ſhepherd's crook, and draws it aſide; then another man releaſes the clog or brake on the wheel C D, and the wheel and the corve immediately deſcend upon the ground at the ſide of the pit. The pulley over the pit is raiſed up to a conſiderable height, becauſe the machine cannot be ſtopped exactly at the preciſe ſpot; but if the corve ſhould be drawn up a few feet higher than neceſſary, no harm can enſue as ſoon as the full corve is landed and exchanged for an empty one; and the ſame is done at the bottom of the pit. The boy throws the trundle in gear with the oppoſite wheel, then draws the ſhuttle to let the water flow upon the wheel, and the wheel reſumes its motion.

For the facility of ſtopping the machine at the proper moment, Mr. Smeaton applied a piece of machinery, which he called a count-wheel. This received its motion from a pinion of 15 teeth, fixed upon the extremity of the pivot of the lantern W; the pinion gave motion to a ſmall cog-wheel of 60 teeth, ſituated between the two great cog-wheels U V, being fixed at one end of an horizontal ſpindle; and at the oppoſite end of it was a pinion of eight teeth, which gave motion to the count-wheel. This wheel had 80 teeth, and was fixed in a vertical poſition. It had affixed to its plane two projecting pieces of iron, which operated upon a lever that was connected with the lever which lets down or draws up the ſhuttle to regulate the flow of water upon the wheel. Theſe projections were ſo fixed to the wheel as to be capable of regulation in ſuch manner, that when the machine had worked long enough to have brought up the corve to the top of the pit, the projection of the count-wheel would ſeize the lever, and let fall the ſhuttle ſo as to ſtop the water-wheel at the proper moment, without any attention on the part of the boy. This could be eaſily regulated by the poſition of the projection on the count-wheel, and when once adjuſted always operated correctly; for as the count-wheel turned only once for forty turns of the barrel, the machine would therefore draw up a corve from the bottom of the pit before the count-wheel made a complete turn.

As the two corves in the pit aſcend and deſcend mutually, they muſt paſs each other at half the breadth of the pit; and it ſometimes happens that they ſtrike together, and overſet the coals. The beſt remedy for this is to divide the pit in two, or make two ſeparate pits, and the barrel may be ſituated between the two. As it is frequently impracticable to do ſo, a ſmaller projection was applied in Mr. Smeaton's machine upon the count-wheel, which acted in the middle of the courſe upon the lever, and raiſed it up ſo as to diminiſh the opening of the water-ſhuttle, and make the machine move ſlowly at the moment when the corves met and paſſed each other: this prevented accidents.

The principal dimenſions of this machine were as follow:—The cylinder of the ſteam-engine 26 inches diameter, and 5 feet 8 inches the length of ſtroke. It made 14 ſtrokes *per* minute. It was on the principle of Newcomen, *i. e.* atmoſpheric, with injection into the cylinder. The pump was $18\frac{1}{2}$ inch bore, and 5 feet 8 inches ſtroke: it raiſed the water 33 feet high. This water, being conveyed in a trough to the machine, was delivered upon the water-wheel, which was 30 feet diameter, with 72 buckets; its caſt-iron axis was 7 inches diameter; the great cog-wheels 12 feet diameter, with 88 cogs; the trundle 20 cogs, ſo that the barrel turned 4.4 times for once of the water-wheel. The barrel was 5 feet 3 inches diameter in the middle, and 2 feet $11\frac{1}{2}$ inches diameter at the ends; the whole length being $10\frac{1}{2}$ feet. Upon the circumference of the barrel a ſpiral line is traced, and a groove ſunk, which receives half of the rope, to prevent the rope from ſlipping on the barrel.

The depth of the pit was 165 yards; and it was found, on a long courſe of experiments, that the total conſumption of coals was one corve of coals to draw up $82\frac{1}{2}$ corves from that depth. The machine would draw 18 ſcore of corves, each containing 20 pecks and weighing $5\frac{1}{2}$ cwt., every 12 hours.

The more modern winding-engines by ſteam are upon a much more ſimple conſtruction. The power of the ſteam-engine is applied at once to the barrel which winds up the rope, with only one pair of cog-wheels; *viz.* a large wheel fixed on the axis of the barrel, and a ſmaller one on the axis of the fly-wheel of the ſteam-engine. Theſe engines are frequently made on Newcomen's principle, as the conſumption of coals is a ſmall object, but Mr. Watt's engines are more manageable. As the ſteam-engine with a crank will turn either way, according as it is ſet in motion, it is very well adapted for winding-machines; the boys who manage them are very dexterous in ſtopping and turning them the contrary way. See STEAM-*Engine*.

There are many ingenious contrivances for facilitating the landing of the corves when they come up to the pit's mouth. The beſt is a platform, which runs upon wheels, and can be puſhed over the pit's mouth, when the corve is drawn up, by means of a light carriage with one horſe, which is backed on the platform beneath the corve, and puſhes the platform over the pit by the ſame motion. The corve is lowered down upon the carriage, and then the horſe draws the corve away; the ſame motion withdraws the platform from the pit's mouth, ready to let down an empty corve and draw up another full one.

In many modern pits, conductors are fixed in the pit. Theſe are perpendicular rods, and the baſkets have projecting parts which embrace the conductors, and guide the corve regularly up or down the pit.

In many collieries flat ropes are uſed. Theſe are compoſed of four ſmall ropes placed flat, ſide by ſide, and ſewed together by a packthread, which pierces all the four ropes. When theſe flat ropes are uſed, a barrel or drum of ſmall ſize is uſed, and the coils of the rope wind one upon the other, ſo as to form a ſpiral, and increaſes the diameter of the effective barrel as the rope winds up, ſo as to balance the weight of the rope. This was invented by Mr. John Curr, of Sheffield, who has ſeveral patents for machinery for manufacturing ſuch flat ropes, as they are extenſively uſed in Yorkſhire.

In others, iron chains are uſed inſtead of ropes, and are found to anſwer extremely well.

WINDING *of Cotton*. See COTTON *Manufacture*.

WINDING *of Silk*. See *Manufacture of* SILK.

WINDING-*Screw Cheeſe-Preſs*, in *Rural Economy*, a contrivance of this ſort, in which the weight is ſaid, in the Glouceſterſhire Report on Agriculture, to be capable of being gradually let down on the vats. It is thus deſcribed:—A ſtrong platform, or ſill, is raiſed on four legs, about a foot from the floor; near the edge is made a channel all round, to carry off the whey as it is expreſſed, by a lip, into the pan or receiver. Two ſtrong ſide-poſts are mortiſed into the ſill, reaching about ſix feet high; acroſs which, about four feet high, is firmly faſtened a ſtrong bar, with an aperture in the centre large enough to let in the ſcrew with eaſe. This ſcrew is fixed, at the lower part, into a heavy cubical ſtone of of two feet dimenſions, or nearly: the upper part of the ſcrew, having paſſed the perforation in the croſs-bar, enters a nut or female ſcrew, large in the middle, but worked off at the two ends fine enough to be graſped by the hand: by turning this nut, the weight is raiſed or let down on the cheeſe-vats underneath.

Where ſtones of the required weight and dimenſions are not to be had, a wooden frame of the ſame ſize is uſed, which is filled with ſand, pebbles, or rubble-ſtones.

The ſcrew part of this preſs has, in many dairies, been lately ſuperſeded by the adoption of an apparatus leſs ſimple in its conſtruction, though more eaſily worked. In which, on the right ſide of the preſs, a third upright is raiſed from the floor, and connected by two croſs-bars, about a foot long, with the upright poſt parallel with it. About four feet high, a cylinder of wood, from five to ſix inches diameter, is inſerted, paſſing quite through the additional upright, but kept to its place by a ſhoulder. To the end are fixed four ſpokes, or levers, or an iron handle, to which manual power is applied. A ſtrong rope is faſtened to and coiled round the cylinder, which paſſing over a pulley let lengthways into the upper bar, proceeds horizontally to another pulley, fixed directly over the centre of the weight, and by an iron hook attached to it. Very moderate ſtrength will raiſe the weight, which in this conſtruction ſlides with grooves fitted to the ſide-poſts. The mechanical powers are varied in ſome preſſes by the uſe of a wheel of a foot or eighteen inches diameter, inſtead of the pulley; but the effect is ſimilar. In either way of working the weight, there is a ſuperiority over the old preſs, and little difference in the expence.

WINDING *Stairs*. See STAIR.

WINDING *of Wool*, in *Rural Economy*, the practice of putting it up into fleeces. There is ſome nicety required in this operation; all the looſe ragged parts are to be turned inwards, ſo as to form a neat ſolid ſort of fleece, and all the dirty parts removed. The work is done on a large table or bench for the purpoſe. In ſome caſes of expert winders, four hundred fleeces can be wound in the courſe of the day.

WINDISCH FEISTRITZ, in *Geography*, a town of the duchy of Stiria, on the river Pluſcka; 40 miles S. of Gratz. N. lat. 46° 30′. E. long. 15° 28′.

WINDISCH *Gratz*, a town of the duchy of Stiria; 18 miles N.N.W. of Cilley. N. lat. 16° 35′. E. long. 15°.

WINDISCH *Landſberg*, a town of the duchy of Stiria; 12 miles E. of Cilley.

WINDISCH *Mark*, a part of Carniola, bordering on Hungary and Croatia.

WINDISCH *Matray*, a town of the archbiſhopric of Salzburg; 54 miles S.S.W. of Salzburg. N. lat. 46° 55′. E. long. 12° 36′.

WINDISH, a village of Switzerland, near Konigsfelden, at the conflux of the Aar and the Reuſs, in the canton of Berne, in which are found the ruins of the ancient city of Vindoniſſa, a fortreſs mentioned by Tacitus, which the Romans made a place of arms to ſtop the irruption of the Germans, and is ſaid to have been the ſee of a biſhop. It was deſtroyed in the 7th century; 3 miles W. of Baden.

WINDISHGARTEN, a town of Auſtria; 16 miles S.W. of Bavarian Waidhoven.

WINDLASS, or WINDLACE, a machine uſed for raiſing heavy weights, as guns, ſtones, anchors, &c.

It is very ſimple, conſiſting only of an axis, or roller, ſupported horizontally at the two ends by two pieces of wood and a pulley. The two pieces of wood meet at top; being placed diagonally, ſo as to prop each other. The axis, or roller, goes through the two pieces, and turns in them. The pulley is faſtened at top, where the pieces join.

Laſtly, there are two ſtaves, or handſpikes, which go through the roller, by which it is turned; and the rope, which comes over the pulley, is wound off and on the ſame.

WINDLASS, an horizontal machine, compoſed of timber, &c. and moſt uſed in merchant-ſhips for heaving up their anchors in lieu of a capſtan. The body of the windlaſs is octagonal, and is tapered from the middle to the ends by given dimenſions. It is ſawn from oak-timber of the beſt quality, and the length between the cheeks is in one piece. But when fitted with an iron axle or ſpindle in the middle, it muſt be in two pieces. The ends without the cheeks are fitted with iron ſpindles, and have a hoop driven over their ends. The ſpindles muſt be very accurately let into the ends and middle of the body, that the axis of each may exactly agree in a right line. A bolt is driven through the body of the windlaſs and each end of the ſpindles. On each end of the body is let on and ſecurely bolted an iron pall-hoop, with teeth or notches at every two or three inches. The palls, which are iron, are fixed againſt the aft-ſides of the pall-bits, and fall into the teeth or notches of the pall-hoop, ſo as to prevent it turning backwards when charged by the effort of the cable, &c. Holes or mortiſes are cut through, along the middle of the windlaſs on each ſquare, to admit the handſpikes, and each ſquare of the body is covered with elm or fir facings between the cheeks, on the working ſide in particular. It is ſuſpended by its axles or ſpindles in braſs rhodings, or gudgeons, which are let in and bolted into a frame of oak-timber called the cheeks, which are let down through the deck, and bolted to the pall-bits.

There are other methods of fitting windlaſſes, but this is recommended as the beſt.

WINDLASS-*Cheeks*, pieces of oak or elm faſtened to the ſides of ſmall veſſels, and by which the ends of their windlaſſes are ſuſpended.

WINDLE, in *Geography*, a townſhip of England, in Lancaſhire; 10 miles N.E. of Liverpool.

WINDLESTRAW, in *Agriculture*, a term applied to the naked ſtems of the creſted dog's-tail, and other natural graſſes.

It is obſerved in the third volume of the Tranſactions of the Highland Society of Scotland, that the common *poa* there ſometimes goes by the name of windleſtraw-graſs. See GRASS, and POA.

WINDMANNIA, in *Botany*. See WEINMANNIA.

WINDO, in *Geography*, a ſea-port town of Sweden, in the province of Smaland; 85 miles N. of Calmar.

WINDORS, a town of the biſhopric of Paſſau; 10 miles W. of Paſſau.

WINDOT CREEK, a river of America, which runs into the Ohio, N. lat. 37° 59′. W. long. 86° 48′.

WINDOW, *q. d.* WIND-DOOR, an aperture, or open place, in the ſide of a houſe, to let in the air and light.

Before glaſs windows came into uſe, (for the antiquity and firſt introduction of which, ſee GLASS,) the window caſements were commonly made of a tranſparent ſtone, called *ſpecularis lapis*, and thence called *ſpecularia*; and before the *ſpecularia*, veils were the only defence they had againſt the weather. Pitiſc. Lex. Antiq. in voc. *Specularia*.

We have various kinds and forms of windows; as glaſs-windows, wire-windows, horn-windows, &c. Arched windows, circular windows, elliptical windows, ſquare and flat windows, round windows, oval windows, Gothic windows, regular windows, ruſtic windows; to which add ſky-lights.

The chief rules with regard to windows are, 1. That they be as few in number, and as moderate in dimenſions, as may conſiſt with other reſpects; inaſmuch as all openings are weakenings.

2. That they be placed at a convenient diſtance from the angles, or corners of the building; becauſe thoſe parts ought not to be opened and enfeebled, whoſe office is to ſupport and faſten all the reſt of the building.

3. That care be taken the windows be all equal one with another, in their rank and order; ſo that thoſe on the right-hand may anſwer to thoſe on the left, and thoſe above be right over thoſe below; for this ſituation of windows will not only be handſome and uniform, but alſo, the void being upon the void, and the full upon the full, it will be a ſtrengthening to the whole fabric.

As to their dimenſions, care is to be uſed to give them neither more nor leſs light than is needful; therefore regard is to be had to the bigneſs of the rooms which are to receive the light. It is evident, that a great room needs more light, and, conſequently, a greater window, than a little room; and *e contra.*

The apertures of windows, in middle-ſized houſes, may be four and a half or five feet between the jambs; and in the greater buildings, ſix and a half or ſeven feet; and their height may be double their length at the leaſt. But in high rooms, or larger buildings, their height may be a third, a fourth, or half their breadth, more than double the length.

Such are the proportions for windows of the firſt ſtory; and, according to theſe, muſt thoſe in the upper ſtory be for breadth; but, as to height, they muſt diminiſh; the ſecond ſtory may be one-third part lower than the firſt; and the third ſtory, one-fourth part lower than the ſecond.

WINDOWS, *Architrave.* See ARCHITRAVE.

WINDOWS, *Dormer*, or *Lutherns.* See LUTHERNS, &c.

WINDOWS, *Scenography of.* See SCENOGRAPHY.

WINDOWS, *Tranſom.* See TRANSOM.

WINDOW *and Houſe Tax*, is one of the aſſeſſed taxes transferred to the commiſſioners for the affairs of taxes. The duties charged annually with reſpect to the windows or lights in every dwelling-houſe, (for which, ſee TAX,) are ſubject to the following regulations.

All ſkylights, and all windows or lights, however conſtructed, in ſtaircaſes, garrets, cellars, paſſages, and all other parts of dwelling-houſes, to what uſe or purpoſe ſoever applied, and whether ſuch windows or lights ſhall be in the exterior or interior parts of ſuch dwelling-houſes, to be charged to the ſaid duties.

Every window or light in any kitchen, cellar, ſcullery, buttery, pantry, larder, waſhhouſe, laundry, bakehouſe, brewhouſe, and lodging-room, belonging to or occupied with any dwelling-houſe, whether the ſame ſhall be within or contiguous to or disjoined from the body of ſuch dwelling-houſe, ſhall be charged to the ſaid duties.

The ſaid duties to be charged yearly upon the occupier or occupiers of the houſes, cottages, or tenements, in reſpect whereof the ſaid duties ſhall be charged, and to be in force for one whole year, from the 5th day of April in the year in which the ſame ſhall be charged, to be levied on them, or on their reſpective executors or adminiſtrators, except as hereinafter provided.

Where any change in the occupation of any houſe, cottage, or tenement, ſhall take place after the aſſeſſment ſhall be made, then the ſaid duties ſhall be levied upon and paid by the occupier, landlord, or owner, for the time being, or on both or all of them, according to their times or poſſeſſion thereof, without any new aſſeſſment, notwithſtanding ſuch change in the occupation for the year that ſuch houſe ſhall have been aſſeſſed: provided, that where a tenant ſhall quit the ſame, on the determination of the leaſe or demiſe after an aſſeſſment made, and ſhall have given notice thereof to the aſſeſſor, the duty ſhall be diſcharged by the commiſſioners for this act for the remainder of that year, in caſe it ſhall appear to them at the end of ſuch year, that ſuch houſe, &c. ſhall have continued wholly unoccupied during the remainder of ſuch year.

Where any dwelling-houſe is or ſhall be let in different apartments, tenements, lodgings, or landings, and ſhall be inhabited by two or more perſons or families, the ſame ſhall nevertheleſs be charged as if inhabited by one perſon or family only; and the landlord or owner ſhall be deemed and taken to be the occupier, and ſhall be charged with the ſaid duties: provided, that where the landlord ſhall not reſide within the limits of the collector, or the ſame ſhall remain unpaid by him for twenty days after the ſame is due, the duties ſo charged may be levied on the occupier or occupiers reſpectively, and ſuch payment ſhall be deducted and allowed out of the next payment on account of rent.

Every houſe, of which the keeping is left to the charge of any perſon or ſervant, ſhall be ſubject to the like duties as if it were inhabited by the owner or by a tenant; and, if ſuch perſon or ſervant ſhall not pay rates to the church and poor, the ſaid duties ſhall be paid by the reſpective owners or tenants of the ſaid houſe.

Every diſtinct chamber or apartment in any of the inns of court, or of chancery, or in any college or hall in either of the univerſities of Oxford or Cambridge, or any public hoſpital, being ſeverally occupied, ſhall be ſubject to the ſame duties as if an entire houſe, which ſhall be paid by the reſpective occupiers; provided, that every ſuch chamber or apartment, which ſhall not contain more than ſeven windows or lights, ſhall be charged at the rate of 3*s.* 6*d.* for every ſuch window or light.

All dwelling-rooms in any hall or office whatever, belonging to any perſon, or to any body politic or corporate, or to any company, lawfully charged with the payment of any other taxes or pariſh-rates, ſhall be ſubject to thoſe hereby payable, and be reſpectively charged as dwelling-houſes; and the perſon, &c. to whom the ſame ſhall belong ſhall be charged as the occupier or occupiers thereof.

When a partition or diviſion between two or more windows or lights, fixed in one frame, is of the breadth or ſpace of twelve inches, the window or light on each ſide of ſuch partition or diviſion ſhall be charged as a diſtinct window or light.

Every window extending ſo far as to give light into more rooms, landings, or ſtories than one, ſhall be reckoned and charged as ſo many ſeparate windows as there are rooms, landings, or ſtories enlightened thereby.

Every window or light, including the frame, partitions, and diviſions thereof, which by due admeaſurement of the whole ſpace on the aperture of the wall of the houſe or building, on the outſide of ſuch window or light, ſhall exceed in height twelve feet, or in breadth four feet nine inches, not being leſs than three feet ſix inches in height, ſhall be reckoned and charged as two windows or lights, except ſuch windows or lights as ſhall have been made of greater dimenſions at any time prior to April 5, 1785; except alſo the windows or lights in ſuch parts of dwelling-houſes as are uſed for ſhops, workſhops, and warehouſes, and except the windows or lights in the public room of any houſe licenſed to ſell wine, ale, or other liquors by retail, which ſhall be uſed for the entertainment of gueſts; and the windows or lights in farm-houſes eſpecially exempted from the duties

duties in the fchedule marked (B.), or in any dwelling-houfe not chargeable to the duties mentioned in the faid fchedule.

Where any dwelling-houfe fhall be divided into different tenements, being diftinct properties, every fuch tenement fhall be fubject to the fame duties as if the fame were an entire houfe, which duties fhall be paid by the refpective occupiers; provided, that every fuch tenement, which fhall not contain more than feven windows or lights, fhall be charged at the rate of 3*s.* 6*d.* for every fuch window or light; and every fuch tenement in Scotland, which fhall not contain more than feven windows or lights, fhall be charged at the rate of 3*s.* for every fuch window or light.

The cafes in which windows are exempted are the following.

1. Any houfe belonging to his majefty, or any of the royal family, and every public office, for which the duties heretofore payable have been paid by his majefty or out of the public revenue.

2. Any hofpital, charity-fchool, or houfe provided for the reception and relief of poor perfons, except fuch apartments therein as are or may be occupied by the officers or fervants thereof, which fhall feverally be affeffed, and be fubject to the faid duties as entire dwelling-houfes.

3. The windows in any room of a dwelling-houfe, licenfed according to law as a chapel for the purpofes of divine worfhip, and ufed for no other purpofe whatfoever.

Provided that every fuch hofpital, charity-fchool, houfe for the reception and relief of poor perfons, or room licenfed as a chapel as aforefaid, fhall be brought into charge by the affeffor or affeffors, or in their default, by the furveyor or infpector, and fhall be ftated on the certificate of affeffments as fuch; and on due proof of the fact before the commiffioners by the affeffors, it fhall be lawful for the commiffioners for executing the faid act to difcharge fuch hofpital, &c. from the faid duties, or fuch part thereof as is hereby intended to be exempted, in like manner as they are authorized to difcharge the affeffment on poor perfons by this act, but not otherwife.

4. The windows or lights, in any dairy or cheefe-room belonging to and occupied with any dwelling-houfe, chargeable with the faid duties, although the fame fhall be part thereof, which fhall be ufed by the occupiers for the purpofe of keeping butter or cheefe, being their own produce, for fale or private ufe; provided, that the windows or lights in fuch dairies or cheefe-rooms fhall be made with fplines or wooden laths, or iron bars, or wires, and wholly without glafs, and that the occupiers of the dwelling-houfes to which fuch dairies and cheefe-rooms belong fhall caufe to be painted on the outer door thereof, or on the outfide of the windows thereof, or one of them, in large Roman letters, the words, "dairy, or cheefe-room," as the cafe may require, and fhall keep fuch words fo painted diftinctly legible, during all fuch time as fuch exemption fhall be claimed; and provided, that fuch dairies or cheefe-rooms fhall not be ever ufed to dwell or to fleep in by any perfon, but fhall be wholly kept for the feveral purpofes hereinbefore mentioned; and provided alfo, that an affeffment of all fuch windows or lights fhall be duly made, and the fact be truly returned in the manner directed by this act, in other cafes of exemption from the faid duties, fo that the number of windows fo to be exempted may be afcertained, and the exemption be allowed by the commiffioners for executing this act.

The provifions that refpect the exemptions of windows from affeffment by 43 Geo. III. c. 161. are as follow.

Windows are to be ftopped up with ftone or brick, or the fame kind of materials as the outfide of the houfe; allowance being made for thofe in the roof made of the fame materials with the outfide of the roof, or ftopped up before the commencement of this act; or windows are not to be made, reftored, or ftopped up without fix days' previous notice given to the furveyors, under a penalty of 10*l.*: and furveyors are to charge windows newly made or reftored, and omitted in the affeffment; and the penalty on ftopping up windows to elude payment is a charge on the occupier of the tenement, at the rate of double the fum by which the affeffment fhall be augmented, by reafon of fuch certificate, fubject to appeal, provided it be proved to the fatisfaction of the commiffioners for executing this act, that the fame windows or lights were refpectively ftopped up according to the directions of this act, previous to the commencement of the year on which the faid affeffment fhall or ought to have been made.

The duty on dwelling-houfes (for which, fee TAX) comprehends every coach-houfe, ftable, brewhoufe, wafhhoufe, laundry, woodhoufe, bakehoufe, dairy, and all other offices, and all yards, courts, and curtilages, and gardens, and pleafure-grounds, belonging to and occupied with any dwelling-houfe, within the limits of one acre.

All fhops and warehoufes which are attached to the dwelling-houfe, or have any communication therewith, fhall, in charging the faid duties, be valued together with the dwelling-houfe and the houfehold and other offices aforefaid thereunto belonging, (except fuch warehoufes and buildings upon or near adjoining to wharfs which are occupied by perfons who carry on the bufinefs of wharfingers, and who have dwelling-houfes upon the faid wharfs for the refidence of themfelves or fervants employed upon the faid wharfs.)

And alfo except fuch warehoufes as are diftinct and feparate buildings, and not parts or parcels of fuch dwelling-houfes, or the fhops attached thereto, but employed folely for the purpofe of lodging goods, wares, and merchandize, or for carrying on fome manufacture (notwithftanding the fame may adjoin to or have communication with the dwelling-houfe or fhop.)

Every chamber or apartment in any of the inns of court, or of chancery, or in any college or hall in any of the univerfities of Great Britain, being feverally occupied, fhall be charged thereto as an entire houfe, and on the refpective occupiers thereof.

Every hall or office whatever belonging to any perfon or to any body politic or corporate, or to any company lawfully charged with the payment of any other taxes or parifh-rates, fhall be fubject to the duties as inhabited houfes; and the perfon, &c. to whom the fame fhall belong fhall be charged as occupier.

Where any houfe fhall be let in different ftories, tenements, lodgings, or landings, and fhall be inhabited by two or more perfons or families, the fame fhall neverthelefs be charged to the faid duties as if inhabited by one perfon or family only, and the landlord or owner fhall be deemed the occupier, and fhall be charged to the faid duties: provided, that where the landlord fhall not refide within the limits of the collector, or the fame fhall remain unpaid by fuch landlord for the fpace of twenty days after the fame is due, the duties fo charged may be levied on the occupier or occupiers refpectively; and fuch payment fhall be deducted and allowed out of the next payment on account of rent.

No dwelling-houfe, or other fuch premifes as aforefaid, fhall be eftimated or rated at any lefs annual value than the rent or value at which the fame premifes ftand charged in the laft rate made on or before the time of making the affeffment

affeffment for the relief of the poor in the fame parifh or place, under certain fpecified reftrictions with regard to the poor rate.

Where any dwelling-houfe fhall be divided into different tenements being diftinct properties, every fuch tenement fhall be fubject to the fame duties as an entire houfe, which duty fhall be paid by the occupiers refpectively.

The cafes of exemption are the following.

1. Any houfe belonging to his majefty, or any of the royal family, and every public office for which the duties heretofore payable have been paid by his majefty, or out of the public revenue.

2. Every dwelling-houfe, being a farm-houfe occupied by a tenant, and *bonâ fide* ufed for the purpofes of hufbandry only.

3. Every dwelling-houfe, being a farm-houfe occupied by the owner thereof, and *bonâ fide* ufed for the purpofes of hufbandry only, which, together with the houfehold and other offices aforefaid, fhall be valued under this act at 10*l. per annum*, or any lefs fum.

4. Any hofpital, charity-fchool, or houfe provided for the reception or relief of poor perfons.

5. Every houfe whereof the keeping is committed to the care of any perfon or fervant, who doth not pay rates to the church and poor, and who refides therein for the purpofe only of taking care thereof: provided, that an affeffment fhall be duly made in every fuch cafe, and the fact be truly returned in the manner directed by this act in other cafes of exemption from the faid duties, and the exemption be allowed by the commiffioners for executing this act.

Any perfon inhabiting a dwelling-houfe, containing not more than fix windows in the whole, fhall be exempted from the duties in fchedule (A.), in cafe fuch perfon fhall be on the books of fuch parifh or place as receiving parochial relief; and fhall not be affeffed, or liable to be affeffed to any of the duties contained in fchedules (B.), (C.), (D.), or (E.); which feveral exemptions fhall be proved or claimed in the manner hereinafter mentioned.

And, in order to relieve fuch perfons who may be charged to the feveral duties fet forth in the fchedules (A.) and (B.), or either of them, it is enacted, that where any fuch houfe, cottage, or tenement, as is defcribed in the preceding claufe, fhall be brought into charge, and the occupier thereof fhall be entitled to the faid exemption by reafon of poverty, in every fuch cafe, the affeffors fhall, on the certificate of affeffment, fet oppofite the fum charged on the occupier thereof, the fact of his or her being poor, and fhall return the fame, together with the affeffment and a certificate, as hereinafter mentioned, to the commiffioners for executing this act in the diftrict where fuch affeffment fhall be made; who, before allowing any fuch affeffment, or making any order thereupon, fhall examine the affeffors, who fhall refpectively attend them for that purpofe, at fuch time as they fhall appoint, touching the return fo made; and if the faid commiffioners fhall, from fuch examination, and from the certificate hereinafter mentioned, be fatisfied that any fuch occupier is entitled to fuch exemption, they may, after fuch proof, ftrike out the charge, leaving his name, and the number of windows and rent of fuch houfe in the affeffment, and every fuch occupier fhall be exempted accordingly; which exemption fhall, in the like cafes, extend to, and fhall be allowed on all affeffments on fuch poor perfons, of the duties payable at the time of paffing this act, which fhall have been, or fhall be made, at any time after the commencement of the prefent year.

But before any fuch exemption or abatement fhall be allowed, the affeffors fhall produce to the commiffioners a certificate under the hands of five or more fubftantial houfeholders of fuch parifh or place, in veftry affembled, of whom the refident minifter fhall be one; but in cafe there fhall be no fuch minifter refident therein, then at leaft two or more churchwardens and overfeers of the poor of fuch parifh or place fhall concur with fuch houfeholders in fuch certificate, certifying thereby, that they have carefully examined the affeffment of the faid duties, and the allegations therein made by the affeffors, touching fuch perfons who fhall be therein ftated to be poor, and that in their judgment and belief the perfons therein certified to be poor are entitled to be exempted by reafon of their poverty, and are wholly unable to pay the duties affeffed upon them; provided, that if in any parifh or place there fhall not be five fubftantial houfeholders, then fuch certificate may be made by the fubftantial houfeholders there refiding; or if there fhall be no churchwardens or overfeers, then the fame may be granted by the refident minifter, or by any two churchwardens or overfeers of any adjoining parifh or place, who can certify the truth of fuch allegations, concurring therein with the fubftantial houfeholders refiding in the parifh or place where fuch affeffment fhall be made.

And where the occupier of any houfe, cottage, or tenement, containing more than the number of windows or lights before fpecified, fhall be brought into charge, and the occupier thereof fhall, at the commencement of the year for which fuch affeffment is made, be poor and indigent, or fhall become fo during that year, in every fuch cafe, fuch occupier may give notice thereof in writing, ftating the caufes to the affeffor, or to the furveyor of the diftrict in which fuch houfe is fituate, annexing thereto a certificate, under the hands of fuch perfons as aforefaid, certifying that, in their judgment and belief, fuch perfon is juftly entitled to relief on account of poverty for the caufes mentioned in fuch notice; and every affeffor fhall deliver the notices by him received to fuch furveyor: and if fuch furveyor fhall be fatisfied of the truth thereof, after due examination of the facts and circumftances, and that fuch perfon is unable to pay the duties charged on him or her, and has no probable means of bettering his or her condition within that year, he is hereby required to certify the fame to the commiffioners; and if fuch furveyor fhall not be fatisfied, then, on notice thereof to fuch occupier, he may appeal from fuch charge to the commiffioners, giving ten days' previous notice thereof to the faid furveyor.

And in every cafe where the furveyor fhall certify to the faid commiffioners that he is fatisfied of the truth of the claim made by any fuch occupier, and that he is, and will be unable to pay the duties charged on him or her within that year; or if, upon appeal, it fhall appear to the fatisfaction of the major part of the faid commiffioners prefent, on the oath of fuch appellant, or by other lawful evidence on oath produced by fuch appellant, that he or fhe is entitled to maintain fuch appeal, and wholly unable to pay the duties charged on him or her, the faid commiffioners may give fuch relief, either by ftriking off the whole of the duty fo charged, or diminifhing the fame, as to them fhall feem meet and neceffary; and which appeals, for the caufes in this claufe mentioned, may be heard and determined, either on the days mentioned in this act for hearing appeals in other cafes, or at the end of the year, or any days to be appointed by the refpective commiffioners for executing this act; which exemption fhall, in the like cafes, extend to, and fhall be allowed on all affeffments on fuch poor perfons of the duties payable at the time of paffing this act, which fhall have been or fhall be made at any time after the commencement of the prefent year.

Unoccupied

Unoccupied houfes are to be inferted in the affeffment, and the affeffors, or the furveyors and infpectors, are to certify when they become occupied; and the perfon occupying fhall give notice to the affeffor, furveyor, or infpector, within twenty days after occupation, under a penalty of 5*l.*, and be liable to be charged for the reft of the preceding quarter; and houfes becoming unoccupied after affeffment are to be charged for the whole year, unlefs notice is given. Notices are alfo to be given by occupiers of houfes or managers of hofpitals, charity-fchools, poor-houfes, or licenfed chapels, entitled to exemptions; and the exemptions are to be allowed by the commiffioners after examination. Burn's Juftice, vol. v. See TAX and COMMUTATION.

WINDOW, in *Anatomy*, &c. See FENESTRA.

WINDRUSH, in *Geography*, a river of England, in the county of Oxford, which runs into the Thames, 5 miles S.S.W. of Witney.

WINDSBACH, a town and citadel of Germany, in the principality of Anfpach; 10 miles S.E. of Anfpach. N. lat. 49° 13′. E. long. 10° 46′.

WINDSHEIM, a town of Bavaria. The inhabitants are chiefly Lutherans. This town was imperial till 1802, when it was given to the elector of Bavaria; 28 miles S.W. of Wurzburg. N. lat. 49° 34′. E. long. 10° 26′.

WINDSOR, commonly called NEW WINDSOR, to diftinguifh it from a parifh named Old Windfor, a market and borough town of Berkfhire, England, is eminent in the hiftoric annals of the kingdom, on account of containing one of the palaces of the fovereigns, and from the many diftinguifhed events which are identified with the place. Some of our moft eminent military and chivalrous fovereigns have made the caftle, or palace of Windfor, their chief refidence, and confequently the fcene of various celebrated feftivities, tournaments, and national affemblies. In the annals of the caftle, this is fully verified. When the Domefday-book was compiled, the caftle, which had been then lately built by William the Conqueror, was within the manor, and it is probable within the parifh of Clewer, of which Windfor was formerly a chapelry: it afterwards became the feat of an extenfive honor.

We are told by the Saxon Chronicle, that William the Conqueror kept his Whitfuntide at Windfor in 1071; and that a fynod was held there in 1072, wherein the province of York was made fubject to Canterbury. It is probable, that William Rufus kept his Whitfuntide at Windfor in 1095, his Chriftmas in 1096, and his Eafter in 1097: but in all probability all thefe feftivals were held at the palace at Old Windfor. Windfor-caftle feems to have been intended by William the Conqueror more for a military poft, for which by its fituation it was well adapted, than for the refidence of himfelf and his fucceffors.

Several monarchs kept their Chriftmas and other feftivals at Windfor; on fome of which occafions there were tournaments and other chivalrous fêtes performed. After the contentions between Stephen and Maud, Windfor-caftle, as the fecond fortrefs of the kingdom, was committed to the cuftody of Richard de Lacy.

It appears that a new barbican, or out-work, was built to the caftle by king Henry III. In 1263, during the wars between that monarch and his barons, prince Edward garrifoned Windfor-caftle with foreigners, who nearly deftroyed the town, and did much injury to the furrounding country. The fame year it was given up to the barons, and the king made an order that Eleanor, wife of prince Edward, with her daughter and all her houfehold, fhould, without delay, retire from the caftle.

A great tournament was held in Windfor-park on the 9th of July, in the fixth of king Edward I. That monarch and his fucceffor, king Edward II., refided frequently at Windfor, where feveral of their children were born.

John, king of France, and his fon Philip, were prifoners in Windfor-caftle. David, king of Scotland, is alfo faid to have been prifoner there at the fame time.

All hiftorians agree, that Windfor-caftle owes its magnificent fabric to the affection which king Edward III. bore to the place of his nativity. Walfingham relates, that in 1334, he built a chamber, which he called the round table, 200 feet in diameter: this, by other accounts, appears to have been only a temporary ftructure. Holingfhed fays, that in 1359, "the king fet workmen in hand, to take down much old buildings belonging to the caftle of Windfor, and caufed divers other fair and fumptuous works to be fet up in and about the fame caftle, fo that almoft all the mafons and carpenters, that were of any account within the land, were fent for, and employed on the fame works." But it appears that various commiffions for appointing furveyors and impreffing workmen had been iffued fome years before; and that in 1356, William of Wykeham, then one of the king's chaplains, was made clerk of the works with ample powers, and a fee of one fhilling a day whilft at Windfor, and two fhillings when he went elfewhere upon bufinefs: his clerk had a falary of three fhillings a week. In 1359, the architect's powers were further enlarged, and he was appointed keeper of the manors of Old and New Windfor. The next year 360 workmen were impreffed to be employed on the buildings at the king's wages, fome of whom having clandeftinely left Windfor, and engaged in other employments for greater wages, writs were iffued to prevent perfons employing them, on pain of forfeiting all their goods and chattels, and to commit fuch of the workmen as fhould be apprehended to Newgate. The plague having carried off a great number of the king's workmen in 1362, new writs were iffued to the fheriffs of feveral counties to imprefs 302 mafons and diggers of ftone to be employed in the king's works. The counties of York, Salop, and Devon, were to furnifh fixty men each. Glaziers were impreffed in the year 1363; very few commiffions were iffued after the year 1369, and none after 1373, fo that it may be prefumed that this noble work was then completed; comprifing the king's palace, the great hall of St. George, the lodgings on the eaft and fouth fides of the upper ward, the round tower, the chapel of St. George, the canon's houfes in the lower ward, and the whole circumference of the walls, with the towers and gates.

The appeal of high treafon, brought by the duke of Lancafter againft Thomas Mowbray, duke of Norfolk, in 1398, was heard by king Richard II., on a fcaffold erected within the caftle at Windfor, when, it being found impoffible to reconcile the opponents, a day of combat was appointed to take place at Coventry. The caftle continued to be the occafional refidence of our monarchs, who from time to time made various alterations in the buildings, particularly king Henry VII. Windfor-caftle was garrifoned by the parliament, foon after the breaking out of the civil war between Charles and his fubjects; and colonel Venn, who was afterwards one of the king's judges, was appointed the governor. Prince Rupert made an unfuccefsful attack upon it in the autumn of 1642. The caftle continued under the jurifdiction of parliament during the war, and in the year 1648 became the prifon of its unfortunate monarch. Judge Jenkyns was alfo a prifoner here for feveral years; whence he was removed to Wallingford, in 1656.

Upon the Reftoration, king Charles II. finding the buildings

ings of the caſtle much dilapidated by plunder and neglect, cauſed it to be thoroughly repaired and richly furniſhed. During the greater part of his reign, he made Windſor his ſummer reſidence. King James II. in 1687 received the pope's nuncio at Windſor-caſtle. Queen Anne, when princeſs of Denmark, lived in a ſmall houſe adjoining the little park, and was very partial to Windſor.

During the reign of his preſent majeſty, Windſor-caſtle has undergone conſiderable improvements, under the direction of the late James Wyatt, eſq. ſurveyor-general of his majeſty's works.

The caſtle conſiſts of two courts, between which is the keep, or round tower. The upper court contains on the north ſide the ſtate apartments, chapel, and the hall of St. George. The eaſt and ſouth ſides have been lately fitted up for the reſidence of their majeſties and the royal family. Our limits will not allow us to enter into a detail of the magnificent rooms which conſtitute the ſtate apartments, or of dwelling on the valuable collection of pictures therein contained.

St. George's hall, on the north ſide of the upper ward, was built by king Edward III., as a refectory for the knights companions of the garter: it is a noble room 108 feet in length. The ceiling and walls are painted by Verrio; the ſubjects are the triumphs of the warlike founder, and his brave ſon, Edward the Black Prince.

In the area of the upper court is a bronze ſtatue of king Charles II. on horſeback, executed by Stada at the expence of the munificent Tobias Ruſtat.

On the north ſide of the caſtle is the terrace made by queen Elizabeth, which was extended by king Charles II. along the eaſt and ſouth ſides: its whole length is 1870 feet, and it may be regarded as the nobleſt walk of the kind in Europe, as well as the moſt intereſting in ſituation.

The chapel of St. George is ſituated on the north ſide of the lower court of the caſtle. King Henry I. built a chapel at Windſor, dedicated to St. Edward the Confeſſor, and placed in it eighty canons, who were maintained out of the king's exchequer. This chapel appears to have been rebuilt, or conſiderably enlarged and decorated, by king Henry III.: that monarch, in the year 1243, iſſued a commiſſion to Walter de Gray, archbiſhop of York, to expedite the works at the king's chapel at Windſor, directing that the workmen ſhould proceed as well in winter as in ſummer, till the whole was completed; that a lofty wooden roof, like the roof of the new work at Lichfield, ſhould be made to appear like ſtone-work, with good ceiling and painting: that the chapel ſhould be covered with lead, and four gilded images be put up in it, where the king had before directed images of the ſame kind to be placed; and that a ſtone turret ſhould be made in front of the chapel of ſufficient ſize to hold three or four bells. Some remains of Henry III.'s buildings, as may be preſumed by the ſtyle of the arches and architectural decorations, may be ſeen on the ſouth ſide of the dean's cloiſters, and at the eaſt end of the chapel behind the altar.

King Edward III., who had been baptized at Windſor, rebuilt St. Edward's chapel there, and dedicated the new ſtructure to the Virgin Mary and St. George. In the year 1349, he augmented the number of canons to twenty-three, beſides a warden; and appointed 24 poor knights, for all of whom he built habitations, and granted land for their ſupport. In 1351, the biſhop of Wincheſter made conſiderable alterations in the college; and Henry IV. changed the title of warden to that of dean.

The preſent ſplendid and truly intereſting chapel of St. George may be regarded as the moſt perfect and moſt beautiful pile of eccleſiaſtical architecture in the kingdom. It was commenced by king Edward IV. and committed to the ſuperintendance of Richard Beauchamp, biſhop of Saliſbury. The work was not completed till the reign of king Henry VIII.: the beautiful roof of the choir was put up in the year 1508. Sir Reginald Bray, prime miniſter to king Henry VII., and one of the knights companions of the order of the garter, who died in 1502, ſucceeded biſhop Beauchamp in the ſuperintendance of this great work, and was a liberal contributor to the building of the choir and other parts of the fabric: his cognizance is frequently repeated on the roof of the choir, as are the royal arms and thoſe of ſeveral noble families with the order of the garter. The rood loft and lanthorn were erected in 1516; the preſent organ-gallery and ſcreen at the end of the choir are of Coade's artificial ſtone. The ſtalls of the knights companions, which are very richly carved in wood, exhibit the names and arms of the ſeveral illuſtrious and noble perſons by whom they have been reſpectively filled. The altar-piece, which repreſents the Laſt Supper, is by Mr. Weſt, from whoſe deſigns the eaſt window, repreſenting the Reſurrection of our Saviour, was executed in painted glaſs by Jarvis and Foreſt, and put up in 1788: the expence of the latter was about 4000*l.* Another window by the ſame artiſts diſplay the angels appearing to our Saviour. Moſt of theſe improvements, as well as ſeveral others in the chapel and caſtle, have been executed under the patronage, and partly at the expence, of his preſent majeſty. Beneath the choir repoſe the remains of Henry VIII., his queen, lady Seymour, and king Charles I. Henry VI. was alſo interred in this chapel; alſo his rival and ſucceſſor, Edward VI.

At the eaſt end of the ſouth aiſle is the Lincoln chapel, which contains the monument of Edward, earl of Lincoln, lord high admiral of England for thirty years, who died in 1584. Sir Henry Clinton, bart., a deſcendant of the earl of Lincoln, was buried in this chapel in 1795. In the ſame aiſle is an elegant chantry chapel, built by John Oxenbridge, canon of Windſor. Farther weſt is a chapel built by Dr. Oliver King, biſhop of Bath and Wells, who died in 1492.

In the middle of the ſouth aiſle is a ſpacious chapel, founded by ſir Reginald Bray, who died in 1502, and is here interred: his arms and creſt appear in ſeveral parts of the chapel, particularly in the beautiful ſcreen which ſeparates it from the aiſle.

At the weſt end of the ſouth aiſle is the Beaufort chapel, in which is an altar-tomb with the effigies of the founder, Charles Somerſet, earl of Worceſter, who died in 1526, and his lady; and a ſplendid monument, ſupported by Corinthian pillars, to the memory of Henry, the firſt duke of Beaufort, who died in 1699.

Near the ſouth door of the choir is interred Charles, duke of Suffolk, a favourite miniſter and brother-in-law of king Henry VIII., who died in 1545.

On the weſt ſide of the choir-door in the north aiſle is a chapel built by Elizabeth, wife of William, lord Haſtings, who is buried here.

At the eaſt end of the chapel is a diſtinct though attached building, called the tomb-houſe, which was commenced by Henry VII. and intended for his burial place. It was granted by Henry VIII. to cardinal Wolſey, who began a ſumptuous monument for himſelf within its walls. This was deſtroyed in the civil wars. James II. fitted up the building as a Roman Catholic chapel; and publicly attended the celebration of maſs. After that monarch's deceaſe the chapel was deſerted; but in 1800 his preſentt majeſty gave orders

orders for it to be repaired, beautified, and appropriated for the interment of his family. The princess Mary and the princess Charlotte of Wales have been committed to its vault. On the north and east sides of the chapel are houses and lodgings for the dean and canons. The south and west sides of the lower ward are occupied by houses appropriated to the poor knights.

Between the two wards or courts of the castle is the keep, or round tower, for the residence of the governor of the castle. It consists of a lofty, artificial, conical mount, surrounded by a moat, and surmounted by a strong fortified tower, which is approached by a flight of 100 steps. The circumference of the whole castle is 4180 feet; its length from east to west 1480 feet; and the area, exclusive of terrace walks, is about twelve acres.

On the south side of the castle is a modern mansion, called the Queen's-lodge, where the royal family resided for several years; but it is now unoccupied. About half a mile S.E. of the castle is Frogmore, a modern seat belonging to the queen. It is principally noted for its beautiful garden.

To the south and west of the town is *Windsor Forest*, which formerly was computed to measure 120 miles in circuit. At present it is about 56 miles. A part of this, called the great park, consists of 3800 acres. The little park, on the north and east sides of the castle, contains about 500 acres.

Windsor is a large irregular town, disposed on the sides of a hill, and at its base, on the southern banks of the Thames. In 1276 it was declared a free borough by king Edward I., who granted to the burgesses a mercatorial guild, and various privileges and exemptions. He constituted it the county-town. King Edward IV. incorporated the burgesses by the name of mayor, bailiffs, and burgesses. By the last charter of king Charles II., the corporate body is made to consist of twenty-eight or thirty members. A weekly market is held by royal grant, as well as three annual fairs. Near the centre of the town is a guildhall or town-house, which was built in 1666.

This borough sent two members to parliament in the reign of Edward I.; but omitted making any returns from 1340 to 1446. The right of election has frequently been contested, but was finally settled to be vested in all the inhabitant householders not receiving alms. Windsor has continued to increase in population for the last 300 years. In 1555, there appears to have been 1000 persons; in 1801, they amounted to 3461; and in 1811 to 6155, who occupied 1051 houses. The parish-church is a spacious building, and part of it ancient, though it was formerly only a chapel subordinate to the church of Clewer. In it are several old monuments. On the west side of the town are extensive barracks, and an hospital for sick soldiers.

Windsor, *Old*, a village about two miles S.E. of New Windsor, was a place of some consequence at the time of the Domesday-survey, as by that record it is stated to contain 95 houses, which paid gabel tax to the crown. Some of the Saxon kings had a palace here, and Edward the Confessor sometimes kept his court at this place. After William the Conqueror had erected a castle at New Windsor, the old palace and the surrounding houses were gradually deserted. A great part of Windsor-park is within the parish of Old Windsor, and includes three lodges: 1. The great lodge built in the reign of Charles I. and occupied by the illustrious William, duke of Cumberland; 2. The little lodge or dairy, occupied by the deputy ranger; and 3. The manor lodge near Virginia water. Beaumont lodge, the seat of lord viscount Ashbrooke, was originally built by lord Weymouth, who died in 1705. There are other family mansions and villas in this parish; one of which was lately fitted up and occasionally occupied by the princess Elizabeth, now princess Homberg.—The Magna Britannia, by S. Lysons and the Rev. D. Lysons, Berkshire, 4to. 1806. The Beauties of England, &c. vol. i. by J. Britton, F.S.A. and E. W. Brayley, 8vo. 1801. The History of Windsor and its Neighbourhood, by J. Hakewill, Architect, 4to. 1813. This elegant volume contains accounts and views of several places in the vicinity of Windsor. The History of the Royal Residences, 4to. 1817, by J. Pyne, a very handsome and interesting work, contains several views of the state apartments in Windsor-castle. The Architectural Antiquities of Great Britain, 4 vols. 4to. by J. Britton, contains several views, and a full history and description of St. George's chapel.

Windsor, a large township in the south-east corner of Broome county, New York, erected in 1807 from the east part of Chenango; situated 15 miles E. of Chenango; bounded north by Chenango county, east by Delaware county, south by the state of Pennsylvania, and west by Chenango. Its extent is nearly 15 miles square, and it has two post-offices. It is traversed by the Susquehanna river. In 1810 it had eleven saw-mills, seven grain-mills, a fulling-mill, and carding-machine, eight school-houses, one house of worship, a population of 1960 souls, 138 electors, and nearly 300 families.

Windsor, a town of Nova Scotia; 25 miles N.W. of Halifax.—Also, a town of the state of Vermont, capital of a county of the same name, which contains 34,877 inhabitants; the town contains 2757 inhabitants; 92 miles N.W. of Boston. N. lat. 43° 33′. W. long. 72° 22′.—Also, a town of the state of Connecticut, on the west side of the Connecticut river, in the county of Hartford, with 2868 inhabitants; 3 miles N. of Hartford.—Also, a town of Massachusetts, in the county of Berkshire, with 1108 inhabitants; 136 miles W. of Boston.—Also, a township of Pennsylvania, in Berks county, with 1358 inhabitants; 70 miles W. of Philadelphia.—Also, a township of Pennsylvania, in York county, with 1739 inhabitants.—Also, a town of New Hampshire, in the county of Hillsborough, with 238 inhabitants.—Also, a town of North Carolina; 23 miles S.W. of Edenton.—Also, a township of Lower Canada, on the St. Francis.

Windsor, *East*, a town of New Jersey, in Middlesex county, with 1747 inhabitants.—Also, a town of the United States of America, in Connecticut, on the east side of the Connecticut, opposite Windsor, with 3081 inhabitants.

Windsor, *West*, a town of New Jersey, in Middlesex county, with 1714 inhabitants.

Windsor, *New*, a post-township of Orange county, New York, on the west bank of the Hudson; 100 miles S. of Albany; bounded north by Montgomery and Newburgh, east by the Hudson, south by Cornwall and Blooming-grove, west by Montgomery and Wallkill. Its medial extent east and west is eight miles, and north near four, giving an area of about 30 square miles. Its population in 1810 consisted of 2331 persons, and its senatorial electors were 147. It has two post-offices, *viz.* the village of New Windsor, pleasantly situated on the west bank of the Hudson, and having considerable trade; and Little Britain, said to be discontinued in 1813. This township has several mill-streams, and the land is occupied chiefly by farmers, who enjoy much of the independence resulting from prosperous industry. The whole is well watered by springs and brooks.

Windsor *Forest*. See Windsor.

Windsor *River*, a river of the state of Connecticut, which runs into the Connecticut, 4 miles N. of Hartford.

Windsor *Bean*, in *Agriculture* and *Gardening*. See Bean, and Vicia.

WINDTBERG, in *Geography*, a town of the duchy of Holftein; 4 miles S.S.E. of Meldorp.

WINDTHAAG, or Windthag, a town of Auftria; 3 miles E. of Bavarian Waidhoven.

WINDWARD Passage, a name given to a courfe from the fouth-eaft angle of the ifland of Jamaica, in the Weft Indies, and extending from 160 leagues to the north fide of Crooked ifland, in the Bahamas. Ships have often failed through this channel, from the north part of it to the ifland of Cuba, or the gulf of Mexico, notwithftanding the common opinion, on account of the current which is againft it, that they keep the Bahama fhore on board, and that they meet with the wind in fummer for the moft part of the channel eafterly, which, with a counter current on fhore, pufhes them eafily through it.

Windward *Iflands*, in oppofition to Leeward. Thefe iflands in the Weft Indies extend from Martinico to Tobago. See West Indies.

Windward *Point*, a cape on the north-eaft coaft of the ifland of St. Chriftopher. N. lat. 17° 23′. W. long. 62° 22′.

WINDY Tumours. See Tumour.

WINE, the fermented juice of the grape. The name is alfo applied to the fermented juice of other fubacid fruits.

It is impoffible to fix the era when mankind firft difcovered fermented liquors. Some hiftorians have afcribed the difcovery to Noah, others to Saturn, others to Bacchus, &c. In fhort, almoft every country in which the vine is indigenous has boafted of fome individual or native deity, to whom the honour has been attributed; and if we reflect upon the fimplicity of the proceffes effentially neceffary to be had recourfe to in making wine, it will appear exceedingly probable that the difcovery was not made by one perfon or country exclufively, but by different individuals and nations at very different periods. A poet has elegantly reprefented wine as a recompence given by the deity for the miferies brought upon mankind by the general deluge:

> " ——— Deus nobis felicia vini
> Dona dedit, triftes hominum quo munere fovit,
> Reliquias; mundi folatus vite ruinam."
> Prædium Rufticum.

Different kinds of wine were known at a very early period; and as civilization and luxury advanced, the number was greatly extended. Hence the cultivation of the vine became an object of importance, and many new varieties were produced, which, favoured by foil and fituation, rendered particular places more famous than others. Thus the ancient Romans not only poffeffed a great variety of native wines, but, in the days of their greateft fplendour, thofe alfo of diftant and ftill more favoured climes, as the *Vinum Chium*, *Lefbium*, *Leucadium*, *Rhodium*, &c. &c. See Pliny, xiv. 6.

Little is known refpecting the modes of manufacturing fome of the moft celebrated of the ancient wines. The general proceffes, however, did not perhaps differ much from thofe at prefent in ufe. The fruit was collected, bruifed by the feet, and fubjected to preffure, as now practifed. The juice that firft flowed fpontaneoufly was called πρωτοτον by the Greeks, and by the Romans *vinum primarium*; fuch as was obtained by preffure was denominated δευτεριον, or *vinum fecundarium*, and confidered as inferior.

Both Greeks and Romans appear to have frequently concentrated their wines, either by fpontaneous evaporation, or by boiling. For the former purpofe, the wine was fometimes introduced into bladders or large jars, and expofed in the chimney to the heat of the fire, or in the upper parts of the houfe to the heat of the fun. Sometimes the fruit was converted into raifins by drying, and the wine prepared from fuch fruit was denominated *paffum*. At other times the *muft* was reduced by boiling to one-half. This formed the *vinum defructum*: occafionally even to one-third, when it was termed *Sapa*. (See Pliny, xiv. 9.) By one or perhaps more of thefe methods, the wines were reduced to the ftate of fyrup, or in fome inftances even to drynefs, and were capable of being preferved for a very long time. Thus Ariftotle ftates, that the Arcadian wines required to be diluted with water before they were drank, as indeed was the cafe with moft of the ancient wines; and Pliny fpeaks of wines as thick as honey, which it was neceffary to diffolve in warm water, and filter through linen, before they were ufed. This was the cafe with the wine of Cæcuba, according to Martial:

> "Turbida folicito tranfmittere Cæcuba facco."

Pliny mentions Staphylus as the firft who mixed wine with water; but Athenæus gives the credit of it to Amphitryon, king of Athens. On this occafion a fable was invented, that Bacchus, having been ftruck by a thunderbolt, and being all inflamed, was prefently caft into the nymphs' bath, to be extinguifhed.

Thefe remarks, however, are applied by the above authors chiefly to very old wines. Thus the wine compared by Pliny to honey had been made two hundred years before, in the time of conful Opimius: indeed wines of a hundred years old, and upwards, feem not to have been uncommon among the luxurious citizens of ancient Rome. (See Hor. od. iii. 14. 18. Juvenal, v. 34.) And fimilar allufions will be found in various other authors. Seven years was the fhorteft period, according to Ariftotle and Galen, for keeping a wine before it was fit for drinking.

Among the Romans, the age of wines was, as it were, the criterion of their goodnefs. Horace, in his odes, which one may call *Bacchic fongs*, boafts of his drinking Falernian wine, born, as it were, with him, or which reckoned its age from the fame confuls.

The age of wine has been reckoned by leaves: thus they fay, wine of two, four, or fix leaves, to fignify a wine that was two, four, or fix years old; taking each new leaf put forth by the vine, fince the wine was made, for a year. The moderns keep no wine to fuch an age as that mentioned by Pliny. Where they are kept the longeft, as in Italy and Germany, there are fcarce any to be found of above fifteen leaves. In France, the wines that keep beft, as thofe of Dijon, Nantz, and Orleans, are reckoned fuperannuated at five or fix years old.

Wine kept in a cool vault, and well fecured from the external air, will preferve its texture entire in all the conftituent parts, and fufficiently ftrong for many years, as appears not only from old wines, but other foreign fermented liquors, particularly thofe of China, prepared from a decoction of rice, which being well clofed down in the veffel, and buried deep under ground, will continue, for a long feries of years, rich, generous, and good, as the hiftories of that country univerfally agree in affuring us.

Sir Edward Barry, in his Obfervations, hiftorical, critical, and medical, on the Wines of the Ancients, fuggefts, that our beft modern wines, efpecially thofe of a delicate texture and flavour, may be more effectually preferved in earthen veffels of a larger fize than our bottles, well glazed externally and internally: that dry fand is preferable for covering the bottles in the binns to faw-duft; and that a fmall ſmall anti-cellar, built before all large cellars, would be a conſiderable defence and improvement.

The ancients were fond of giving their wines an artificial flavour, and for this purpoſe they introduced pitch, turpentine, and different herbs into the *muſt;* a practice ſtill followed by the modern Greeks. Plin. *ubi ſupra.*

Such are the principal facts known reſpecting the celebrated ancient wines, which, as Chaptal juſtly remarks, appear in general to have rather deſerved the name of *extracts* or *ſyrups* than wines. They muſt have been ſweet and little fermented, and conſequently have contained a very ſmall proportion of alcohol. Indeed it is difficult to ſuppoſe how they could contain any ſpirit whatever, or poſſeſs in conſequence any intoxicating properties.

The above remarks, however, can be only applicable to thoſe wines which the refinements of luxury or caprice had rendered valuable, from their uncommon occurrence, or the difficulty with which they were procured. It is certain that the ancients were well acquainted with the fermentative proceſs, and ordinarily took advantage of it in the formation of their wines: hence it is extremely probable that the wines uſed in the primitive ſtates of ſociety, and perhaps at all times by the common people, conſiſted ſimply of the fermented juice of the grape, and therefore differed in no reſpects whatever from the wines in common uſe at the preſent time.

General Principles of Wine-making.—We ſhall conſider this intereſting ſubject under two principal points of view: 1ſt, The manufacture of wine from grapes; and 2d, From other fruits.

1. The manufacturing of wine from grapes is liable to be influenced by a great variety of circumſtances, ſuch as *climate, ſoil, aſpect, ſeaſon,* &c.; of ſome of the moſt important of which we ſhall take a curſory view.

The vine is a native of the middle regions of the temperate zone, that is to ſay, between the latitudes of 25° and 50°, and here only does it flouriſh and mature its fruit in abſolute perfection. Indeed a belt compriſed between the latitudes of 40° and 50°, may be ſaid to include all the moſt celebrated vineyards of the northern hemiſphere; thoſe, namely, of Spain, Portugal, France, Italy, Auſtria, Styria, Carinthia, Hungary, Tranſylvania, and part of Greece. The vine grows beyond the latitude of 50°, but its juices are auſtere, and without the requiſite degree of ſaccharine matter to form good wine. The fine aromatic odour and flavour of its fruit alſo are not developed much beyond this latitude. In the ſouthern hemiſphere, which is colder than the northern, the vine flouriſhes ſomewhat nearer the equator.

The vine grows in every ſoil, but that which is light and gravelly is beſt adapted for its cultivation. It flouriſhes extremely well alſo in volcanic countries. Thus ſome of the beſt wines in Italy are made in the neighbourhood of Veſuvius. The famous Tokay wine is alſo made in a volcanic diſtrict, as are ſeveral of the beſt French wines; many parts of the ſouth of France bearing evident marks of extinct volcanoes. The vine alſo flouriſhes well in primitive countries, and eſpecially among the debris of granite rocks: thus the celebrated Hermitage wine is made from a ſoil of this deſcription.

The ſame climate, ſoil, and mode of culture, however, often produce wines of very different qualities. Poſition and aſpect alone, all other circumſtances being the ſame, make a prodigious difference. The ſame vineyard, for example, according as its different parts have a northern or ſouthern aſpect, will produce wines of oppoſite characters, as will alſo the ſame hill, at its top, middle, and bottom. The aſpect moſt favourable for a vineyard is upon a riſing ground or hill facing the ſouth-eaſt, and the ſituation ſhould not be too confined:

> " —————— apertos
> Bacchus amat colles."

If the ſoil be not favourable for the vine no art can make it ſo. Manure of different ſorts will indeed render the fruit more abundant, but the wine will ſuffer in quality. The beſt manure is ſtated to be the dung of pigeons or poultry. Burnt ſea-wrack alſo is a favourite manure with ſome. Fat and putrid manures are abſolutely to be rejected, as they deſtroy the wine altogether, by vitiating its flavour.

The qualities of wines are very much affected by the ſeaſons. In cloudy and wet ſeaſons the wine is always inferior. Rain is moſt to be dreaded at the ſeaſon of the vintage. Moderate rains juſt after the ſeaſon of bloom are of great advantage, and cauſe the fruit to ſwell very rapidly. Rough winds are very prejudicial to vineyards. Miſts are ſtill more ſo, eſpecially during the ſeaſon of bloom, as they are apt to deſtroy the flower, and conſequently the fruit: the reaſon of this is perhaps not very evident, but it ſeems to depend in part upon the rapid evaporation of the moiſture left by the fogs, when the ſun breaks through them, and the great and ſudden change of temperature which takes place in conſequence. Too great a degree of heat is injurious to the vine; the perfection of their fruit, as well obſerved by Chaptal, depends upon a due equilibrium between the quantity of water affording aliment to the plant, and the degree of heat neceſſary to elaborate this water into its juices.

Towards the northern limits of the vine country, the plants are always ſupported on poles, and in cold and wet ſeaſons they ſometimes ſtrip off the leaves, or twiſt the ſtalks of the cluſters, in order to ſuppreſs vegetation and facilitate the ripening of the grapes. The latter practice was not unknown to the ancients: "Ut dulcia præterea fierent, aſſervabant uvas diutius in vite, *pediculo intorto.*" Pliny. But in warmer climates, on the contrary, the earth requires to be ſhielded from the heat, and here the vine is generally left to ſpread over the ground, and thus by its foliage to protect the ſoil, as well as its fruit, from the direct rays of the ſun. With reſpect to the beſt methods of pruning and training vines, ſee the articles VINE, and VITIS.

Of the Vintage.—It is of the utmoſt importance in the manufacture of wines, to attend to the preciſe moment when the grapes have arrived at their full maturity; and then, and not before, ought the vintage in general to commence. This may be known, according to Chaptal, by the following ſigns.

1. The green end of the cluſter becomes brown.
2. The cluſter becomes pendant.
3. The ſeed loſes its hardneſs, and the ſkin becomes thin and tranſparent.
4. The cluſter and ſeeds are eaſily detached.
5. The juice is ſweet, bland, thick, and clammy.
6. The kernels of the ſeeds are free from glutinous matter.

The fall of the leaves denotes rather the approach of winter than the maturity of the fruit, eſpecially in the more northern climates. This therefore is a fallacious ſign. Nevertheleſs, when the froſt has been ſo ſevere as to deſtroy the leaves, it will ſeldom be proper to delay the vintage much longer, as the fruit can hardly be expected after this to become ripe; and by delay it may ſtand a chance of being ſpoiled entirely.

On the contrary, in the manufacture of particular wines, the grapes are permitted to remain till they wither, or they are

are gathered and dried in the ſun. Thus the celebrated Tokay wine is made of dried fruit, as are alſo many of the luſcious wines of Italy. Some of the French wines likewiſe are made with fruit that has been ſuffered to ripen and wither upon the vines.

It is deſirable in general that the weather ſhould be ſettled, and the ſoil and fruit dry during the vintage. It is therefore recommended to abſtain from gathering till the ſun has diſperſed the dew. As a general rule, this is proper; but in Champagne they commence gathering the fruit before the ſun is riſen, and ceaſe their labours about nine o'clock, unleſs there be a fog, when they continue to gather all day; by theſe means they improve the whiteneſs and briſkneſs of their wine, which are the qualities that chiefly render them celebrated. They alſo increaſe their quantity. Thus it is found in Champagne, that they gain a tun in every twenty-four where they collect the fruit moiſt with dew, and a great deal more if there happens to be a fog.

When the fruit is ripe, a proper number of experienced hands ſhould be procured, ſo as to be able, in a ſingle day, to fill the fermenting tub or vat, in order to enſure an uniform degree of fermentation. Women are commonly employed for the purpoſe, but the preſence of an intelligent male overſeer is abſolutely neceſſary. In ſome parts of France the fruit is ſeparated with ſciſſors; in others with the nail; and in Champagne they uſe a knife. The ſciſſors is undoubtedly preferable, as it does not ſhake the ſtock. The ripe fruit only ſhould be collected, if the object be to make good wine, and what is unripe or decayed ſhould be carefully rejected; indeed they have always two or three ſeparate vintages in thoſe countries, where they are careful of the quality of their wines; and the wine made firſt is always conſidered the beſt. In thoſe parts, on the contrary, where the wine is chiefly diſtilled, as in Languedoc and Provence, they uſually collect all the fruit indiſcriminately at one time. In ſome diſtricts, where the fineſt wines are made, as in Bourdeaux, &c. the fruit is carefully picked, and only the prime of the cluſters taken. On the contrary, they carefully avoid having the fruit too ripe in Champagne, and other diſtricts where ſparkling wines are chiefly manufactured, and prefer the preſence of a certain proportion of unripe fruit. It need ſcarcely be remarked, that the greateſt care ſhould be taken to prevent the fruit from being bruiſed or otherwiſe damaged.

The next important ſtep is the management of the fruit after it has been collected. In different countries different preliminary ſteps are purſued before the fruit is ſubmitted to preſſure. Thus in Spain, eſpecially in the neighbourhood of St. Lucar, they leave the fruit expoſed for two days to the rays of the ſun. In Lorraine, part of Italy, in Calabria, and the iſland of Cyprus, as before obſerved, they dry the fruit completely, and this is the caſe in the manufacture of all the rich white wines.

A queſtion that has been much agitated is, whether it be advantageous to ſtrip the grapes from the ſtalks and remove the latter, or ſuffer them to remain. Both theſe methods have their advocates; but Chaptal remarks very properly that neither ought to be followed excluſively. It is true, the ſame celebrated chemiſt obſerves, that the ſtems have a rough and auſtere taſte; but this appears to be of advantage to ſome wines, eſpecially thoſe made in the more northern diſtricts, where the ſlight aſtringency imparted by the ſtems corrects their inſipidity, and appears to have the property of making them keep better, perhaps by rendering the fermentation more complete. In the neighbourhood of Bourdeaux, indeed, they remove the ſtalks from the red grapes in the manufacturing of their beſt wines, but they modify that part of the proceſs in ſome degree according to the ripeneſs of the fruit: when the fruit is unripe, or has been injured by the froſt, they remove nearly the whole of the ſtalks, but if the fruit be over-ripe they leave a very large proportion of them. A certain portion, however, is always permitted to remain with the view of facilitating the fermentative proceſs, and rendering it more perfect. From the white grapes, the ſtalks are never removed. In ſhort, in the colder diſtricts, where the wines are of an inferior quality, or where the object is to render the wines as ſtrong as poſſible, with the view of diſtilling them, the ſtems in general do not require to be removed; but in warmer countries, where the finer-flavoured and richer wines are manufactured, every thing liable to affect theſe deſirable qualities is to be carefully removed, and the ſtems among the reſt. The ſtems are ſeparated in various ways: ſometimes by agitating the grapes in the veſſels in which they are depoſited with three-pronged forks, ſometimes by coarſe ſieves made of oziers, &c.

The next important ſtep is bruiſing the fruit, which is generally performed by treading them with the feet in perforated tubs or baſkets placed over the *vat* or tub deſtined to receive the muſt. This mode of bruiſing grapes, though as ancient perhaps as wine-making itſelf, is very imperfect, as a great deal of the fruit remains unbroken. In England we ſhould adopt the uſe of machinery.

Of Fermentation, the Circumſtances affecting it, Phenomena, Products, &c.—The juice, or *muſt*, as it is termed, is no ſooner in the *vat* than it uſually begins to ferment. The *vat* is a capacious veſſel made of wood or ſometimes of maſonry, and its ſize correſponds, or ought to correſpond, with the quantity of wine to be made. Before it is uſed, it requires to be thoroughly waſhed, and its ſides in France are uſually covered with lime, which has the effect of ſaturating a portion of the malic and other acids which exiſt in abundance in the *muſt*.

The fermentative proceſs has been already deſcribed (ſee FERMENTATION); we ſhall therefore be very brief upon the ſubject here, and confine our attention principally to a conciſe recapitulation of the particulars, in order to preſent our readers with a general and connected view of the art of wine-making.

The vinous fermentation is influenced by ſeveral circumſtances, ſuch as temperature, preſence of the air, the volume of the muſt, &c. The muſt of the grape requires a temperature of at leaſt 55°, to enable it to commence the fermentative proceſs. Some have denied that the preſence of the air is neceſſary to fermentation. The recent experiments of Gay Luſſac, however, ſeem to prove the reverſe. This celebrated chemiſt found that the muſt would not begin to ferment in cloſe veſſels, but that the introduction of a little oxygen inſtantly ſet it going; the oxygen being firſt rapidly abſorbed. Perhaps we may explain the oppoſite concluſions of different experimentaliſts upon this ſubject, by ſuppoſing that the preſence of oxygen, though neceſſary to enable the muſt to commence fermentation, is not neceſſary to ſupport it afterwards. The fermentative proceſs is much influenced by the bulk or quantity of the muſt. It is a well-eſtabliſhed fact, that the greater the quantity the more violent is the fermentation. An experienced manufacturer of wine, therefore, will take care to proportion the quantity of muſt to the qualities of his fruit, or rather perhaps to thoſe of the wine which it is his object to procure: the ſweeter and more luſcious the muſt, the greater the quantity in general, which it will be proper to ſubmit to the fermentative proceſs in one maſs.

Other important circumſtances which influence the fermentative proceſs are the requiſite quantities and due relative proportions

proportions to one another of the neceſſary principles. The ſaccharine and fermentative principles, tartar and water, are the principles (as explained under the article FERMENTATION) eſſential to the production of wine. The ſweeteſt grapes do not always make the beſt wine, nor actually contain the greateſt proportion of ſugar, at leaſt of real ſugar, ſuch as is proper for the formation of alcohol. An experienced taſte, it is ſaid, can readily diſtinguiſh between a really *ſaccharine* grape and a *ſweet* grape; and conſequently pronounce *à priori* whether it be adapted for making good wine or not. Pure ſaccharine matter, however, will not ferment alone, but requires a certain proportion of other principles to put it in motion. When the muſt contains too large a proportion of water, the fermentative proceſs is feeble, and the wine is conſequently bad. The ancients obviated this, as we before mentioned, by boiling the muſt; a practice ſtill ſometimes followed in the northern diſtricts, eſpecially in wet ſeaſons. The ſame object is gained alſo by drying the fruit; and ſometimes by the introduction of lime into the vat. The juice of the grape always contains a certain proportion of tartar. This quantity is greater in general as the quantity of ſugar is leſs. If the juice contains too large a proportion of ſugar in relation to the tartar, it is cuſtomary to add a portion of the latter principle. On the contrary, if the ſaccharine principle be deficient and the tartar in exceſs, ſugar is to be added.

The fermentative proceſs is accompanied by the production of heat, by the diſengagement of carbonic acid gas, and the formation of alcohol. Theſe phenomena have been already diſcuſſed under the article above alluded to. Another important circumſtance, however, which takes place during this proceſs, is the *colouring* of the muſt. The juice of the black grape, as well as of the white, is nearly colourleſs; and if the fermentation be not permitted to take place in contact with the huſks or *marc*, a colourleſs wine is obtained in all caſes. The colour of red wines is derived from the *marc*; by permitting the wine to ferment in contact with it, the colouring principle of the *marc* or huſks being ſoluble in alcohol. Hence, when alcohol begins to be developed by the fermentative proceſs, it acts upon the colouring principle and diſſolves it, and the muſt becomes coloured. The following are the principal facts connected with this part of the ſubject. The wine is more coloured the longer the fermentative proceſs is continued, and *vice verſâ*. The wine is more coloured in proportion as the fruit is more ripe and leſs watery. Wine obtained by preſſure is more coloured than other wine, and laſtly wines manufactured in the ſouth are in general deeper coloured than thoſe produced in more northern diſtricts.

Great attention and practical knowledge are required in managing the fermentation properly, as on this important proceſs depend entirely the future qualities of the wines. The ſame fruit in different ſeaſons, and from various cauſes, requires to be managed differently; and almoſt every kind of wine requires a different, and, in ſome caſes, even an oppoſite, mode of treatment. Thus the fine *bouquet* of Burgundy is completely diſſipated by a too violent or laſting fermentation; while, on the contrary, the fermentation of the ſtrong wines of Languedoc, celebrated chiefly for the quantity of alcohol which they contain, ought to be long and complete. In Champagne, as we formerly mentioned, they collect the fruit deſtined to form their white wines while moiſt with dew or miſt: on the contrary, in the manufacture of their red wines, they prefer fruit as dry as poſſible. In the former caſe, the fermentative proceſs is ſo languid, as often to require a gentle heat; in the latter, ſo violent, as to require to be moderated. Weak wines ought in general to be fermented in caſks; ſtrong wines in the vat. No general rules, however, can be given that will apply in all inſtances; but the proceſſes muſt be varied according to circumſtances, and the judgment of the manufacturer.

The fermentative proceſs, for obvious reaſons, is moſt difficult to manage in the northern diſtricts, where the fruit is more imperfect. To encourage the proceſs, they ſometimes introduce a little warm muſt to the bottom of the vat by means of a long funnel. They alſo agitate it frequently, and to preſerve a due degree of temperature, cover the vat with blankets, or heat the room artificially.

The theory or rationale of the fermentative proceſs has been explained, as far as it is known, under the article FERMENTATION, before alluded to; we ſhall therefore paſs it over entirely here, and confine our attention to practical points only.

A moſt material point in the manufacture of wines is to know the preciſe moment when the fermentative proceſs has been carried far enough, and the means neceſſary to prevent its getting farther than this point. In the wine countries almoſt every manufacturer boaſts of his knowledge in theſe particulars, and often adopts different methods. Chaptal lays down the following rules to be attended to.

1. The wine ought to ferment ſo much the leſs time as it contains leſs ſaccharine matter. Thus the light wines of Burgundy require to ferment no longer than from ſix to twelve hours.

2. The muſt ought to ferment a leſs time in the vat when it is intended to retain the carbonic acid gas, and make ſparkling wines. In this caſe, the muſt is ſeldom left longer in the vat than twenty-four hours before it is put into caſks; and frequently it is introduced into the caſks as ſoon as it is ſeparated from the fruit; by theſe means the fermentation is checked, and the carbonic acid gas prevented from eſcaping.

3. The fermentation ought to be of ſhorter duration, in proportion as it is the object to obtain wines more free from colour. This ſhould be, therefore, particularly attended to in the manufacture of thoſe wines where the abſence of colour is an eſſential requiſite.

4. The fermentative proceſs is more active in warm weather, and when the maſs is large, &c. than under the oppoſite circumſtances; and therefore, *cæteris paribus*, is ſooner completed.

5. When the object is to preſerve to the wine the original perfumed flavour of the grape, the fermentation requires to be checked ſooner than under ordinary circumſtances.

6. On the contrary, the fermentation requires to be continued longer in proportion as the muſt is more thick, and the ſaccharine matter more abundant.

7. It will alſo require to be longer when the object is to manufacture wines for diſtillation.

8. It will be longer in cold weather, and eſpecially if the fruit has been gathered on a very cold day.

9. Laſtly, it will be longer in proportion as it is the object to make a deeper coloured wine.

Theſe principles ſteadily kept in view will perhaps be ſufficient, with a little practice, to enable any perſon of ordinary knowledge and powers of obſervation to decide upon the important points in queſtion.

Great care is requiſite in the preparation of the caſks for receiving the wine. When they are new, they will ſpoil its flavour if not prevented. For this purpoſe, boiling-water, holding ſalt in ſolution, is introduced into them, which is frequently agitated, and permitted to remain in them a long time. After this they are to be waſhed out with a portion of boiling muſt in a ſtate of fermentation, or ſometimes with a little wine, &c. If the caſks are old but ſweet, the top is merely

merely taken out, and the tartar removed; they are then washed well with warm water. If the casks have acquired a bad odour, Chaptal recommends to commit them to the flames; for though it may be possible to cover in some degree their bad odours, yet they are very likely to re-appear and spoil the wine.

The vessels being ready, the wine is introduced into them, for which purpose it is drawn off from the vat by a cock placed a few inches above the bottom into an open vessel, from whence it is conveyed to the casks. That portion of the wine resting immediately over the must is termed *surmont* in Burgundy. This is carefully defecated, as it constitutes the most delicate and palest of the wine. The liquor is drawn off till the head comes in contact with the *marc*. The head is then carefully removed, and the *marc* is subjected to repeated pressure. The wine thus farther obtained is usually mixed with the rest. That produced by the first pressure is strongest; that obtained by the last is usually more harsh and coloured. Sometimes, however, when it is the object to make vinegar, the *marc* is pressed but once. At other times, they keep the wine obtained by all the different pressures in separate casks. In Champagne they usually mix together the wines obtained by the different pressures, though they are known by different names. The wines obtained without any pressure, or a very slight one, they call *vins gris*; those obtained by the first and second pressure, *œil de perdrix*; those by the third, *vin de taille*, which are most coloured, though sufficiently agreeable.

The *marc* is employed in various ways in the different districts. Some submit it to distillation; others, especially in the vicinity of Montpellier, prepare verdigris from it; others vinegar. In some districts, they feed cattle with it; in others, they burn it for the sake of the potash it yields, &c.

Of the Management of the Wine in the Casks.—The wine receives its last degree of elaboration in the casks; this consists in a sort of fermentative process, to which the name of *insensible fermentation* has been applied. Almost immediately after the wine is introduced into the casks, a scum begins to be formed upon its top, and escapes by the bung-hole, which at first requires to be covered slightly only with a leaf or tile. In proportion as the fermentation subsides, the mass of wine diminishes in bulk; and they watch this cautiously, in order to supply its place from time to time with new wine, so as to keep the cask always full: this process is denominated in France *ouiller*, which may be rendered *filling up*. In some districts they *fill up* every day during the first month, every other day during the second, and every eight days afterwards, till the time of racking. This is the method they adopt with the wines of Hermitage. In Champagne they permit the *vins gris* to ferment in casks for ten or twelve days, and when the ebullition has ceased, they close the bung-hole, leaving, however, a small spigot-hole by its side, which is permitted to remain open for eight or ten days longer; after which they close this with a plug, in such a manner as to be able to open it at pleasure. When the bungs are introduced, they *fill up* every eighth day by the spigot, for twenty-five days. After this every fifteenth day, for one or two months; and finally, every two months during the whole time the wine remains in the cellar. When the season has been wet and unfavourable, and the wines want body, or when it has been dry and hot, and they are too rich, twenty-five days after they have been made, they roll the casks five or six times, in order to mix the grounds, and re-excite the fermentative process, and this they repeat every eighth day for a month.

The fermentation of the Champagne wines, which are designed to be brisk and sparkling, is very long and tedious. It is generally understood that they will be sparkling, provided they are bottled any time between the vintage and the following May, and that the nearer the vintage the brisker they will be. It is, however, generally taken for granted, that they will be sufficiently sparkling if bottled about the middle of March. Wines begin to sparkle in about six weeks after they have been bottled; those, however, produced on mountains become sparkling sooner than others. Wines bottled in June and July will be very little sparkling, and quite *still* if bottled so late as October and November.

In Burgundy, after the fermentation has relaxed in the cask, they put in a bung pierced with a small hole, in which they introduce a plug that can be easily removed at pleasure, in order to suffer the gas that may be extricated to escape. In the district of Bourdeaux, they begin to *fill up* eight or ten days after the wine has been introduced into the cask. A month after this they introduce the bung, and *fill up* every eight days. At first they bung the casks loosely, and then fasten them down by degrees, without running any risk. The white wines are racked and sulphured in December, and these require much more care than the red wines, from their containing more sediment, and their being more liable to become ropy. The red wines are not racked till towards February or March, and as these are much more apt to become sour than the white wines, they require to be kept in cooler cellars during the summer. There are some who, after the second racking, turn the casks so as to place the bung on one side; and thus the casks being hermetically sealed from there being no loss, there is no need of *filling up*. They then rack off annually, at any time of the year they find it convenient.

Methods nearly similar are adopted in other wine countries; hence it will be needless to repeat them. We shall, however, give a short account of the methods followed in the manufacture of *Port*, *Madeira*, and *Sherry*, the most popular wines of this country.

In *Oporto*, the complete fermentation of the must takes place in the vat. The wine is then introduced into large tuns, capable of holding twenty-five pipes each; and at this stage the brandy is added according to the judgment of the manufacturer.

In *Madeira*, the second or insensible fermentation is carried on in casks, and the wine is racked from them at the end of three or four months, at which time a portion of the brandy is added. The remainder is reserved to be mixed at the time of exportation.

In the manufacture of *Sherry*, the grapes are first slightly dried, and sprinkled with quick-lime. They are then wetted with brandy on being introduced into the press, and a portion of brandy is added to the must before the fermentation commences. The subsequent processes consist in repeated rackings at intervals of a month or two, till March, brandy being added at each racking.

The object of racking the wines is to separate the dregs consisting of tartar, &c. deposited from the wine, and which, if left, are liable to render it sour, by re-exciting from time to time the fermentation. The tendency to fermentation is counteracted by a process termed *sulphuring*, and the spontaneous separation of the dregs is rendered more complete by Clarification, which see. See also Fining and Forcing.

The *sulphuring* of wines consists in impregnating them with the vapours of burning sulphur, or sulphurous acid, and is generally effected by burning sulphur-matches in the casks. (See Matching.) These matches are made in different ways, aromatics being sometimes mixed with the sulphur; but the sulphur is the only useful and necessary ingredient.

Sometimes

Sometimes a wine highly impregnated with fulphurous acid is prepared, a little of which mixed with the reft anfwers the purpofe of burning matches in the cafk. Other fubftances, according to Dr. Macculloch, anfwer the fame purpofe as *fulphuring;* namely, the *black oxyd of manganefe*, and particularly the *fulphite of potafh.* A drachm of which falt is fufficient for a pipe of wine, and is very effectual in counteracting the fermentative procefs. The theory of thefe proceffes is very obfcure.

We have before obferved that the mere racking of wines is not fufficient to render them pure, and various methods are adopted at the racking periods to render this operation more effectual, and thefe altogether conftitute the procefs termed *clarification.*

Lord Bacon mentions a practice among the ancients of putting wine into veffels well ftopped, and letting it down into the fea. That this practice is very ancient is manifeft from the difcourfe of Plutarch (Quæft. Nat. 27.) about the efficacy of cold upon muft.

Different periods, as before-mentioned, are chofen in different diftricts for racking wines. Thus the wines of Hermitage are racked in March and September, thofe of Champagne about the middle of October, the middle of February, and the latter end of March. If poffible, a ferene and fettled ftate of the atmofphere, and a dry and cold day, fhould be chofen for the purpofe, as the wine is always turbid in damp clofe weather, and during the prevalence of foutherly winds.

In racking wines, it is in general defirable to expofe them as little as poffible to the atmofpheric air. In fome diftricts, a fyphon is employed for the purpofe. In Champagne they ufe a fort of pump. Dr. Macculloch recommends that the wine fhould be transferred from one cafk to another by means of a leather hofe, and this method is undoubtedly preferable. For clarifying wines, a great variety of fubftances are employed. Ifinglafs and albumen either from eggs or blood are the moft common; but gum, ftarch, rice, milk, the fhavings of beech-wood, gypfum, fand, &c. are ufed in different wine countries. An ounce of ifinglafs, or about eighteen or twenty whites of eggs, are fufficient for one hundred gallons of wine.

Two very important circumftances in the practice of wine-making require yet to be mentioned; thefe are the *medication* of wines, and the means of *remedying thofe difeafes* to which they are liable.

The *medication* of wines confifts in altering the colour, the flavour, or the ftrength of any given wine, or in fo mixing two or more together, as to produce a compound differing from, or fuperior to, either. It is difficult to give any general rules for this purpofe, and the proper management of the proceffes depends chiefly upon the experience and tafte of the maker.

It generally happens that when two wines are mixed, the fermentative procefs is partially renewed, or the mixture is technically faid to *fret*, whence the practice itfelf has derived the name of *fretting in.* Mixed wines appear to unite into one durable and homogeneous liquor, only in confequence of this fermentation. It is therefore defirable, if poffible, to mix wines only at thofe periods when they both fhew a tendency to *fretting*, which, according to Chaptal, in the wine countries, appears to be at three principal feafons of the year, *viz.* when the vines begin to fhoot, when they are in flower, and when the fruit begins to acquire colour. The wines being then proportioned according to the fancy or experience of the maker, a ftrong fermentation is excited, which is ftill farther affifted by agitation. The wine thus becomes homogeneous, and fhews no more tendency to farther change than if it had been originally produced by one operation; and the repetition of the proceffes of fining and racking renders it perfect.

In wine countries, particular wines, diftinguifhed either by their ftrength, harfhnefs, colour, or flavour, are often manufactured for mixing with others, and are applied according to circumftances. For making fuch wines, different fruit and peculiar management are often reforted to. The ufual faults of wines requiring correction are, *fweetnefs*, *drynefs* bordering on *acidity*, and excefs or defect of *brifknefs.* Connected alfo with this part of the fubject are the means of imparting to wine *colour*, *flavour*, and *ftrength*, and other remarkable properties. *Sweetnefs* arifes from the prefence of too much faccharine matter, and may be generally remedied by prolonging the fermentation. On the contrary, when the fermentation has been carried fo far as to decompofe the whole of the fugar, the wine is faid to be *dry;* and if the original quantity of fugar has been rather defective, it will have a ftrong tendency to become four. The remedy in this cafe is, to add fugar, or fometimes brandy. The modes of enfuring a due degree of *brifknefs* in thofe wines intended to poffefs this quality have been already pointed out.

Many of the proceffes followed in imparting *colour*, *flavour*, *ftrength*, &c. to wines, are unknown to the public, and confined to the cellars of the manufacturer or the merchant. The general principles, however, are fufficiently obvious. The *roughnefs* and *colour* of red wines are derived, as we formerly ftated, from the hufks of the fruit; and when it is wifhed to impart thefe qualities in a higher degree, the manufacturers fometimes mix a certain portion of wild and high-coloured grapes with the other fruit. At other times, various aftringent and coloured drugs are employed, as catechu, kino, logwood, &c.: popular ingredients are the juices of floes or elderberries. The chips of oak and beech-wood are alfo employed. With refpect to yellow tints, thefe can be all accurately imitated by means of burnt fugar. As to *flavours*, in general thofe which are foreign and unufual are commonly unpleafant. Cuftom, however, has reconciled us to many. The ancients, as formerly mentioned, feem to have been much more accuftomed to artificial flavours than the moderns, and the moft in requeft was the turpentine or refinous flavour, which was imparted by means of chips of fir-wood, a practice ftill followed in modern Greece. In Madeira wines, as well as thofe of Xeres and San Lucar, it is the practice at prefent to ufe fweet and bitter almonds; hence the *nutty* flavour of thefe wines. In Egypt, the flower of the vine itfelf has been employed from time immemorial, and is ftill ufed in different wine countries; its odour is very like that of mignonette, which may be doubtlefs fubftituted for it. Rafpberries, orris-root, elder-flowers, worm-wood, and a variety of other fubftances, are employed for a fimilar purpofe. In ufing thefe different articles, the eftablifhed practice is to fufpend the flavouring ingredients in the cafk a few days during the ftage of infenfible fermentation; by which means their flavour is retained without a chance of being diffipated. Where the *ftrength* of wine is deficient, brandy is added, according to circumftances; and to render the mixture of this more complete, it fhould be added while the procefs of infenfible fermentation is going on. If there be a neceffity to add it after the wine is completed, it fhould then be managed by the *fretting-in* procefs.

The laft of the circumftances connected with wine-making is the means of *obviating thofe difeafes* to which wines are liable.

One of the moft common difeafes of weak wines is *acidity.*

Strong

merely taken out, and the tartar removed; they are then washed well with warm water. If the casks have acquired a bad odour, Chaptal recommends to commit them to the flames; for though it may be possible to cover in some degree their bad odours, yet they are very likely to re-appear and spoil the wine.

The vessels being ready, the wine is introduced into them, for which purpose it is drawn off from the vat by a cock placed a few inches above the bottom into an open vessel, from whence it is conveyed to the casks. That portion of the wine resting immediately over the must is termed *surmont* in Burgundy. This is carefully defecated, as it constitutes the most delicate and palest of the wine. The liquor is drawn off till the head comes in contact with the *marc*. The head is then carefully removed, and the *marc* is subjected to repeated pressure. The wine thus farther obtained is usually mixed with the rest. That produced by the first pressure is strongest; that obtained by the last is usually more harsh and coloured. Sometimes, however, when it is the object to make vinegar, the *marc* is pressed but once. At other times, they keep the wine obtained by all the different pressures in separate casks. In Champagne they usually mix together the wines obtained by the different pressures, though they are known by different names. The wines obtained without any pressure, or a very slight one, they call *vins gris*; those obtained by the first and second pressure, *œil de perdrix*; those by the third, *vin de taille*, which are most coloured, though sufficiently agreeable.

The *marc* is employed in various ways in the different districts. Some submit it to distillation; others, especially in the vicinity of Montpellier, prepare verdigris from it; others vinegar. In some districts, they feed cattle with it; in others, they burn it for the sake of the potash it yields, &c.

Of the Management of the Wine in the Casks.—The wine receives its last degree of elaboration in the casks; this consists in a sort of fermentative process, to which the name of *insensible fermentation* has been applied. Almost immediately after the wine is introduced into the casks, a scum begins to be formed upon its top, and escapes by the bung-hole, which at first requires to be covered slightly only with a leaf or tile. In proportion as the fermentation subsides, the mass of wine diminishes in bulk; and they watch this cautiously, in order to supply its place from time to time with new wine, so as to keep the cask always full: this process is denominated in France *ouiller*, which may be rendered *filling up*. In some districts they *fill up* every day during the first month, every other day during the second, and every eight days afterwards, till the time of racking. This is the method they adopt with the wines of Hermitage. In Champagne they permit the *vins gris* to ferment in casks for ten or twelve days, and when the ebullition has ceased, they close the bung-hole, leaving, however, a small spigot-hole by its side, which is permitted to remain open for eight or ten days longer; after which they close this with a plug, in such a manner as to be able to open it at pleasure. When the bungs are introduced, they *fill up* every eighth day by the spigot, for twenty-five days. After this every fifteenth day, for one or two months; and finally, every two months during the whole time the wine remains in the cellar. When the season has been wet and unfavourable, and the wines want body, or when it has been dry and hot, and they are too rich, twenty-five days after they have been made, they roll the casks five or six times, in order to mix the grounds, and re-excite the fermentative process, and this they repeat every eighth day for a month.

The fermentation of the Champagne wines, which are designed to be brisk and sparkling, is very long and tedious. It is generally understood that they will be sparkling, provided they are bottled any time between the vintage and the following May, and that the nearer the vintage the brisker they will be. It is, however, generally taken for granted, that they will be sufficiently sparkling if bottled about the middle of March. Wines begin to sparkle in about six weeks after they have been bottled; those, however, produced on mountains become sparkling sooner than others. Wines bottled in June and July will be very little sparkling, and quite *still* if bottled so late as October and November.

In Burgundy, after the fermentation has relaxed in the cask, they put in a bung pierced with a small hole, in which they introduce a plug that can be easily removed at pleasure, in order to suffer the gas that may be extricated to escape. In the district of Bourdeaux, they begin to *fill up* eight or ten days after the wine has been introduced into the cask. A month after this they introduce the bung, and *fill up* every eight days. At first they bung the casks loosely, and then fasten them down by degrees, without running any risk. The white wines are racked and sulphured in December, and these require much more care than the red wines, from their containing more sediment, and their being more liable to become ropy. The red wines are not racked till towards February or March, and as these are much more apt to become sour than the white wines, they require to be kept in cooler cellars during the summer. There are some who, after the second racking, turn the casks so as to place the bung on one side; and thus the casks being hermetically sealed from there being no loss, there is no need of *filling up*. They then rack off annually, at any time of the year they find it convenient.

Methods nearly similar are adopted in other wine countries; hence it will be needless to repeat them. We shall, however, give a short account of the methods followed in the manufacture of *Port*, *Madeira*, and *Sherry*, the most popular wines of this country.

In *Oporto*, the complete fermentation of the must takes place in the vat. The wine is then introduced into large tuns, capable of holding twenty-five pipes each; and at this stage the brandy is added according to the judgment of the manufacturer.

In *Madeira*, the second or insensible fermentation is carried on in casks, and the wine is racked from them at the end of three or four months, at which time a portion of the brandy is added. The remainder is reserved to be mixed at the time of exportation.

In the manufacture of *Sherry*, the grapes are first slightly dried, and sprinkled with quick-lime. They are then wetted with brandy on being introduced into the press, and a portion of brandy is added to the must before the fermentation commences. The subsequent processes consist in repeated rackings at intervals of a month or two, till March, brandy being added at each racking.

The object of racking the wines is to separate the dregs consisting of tartar, &c. deposited from the wine, and which, if left, are liable to render it sour, by re-exciting from time to time the fermentation. The tendency to fermentation is counteracted by a process termed *sulphuring*, and the spontaneous separation of the dregs is rendered more complete by CLARIFICATION, which see. See also FINING and FORCING.

The *sulphuring* of wines consists in impregnating them with the vapours of burning sulphur, or sulphurous acid, and is generally effected by burning sulphur-matches in the casks. (See MATCHING.) These matches are made in different ways, aromatics being sometimes mixed with the sulphur; but the sulphur is the only useful and necessary ingredient.

Sometimes

Sometimes a wine highly impregnated with ſulphurous acid is prepared, a little of which mixed with the reſt anſwers the purpoſe of burning matches in the caſk. Other ſubſtances, according to Dr. Macculloch, anſwer the ſame purpoſe as *ſulphuring;* namely, the *black oxyd of mangneſe*, and particularly the *ſulphite of potaſh*. A drachm of which ſalt is ſufficient for a pipe of wine, and is very effectual in counteracting the fermentative proceſs. The theory of theſe proceſſes is very obſcure.

We have before obſerved that the mere racking of wines is not ſufficient to render them pure, and various methods are adopted at the racking periods to render this operation more effectual, and theſe altogether conſtitute the proceſs termed *clarification*.

Lord Bacon mentions a practice among the ancients of putting wine into veſſels well ſtopped, and letting it down into the ſea. That this practice is very ancient is manifeſt from the diſcourſe of Plutarch (Quæſt. Nat. 27.) about the efficacy of cold upon muſt.

Different periods, as before-mentioned, are choſen in different diſtricts for racking wines. Thus the wines of Hermitage are racked in March and September, thoſe of Champagne about the middle of October, the middle of February, and the latter end of March. If poſſible, a ſerene and ſettled ſtate of the atmoſphere, and a dry and cold day, ſhould be choſen for the purpoſe, as the wine is always turbid in damp cloſe weather, and during the prevalence of ſoutherly winds.

In racking wines, it is in general deſirable to expoſe them as little as poſſible to the atmoſpheric air. In ſome diſtricts, a ſyphon is employed for the purpoſe. In Champagne they uſe a ſort of pump. Dr. Macculloch recommends that the wine ſhould be transferred from one caſk to another by means of a leather hoſe, and this method is undoubtedly preferable. For clarifying wines, a great variety of ſubſtances are employed. Iſinglaſs and albumen either from eggs or blood are the moſt common; but gum, ſtarch, rice, milk, the ſhavings of beech-wood, gypſum, ſand, &c. are uſed in different wine countries. An ounce of iſinglaſs, or about eighteen or twenty whites of eggs, are ſufficient for one hundred gallons of wine.

Two very important circumſtances in the practice of wine-making require yet to be mentioned; theſe are the *medication* of wines, and the means of *remedying thoſe diſeaſes* to which they are liable.

The *medication* of wines conſiſts in altering the colour, the flavour, or the ſtrength of any given wine, or in ſo mixing two or more together, as to produce a compound differing from, or ſuperior to, either. It is difficult to give any general rules for this purpoſe, and the proper management of the proceſſes depends chiefly upon the experience and taſte of the maker.

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The laſt of the circumſtances connected with wine-making is the means of *obviating thoſe diſeaſes* to which wines are liable.

One of the moſt common diſeaſes of weak wines is *acidity*. Strong

Strong wines, for obvious reafons, feldom become four. When acidity is prefent only in a very flight degree, it may be palliated confiderably by fugar, or by the addition of muft concentrated by boiling. It is obvious, however, that the acid can only be got rid of by neutralizing or deftroying it. For this purpofe, the alkalies and alkaline earths have been employed, but they impart a difagreeable flavour to the wine. Of thefe fubftances, lime is the fafeft and beft. It was formerly the practice to employ lead, in fome form or other, for counteracting acidity in wines; but we truft that this murderous practice has been long fince laid afide. *Ropinefs* is another difeafe to which wines are liable. This occurs more particularly in thofe which contain a good deal of extractive matter. It may be much relieved, and fometimes cured, by expofing the bottles to the fun and air, by agitating and fubfequently uncorking them, by adding a fmall quantity of vegetable acid, and by fining. The laft difeafe we fhall notice is perhaps the moft formidable of any, namely, a *muftinefs*, or other *ill-flavour* communicated by the cafk or cork. This appears to be, in general, abfolutely incurable, though it may be fometimes diminifhed by agitating the wine in contact with the air, or by the introduction of common air or carbonic acid by pumping. Such is a fummary account of wine-making from grapes, as practifed in the countries where that delicious fruit comes to perfection, and more efpecially in France. (See Birch's Hift. of the Royal Society, vol. i. p. 156.) We come now to confider,

2. *The Manufacturing of Wines from other Fruits, or artificial Wines.*—In the above fketch we have endeavoured to prefent our readers with a general view of the principles of wine-making, at the fame time that we defcribed the practice. Thefe principles are equally applicable to the manufacture of wine from all forts of fruit; we fhall therefore take the prefent opportunity of briefly recapitulating them here, as they cannot be too ftrongly impreffed upon the memory, and as they at the fame time conftitute the moft appropriate introduction to the prefent fection that occurs to us.

The juice of the grape confifts of a large proportion of water, holding in folution certain proportions of *faccharine matter*, of the *fweet* or *fermenting principle*, which appears to be a modification of the faccharine principle, of *various acids*, efpecially the tartaric and malic, and of various ill-defined *extractive matters*. Thefe principles, left to themfelves for a fhort time in a medium temperature, foon begin to re-act upon one another, and fome of them at length undergo remarkable changes. This procefs is termed *fermentation*, and conftitutes the grand principle of wine-making. When this procefs has begun to fubfide, it will be found that the greater portion of the faccharine principle has difappeared, and that its place is fupplied by a correfponding portion of ardent fpirit or alcohol. This is the moft ftriking feature of the change that has taken place, but all the other principles of the juice or *muft* appear to have undergone likewife fome change either in quality or quantity. In fhort, the fweet and crude *juice* of the grape is found to be converted into *wine*.

In this ftate, the *wine* is introduced into cafks, where it undergoes further changes, and is matured by a modification of the fermentative procefs, which has been called the *infenfible fermentation*. This is a moft important ftep in the procefs of wine-making, as by different modes of management in this ftage almoft the whole of that infinite variety which exifts among wines is produced. Here alfo it is that all foreign fubftances defigned to impart flavour, &c. to wines are in general introduced with the greateft propriety. When the *infenfible fermentation* has been carried to the point defired, it is checked by the proceffes of *racking*, *fulphuring*, *clarification*, &c.; and thus the wine is rendered capable of being preferved at any point or ftate we choofe.

Let us now apply thefe principles to the manufacture of wines from other fruits.

We ftart upon the grounds that artificial wines are intended to be imitations of wines prepared from grapes. In the firft place, therefore, we have to prepare a juice or muft fimilar to the juice or muft of the grape in its general compofition. Now, no fruit whatever yields a juice precifely fimilar to that of the grape. In our northern climate more efpecially, the faccharine principle, which is the fundamental principle in wine-making, exifts in very minute proportion in moft fruits. It muft be, therefore, fupplied artificially. The tartaric acid, or rather *tartar*, which appears to be another effential principle in wine-making, is likewife wanting in moft of our fruits. This, therefore, muft be fupplied. On the contrary, other principles, and particularly the malic acid, appear to exift in too large a proportion in moft of our fruits, which, in their natural ftate, are thus better adapted for making *cyders* than wines. To get rid of the malic acid, and to prevent its deteriorating effects, as well as the deteriorating effects of other foreign principles, is difficult, or perhaps impoffible; and this will doubtlefs always render artificial wines in general inferior to thofe of the grape, though very near approaches may be made by judicious management.

The practical mode of obviating thefe difficulties is to dilute the juice of the fruit to fuch a degree, that a given quantity of it when diluted fhall contain no more of the malic acid, for example, than a given quantity of the juice of the grape; and, as before obferved, to fupply artificially the two grand principles, fugar and tartar, which are wanting. Having thus prepared an artificial muft, as nearly refembling in its compofition that of the grape as poffible, the application of the other principles will be obvious, as we have nothing to do but to manage, in general, all the fubfequent proceffes precifely as if we were operating upon the muft of the grape. We fhall now, therefore, defcend from generals to particulars, and, after having made a few remarks upon our native fruits, endeavour to point out the modes in which the more important foreign wines may be beft imitated by them.

Fancy or caprice has led to the formation of wine from an infinite variety of fubftances, and almoft every good houfewife boafts of fome favourite *receipt* for making wines from what nature never intended for the purpofe. Such compounds hardly deferve the name of *wine*; we fhall, therefore, principally confine our attention to *fruits*. The following are the domeftic fruits moft ufually employed for the purpofe:

Goofeberry, and three varieties of currant.
Strawberry, rafpberry, blackberry, mulberry.
Sloe, damfon, elderberry.
Quince, cherry.
Britifh *grapes*.

To them may be added the foreign fruits

Raifins.
Orange, lemon.

The goofeberry and currant are of all others the fruits moft commonly employed for the fabrication of artificial wines; and, perhaps, upon the whole, they are beft adapted for the purpofe. When ufed in their green ftate, both goofeberry and currant may be made to form light brifk

brifk wines, falling little fhort of Champagne. Ripe goofeberries are capable of making fweet or *dry* wines; but thefe are commonly ill-flavoured, particularly if the hufk has not been carefully excluded. Ripe currants, if properly managed, make much better wines than goofeberries. Thefe fruits are much improved, according to Dr. Macculloch, by boiling previoufly to fermentation. This, he ftates, is particularly the cafe with the black currant, which, when thus managed, is capable of making a wine clofely refembling fome of the beft of the fweet Cape wines.

The ftrawberry and rafpberry are capable of making both *dry* and fweet wines of agreeable quality. As commonly managed, however, their peculiar flavour is diffipated in the procefs; hence, as Dr. Macculloch obferves, little is gained by their ufe to compenfate for their comparatively high price. A fimple infufion of thefe fruits, in any flavourlefs currant wine during the period of infenfible fermentation, will, with greater cheapnefs and certainty, enfure the production of their peculiar flavour. The blackberry and mulberry are capable of making coloured wines, if managed with that view: they are deficient, however, in the aftringent principle; neverthelefs, they may be occafionally employed with advantage when a particular object is to be gained.

The floe and damfon are fo affociated in qualities, that nearly the fame refults are obtained from both. Their juice is acid and aftringent; and hence they are qualified only for making *dry* wines. By a due admixture of currants or elderberries with floes or damfons, wines not much unlike the inferior kinds of port are often produced. The elderberry is capable of making an excellent red wine. Its cheapnefs alfo recommends it. It does not, indeed, poffefs any great degree of flavour, but it poffeffes no bad one, which is a negative property often of great importance in artificial wine-making.

The quince, from its analogy to the apple and pear, is better qualified for making a fpecies of cyder than wine. The cherry produces a wine of no very peculiar character. If ufed, care fhould be taken not to bruife too many of the ftones, otherwife a difagreeable bitter tafte will be imparted to the wine.

Grapes of Britifh growth are capable of making excellent fparkling and other wines, by the addition of fugar. Dr. Macculloch informs us, that he has fucceeded in making wines from immature grapes and fugar fo clofely refembling Champagne, Grave, Rhenifh, and Mofelle, that the beft judges could not diftinguifh them from foreign wines. The grapes may be ufed in any ftate, however immature; when even but half grown and perfectly hard they fucceed completely.

The cottagers in Suffex, fays Dr. Macculloch, are in the habit of making wine, almoft annually, from the produce of vines trained on the walls of their houfes. Many individuals through various parts of the fouthern counties, and even as far north as Derbyfhire, practife the fame with fuccefs. But the experiment is well known to have been made for many years on a large fcale, and with complete refults, at Pain's-hill, by the Hon. Charles Hamilton, in a fituation with refpect to foil and expofure of which parallel inftances are to be found throughout the country, and produced from land of no value whatever for the ordinary purpofes of agriculture. That our anceftors made wine from the produce of their vineyards there can be no doubt, and Dr. M. juftly remarks, that we can ftill make by far better wine from our grapes, even as produced at prefent, than from any other fruit whatever. Thefe, therefore, are cogent reafons for the cultivation of the vine, efpecially as, the fame gentleman obferves, we might, with care, inure and domefticate to our climate many of the richer and more delicate varieties of fouthern latitudes. See VINE, and VARIETIES; under the laft of which articles fome interefting experiments on this fubject are related.

Raifins are extenfively ufed in this country for making domeftic wines, and alfo for the fraudulent imitation and adulteration of foreign wines, although not a native fruit; therefore they deferve to be mentioned here. When properly managed, they are capable of making a pure and flavourlefs vinous fluid, well adapted for receiving any flavour which may be required, and thus of imitating many wines of foreign growth. See the clofe of this article.

The orange and lemon are likewife ufed for making domeftic wines. Upon the whole, however, they are not very well adapted for the purpofe, as they contain too much acid, and too little of the extractive and of the fweet or fermentative principle.

From what has been faid of the manufacture of wine from grapes, our readers will obferve, that different methods are purfued, according to the kind of wine which it is intended to make. Now thefe remarks are equally applicable to artificial wines, in the manufacture of which it is abfolutely neceffary that the maker fhould determine beforehand upon the kind of wine which it is his object to produce, and to modify his proceffes accordingly. We may, with Dr. Macculloch, confider wines as of four general defcriptions: *fweet* wines; *fparkling* or *effervefcing* wines; *dry* and *light* wines, analogous to hock, grave, and Rhenifh, in which the faccharine principle is entirely decompofed during fermentation; and laftly, *dry* and *ftrong* wines, as Madeira and fherry.

Thofe of the firft and moft fimple clafs are the *fweet* wines, or thofe in which the fermentative procefs has been incomplete. It is to this clafs that by far the greater number of our artificial wines bear the greateft refemblance; a refemblance, fays Dr. M., fo general as to fhew that few makers of this article poffefs fufficient knowledge of the art to enable themfelves to fteer clear of what may be firmly called the radical defect of domeftic wines. *Sweet* wines may be made from almoft any ripe fruits. Thofe moft generally employed, however, are the goofeberry and currant. We fhall fuppofe that we wifh to make the quantity of ten gallons of fweet wine from one or other of thefe fruits. For this purpofe, the following are the proportions and other circumftances to be attended to. Forty pounds of fruit are to be introduced in a clean and fufficiently capacious tub, in which it is to be bruifed in fucceffive portions, by a preffure fufficient to crufh the berries without breaking the feeds, or if goofeberries be employed, without materially compreffing the fkins. Four gallons of water are then to be poured into the veffel, and the contents are to be carefully ftirred and fqueezed in the hand until the whole of the juice and pulp are feparated from the folid matters. The materials are then to be permitted to remain at reft for a period of from fix to twenty-four hours, when they are to be ftrained through a coarfe bag by as much force as can be conveniently applied to them. One gallon of frefh water may afterwards be paffed through the *marc*, for the purpofe of removing any foluble matter which may have remained confined. From thirty to forty pounds of fugar, according to the defired ftrength and fweetnefs of the wine, and about fix ounces of cream of tartar, or, what is better, crude tartar, are now to be diffolved in the juice thus procured, and the total bulk of the fluid made up with water, to the amount of ten gallons and a half.

The liquor thus obtained is the artificial *muft*, which is equivalent

equivalent to the juice of the grape. It is now to be introduced into a tub of fufficient capacity, which is to be well covered, and placed in a temperature varying from 55° to 60°. Here it is to remain two or three days, more or lefs, according to the fymptoms of fermentation which it may fhew, and from this tub it is to be drawn off into the cafk, where the fermentative procefs is intended to be brought to the point defired. As the fermentative procefs proceeds the bulk of the liquor diminifhes, and its place muft be fupplied from time to time by the fuperfluous portion of muft made for the purpofe, fo as to keep the liquor always near the bung-hole. When the fermentation has fubfided a little, the bung may be driven in, taking care, however, to leave a fmall hole open by its fide, which may be ftopped with a peg, and opened occafionally to give vent to any air that may be generated.

When the wine has arrived at the defired point of fweetnefs, &c. it muft be racked and clarified in the manner defcribed in the former part of this article; and thefe proceffes muft be repeated, and the cafks fulphured, if neceffary, in order to prevent the fermentative procefs from proceeding farther. In general, however, one racking in the following December or January will be fufficient, after which it may be kept in the cafk for any length of time, or it may be bottled without the ufual precautions. A fine ferene and cold day fhould be chofen for thefe operations. Sometimes the fermentative procefs will ftop before the wine has arrived at the defired point, in which cafe it may be commonly eafily re-excited by raifing the temperature, and fhaking the cafk; or, if thefe fail, by having recourfe to the means formerly defcribed for that purpofe.

By attending to thefe general directions, fweet wines may be made from other fruits, care being taken to increafe or diminifh the quantity of fugar according to the natural fweetnefs of the fruit employed.

The fecond general defcription of wines comprehends the *brifk* or *fparkling* wines; which may be, at the fame time, either *fweet* or comparatively *dry*. Our readers will recollect the methods adopted in Champagne, and other countries where they manufacture fparkling wines from the grape, and which are defcribed in the former part of this article. Now thefe principles are to be held in view in the manufacture of artificial wines intended to poffefs fimilar properties. The fruits moft generally employed for forming wines of this defcription, are the immature goofeberry and currant; fometimes alfo immature grapes, and even vine leaves are made ufe of for a fimilar purpofe, but grapes are doubtlefs preferable when they can be procured. Wines of this defcription are more difficult to be made than the laft, at leaft they require much more care. If goofeberries are employed, they muft be gathered when they have nearly attained their full growth, but before they have fhewn the leaft tendency to ripen. The variety of goofeberry is perhaps indifferent, but it will be advifable to avoid the ufe of thofe, which in their ripe ftate have the higheft flavour. Dr. Macculloch recommends the *green bath* as among the beft. Thofe which are unfound, as well as the remains of the bloffom and footftalk, fhould be carefully removed. Forty pounds of this fruit, thirty pounds of fine white fugar, and about fix ounces of tartar, are fufficient for making ten gallons of wine. All the preliminary proceffes are to be conducted precifely in the fame manner as thofe above-defcribed for making fweet wines. The *muft*, however, ought to remain in the fermenting tub for about twenty-four hours, or two days only, when it is to be transferred to the cafk, and the proceffes of *filling up*, &c. managed as before, except that the wooden peg or fpile muft be permanently tightened as foon as the danger of burfting the cafk has fubfided. The wine thus made may commonly remain during the winter in a cool cellar, as it is no longer neceffary to excite the fermenting procefs. To enfure its finenefs, however, it is a good practice to draw it towards the end of December into a frefh cafk, fo as to feparate the lees; and if at this time it fhould prove too fweet, inftead of decanting, it will be better to ftir up the lees fo as to renew the fermenting procefs, taking care alfo to increafe the temperature at the fame time. At whatever time the wine has been decanted, it is to be fined with ifinglafs in the ufual manner. Sometimes it will be neceffary to decant it a fecond and even a third time into a frefh cafk. All thefe operations fhould take place, as formerly mentioned, in dry cool weather, and the wine muft, at any rate, be finally bottled in March. If immature currants be employed, which are perhaps upon the whole preferable to goofeberries, the fame proportion of fruit, fugar, and tartar, and the fame modes of management, may be had recourfe to; care being taken to feparate carefully the ftalks of the currants. If grapes be ufed for the purpofe, they may be fafely taken of different degrees of ripenefs, nor is it neceffary to attend to the felection of any particular variety. The fame proportions of fruit and fugar will be proper as when goofeberries and currants are employed, but the tartar muft be omitted. The hufks alfo may be permitted to ferment with the liquor in the vat. The fubfequent management is to be precifely the fame as that defcribed above. An excellent wine of the prefent defcription may be made from the leaves and tendrils of the vine. About forty pounds of thefe, and twenty-five or thirty pounds of fugar, will be fufficient for ten gallons of wine. To prepare it, feven or eight gallons of boiling water are to be poured upon the leaves in a tub, and permitted to remain for twenty-four hours. The liquor being poured off, the leaves muft be ftrongly preffed, and fubfequently wafhed with another gallon of water. The fugar and the remainder of the water are then to be added, and the fermentative and all the fubfequent proceffes conducted precifely the fame as before. The prefent clafs of wines, if the procefs has been fuccefsful, (which is not always the cafe,) is brifk, and precifely fimilar in their qualities (flavour excepted) to the wines of Champagne, with the ftrength of the beft Sicily.

The third variety of wines is that of which hock, grave, and Rhenifh may be taken as examples. In thefe the faccharine principle is entirely overcome by a complete fermentation, while their future change is prevented by a careful application of the proceffes laid down for the prefervation of wines of this clafs. Makers of domeftic wines have rarely, fays Dr. Macculloch, fucceeded in imitating thefe wines. The reafons obvioufly are, the great difproportion of the fugar to the fubfequent fermentation in the firft inftance; and that want of the after-management, the neglect of which foon configns thefe wines to the vinegar cafk, if chance fhould even at firft have produced fuccefs. In making thefe wines, the relative proportion of fruit and fugar in common ufe muft be materially altered, and the fermentative procefs be conducted in a very careful manner. The fubfequent proceffes alfo of racking, fulphuring, and fining, muft be practifed with great affiduity, in order to preferve thefe wines after we have fucceeded in making them. Dr. Macculloch ftates, from his experience, that thefe wines may be fuccefsfully imitated, and that they conftitute fome of the very beft of thofe which can be made from domeftic fruit. The proportion of fruit (generally of immature fruit) to the fugar, in the manufacturing of fweet wines, muft be the greateft. The bung muft remain open, but the fluid within muft not be allowed to efcape, while, if the fermentation proceeds

ceeds languidly, it muſt be accelerated by heat and agitation. If, when it is finiſhed, the wine continues too ſweet, it may be bunged down till the ſpring without racking or fining, when the fermentation muſt again be renewed. The renewal of the fermentation may alſo be effected by adding ſome freſh juice of the ſame fruit. At whatever time, and under whatever of theſe proceſſes, it has become *dry*, it is to be carefully fined and racked into a ſulphured caſk, and bottled, after being once more carefully fined.

The fourth and laſt claſs of wines conſiſts of thoſe which are both dry in their quality, and ſtrong in their nature; ſuch are, Madeira, ſherry, &c.; the theory of theſe, from what has been ſaid, will be ſufficiently apparent. With due attention to the fermentative proceſs, ſuch wines may be made of the requiſite degree of ſtrength without brandy. By means of this, however, if managed as formerly directed, the operator has it always in his power to produce wines of any required degree of ſtrength.

We need not here repeat the methods of imparting different flavours to domeſtic wines, or of correcting their faults, ſince they differ in no reſpect from thoſe recommended to be adopted in the manufacture of wines from grapes, to which therefore we refer.

The following general remarks upon the fabrication of domeſtic wines, will not perhaps prove unintereſting to our readers.

The great radical defect in the manufacture of domeſtic wines, is uſing too ſmall a proportion of fruit compared with the ſugar employed. It is this circumſtance chiefly which renders the fermentative proceſs incomplete, and thus imparts that ſweet and mawkiſh taſte to our domeſtic wines, which renders them intolerable to many people, and even to all, perhaps, without the addition of brandy. The proportions of fruit and ſugar given above may be conſidered as mean ſtandards, which may be varied either way, according to circumſtances and the nature of the wine intended to be produced. A very ſuperior claſs of fruit wines may be manufactured by uſing the juices of our different fruits, either alone or very ſlightly diluted with water.

We mentioned that ſome fruits, and eſpecially the black currant, were much improved by boiling. For this purpoſe, it will be ſufficient that the fruit be ſimply brought to the boiling point before uſing it, the water in the veſſel being ſo managed as to avoid any riſk in burning. The black currant thus treated, and ſubſequently managed upon the principles we have endeavoured to lay down, is capable of making a wine very nearly reſembling ſome of the beſt ſweet Cape wines.

The fermentative proceſs being rendered tardy and incomplete, by the improper adjuſtment of the ſugar to the fruit, is frequently endeavoured to be excited by *yeaſt:* nothing can be more injudicious than this. *Yeaſt* invariably ſpoils wines, by imparting to them a flavour that nothing will ever overcome. The only ferment to be employed in wine-making, is that furniſhed by nature; and when this is defective, as is ſometimes the caſe in our domeſtic fruits, the ferment of the grape muſt be ſupplied artificially. This may be done by introducing a certain proportion of *crude tartar*, the doſe of which may vary from one to ſix *per cent.* without materially affecting the wine, as a great proportion of what eſcapes decompoſition will be ſubſequently depoſited. All fruits, except the grape, will require more or leſs of *tartar*.

The laſt circumſtance we ſhall notice is the introduction of *brandy*, or other ſpirit, into domeſtic wines. As commonly manufactured, they often require, as we have juſt ſtated, this addition to render them tolerable. We truſt, however, that from the attention that has been lately paid to the ſubject of artificial wines, the modes of manufacturing them will be better underſtood, and that this will no longer be the caſe. Fine wines are invariably ſpoiled by the addition of ardent ſpirit, which ſeems to have the effect of ſlowly decompoſing them, and thus of deſtroying that delicate, lively, and briſk flavour, ſo eminently poſſeſſed by all natural wines. Hence it is ſeldom or never uſed in wine countries; or rather it is confined to the manufacture of thoſe wines deſtined for this country, where only this barbarous practice is tolerated. We again repeat, that if the fruit and ſugar be duly adjuſted to one another, and the fermentative proceſs be properly managed, an infinitely better wine will be produced without the uſe of brandy, than can ever be produced with it.

General Chemical Properties and Compoſition of Wines.—The juice of the grape, as we formerly mentioned, conſiſts of a large proportion of water, of certain proportions of the ſaccharine and fermentative principles, of various acids, eſpecially the tartaric, and ſome ill-defined extractive principles. Theſe were ſtated during the fermentative proceſs to undergo different remarkable changes, one of the moſt important of which is the converſion of the ſaccharine principle into alcohol. The nature of the other changes are not ſo well underſtood, nor does the little we know at preſent of the compoſition of wines throw any very ſatiſfactory light upon the ſubject. One principle indeed, *viz.* the fermentative principle, does not exiſt in perfect wines, and therefore muſt be decompoſed or ſeparated during the proceſs of fermentation. The principles formed in wines may perhaps be arranged under the four following heads: 1. *Acids;* 2. *Extractive and colouring matters;* 3. *Eſſential oils;* and 4. *Alcohol.* Water is not mentioned, becauſe it forms the baſis of all potable fluids, and conſequently of wines.

1. *Acids.*—All acids have the property of reddening turnſole or litmus papers, and therefore contain more or leſs of a free acid. The acids found in wines are, the tartaric, the malic, the citric, the carbonic, and occaſionally the acetic.

The tartaric acid, in combination with potaſh, or *tartar*, as it is uſually termed, exiſts in great abundance in the juice of grapes, as formerly ſtated, and appears to be one of its moſt important ingredients. A large proportion of this tartar is doubtleſs decompoſed during the fermentative proceſſes, and a conſiderable quantity of what remains is ſubſequently depoſited in the caſks or veſſels in which the wine is kept, conſtituting what is termed the *cruſt.* It appears probable, however, that the whole is not ſeparated, and conſequently, as Dr. Thomſon juſtly remarks, that wines are never entirely deſtitute of tartar. Satiſfactory experiments, however, upon an extenſive ſcale, are at preſent wanting upon this part of the ſubject. The malic acid, according to the experiments of Chaptal, exiſts in the greater number of wines, if not in all, and that in much greater proportion than any other acid. If this be really the caſe, it is probably, in part at leaſt, a product of fermentation, for the juice of grapes appears to contain very little of this acid. Traces of the citric acid were found by Chaptal to exiſt in ſome wines. This acid alſo exiſts in the juice of the grape, but in ſmall quantity. All wines that have the property of efferveſcing, or ſparkling, when poured from the bottle into a glaſs, contain carbonic acid. Champagne, for example, owes its characteriſtic properties to this acid. Sparkling wines are uſually weak, and contain leſs alcohol than uſual, for reaſons that have been already explained. The acetic acid is not an eſſential ingredient of wine, nor in fact ought it ever to exiſt in it. If the

the fermentation, however, be permitted to go too far, this acid will be formed, and hence it occafionally occurs in inferior wines.

2. *Extractive and colouring Matters.*—Thefe ill-defined fubftances exift more or lefs in all wines. Their properties, however, are not well afcertained, nor are they probably uniformly the fame in every inftance. They have a tendency to feparate fpontaneoufly, and along with the tartar form what is termed the *cruft;* hence, as wines become older, from their containing lefs of thefe matters, they ufually become paler. Thefe extractive matters may be alfo feparated artificially by means of animal charcoal, the fubacetate of lead, and even partially in fome inftances by lime-water, or the heat of the fun. The colouring matter, as we formerly noticed, is not derived from the juice of the grape, but from its hufk.

3. *Effential Oils.*—Wines, though effentially the fame in their general compofition, are diftinguifhed from one another principally by their flavour and odour, no lefs than by the proportion of alcohol they may contain. Now their fenfible properties evidently depend upon fome volatile and fugacious principle, which has been confidered to be analogous to an effential oil. This principle is fometimes derived immediately from the fruit, as, for example, in the wines made from the Frontignac and Mufcat grape. At other times, it is the product of fermentation. Thus the finer flavours of claret, hermitage, and Burgundy, bear no refemblance to thofe of the grapes, from whence they are formed. Very often, as before ftated, the principles of odour and flavour are communicated to wines artificially, by the introduction of foreign ingredients, as orris-root, grape, and elder-flowers, mignonette, &c. The menftruum of this volatile principle is doubtlefs, in moft inftances, the alcohol contained in wines; but its quantity is fo minute as to be incapable of feparation.

4. *Alcohol.*—The characteriftic ingredient of wines is alcohol. Indeed, wines may be confidered as more or lefs dilute folutions of alcohol, impregnated with different flavouring fubftances, and a little acid. There have been great differences of opinion in what ftate alcohol exifts in wines. Some chemifts maintain, that alcohol does not exift ready formed in wines, but that its elements only exift in a peculiar ftate, and that their union is determined, and confequently alcohol formed, by the act of diftillation. This opinion was advanced by Fabroni, and feems to have been adopted by fome fubfequent writers. Mr. Brande, however, has fhewn by very decifive experiments, that all wines contain alcohol ready formed, and that this fluid is merely feparated during the diftillation of thefe liquors; and his experiments have been fince fully confirmed by Gay Luffac.

The following Table, reprefenting the Quantity of Alcohol and other Principles in different Wines, is taken from Dr. Thomfon's Chemiftry, though it was compiled originally by Neumann. The refults are not abfolutely to be relied upon, as the ftate of chemical Knowledge, at the time Neumann wrote, was very imperfect.

A Quart of contains	Highly rectified Spirit.			Thick, oily, unctuous, refinous Matter.			Gummy and tartareous Matter.			Water.			
	oz.	dr.	gr.	oz.	dr.	gr.	oz.	dr.	gr.	lb.	oz.	dr.	gr.
Aland - - - - - -	1	6	0	3	2	0	1	5	0	2	5	3	0
Alicant - - - - - -	3	6	0	6	0	20	0	1	40	2	2	6	0
Burgundy - - - - -	2	2	0	0	4	0	0	1	40	2	9	0	20
Carcaffone - - - - -	2	6	0	0	4	10	0	1	20	2	8	4	30
Champagne - - - - -	2	5	20	0	6	40	0	1	0	2	8	3	0
French - - - - - -	3	0	0	0	6	40	0	1	0	2	8	0	20
Frontignac - - - - -	3	0	0	3	4	0	0	5	20	2	4	6	30
Vin de Grave - - - - -	2	0	0	0	6	0	0	2	0	2	9	0	0
Hermitage - - - - -	2	7	0	1	2	0	0	1	40	2	7	5	20
Madeira - - - - - -	2	3	0	3	2	0	2	0	0	2	4	3	0
Malmfey - - - - -	4	0	0	4	3	0	2	3	0	2	1	2	0
Vino de monte Pulciano - -	2	6	0	0	3	0	0	2	40	2	8	0	20
Mofelle - - - - - -	2	2	0	0	4	20	0	1	30	2	9	0	10
Mufcadine - - - - -	3	0	0	2	4	0	1	0	0	2	5	4	0
Neufchatel - - - - -	3	2	0	4	0	0	1	7	0	2	2	7	0
Palm fec - - - - -	2	3	0	2	4	0	4	4	0	2	2	5	0
Pontac - - - - - -	2	0	0	0	5	20	0	2	0	2	9	0	40
Old Rhenifh - - - - -	2	0	0	1	0	0	0	2	20	2	8	5	40
Rhenifh - - - - - -	2	2	0	0	3	20	0	1	34	2	9	1	6
Salamanca - - - - -	3	0	0	3	4	0	2	0	0	2	3	4	0
Sherry - - - - - -	3	0	0	6	0	0	2	2	0	2	0	6	0
Spanifh - - - - - -	1	2	0	2	4	0	9	4	0	1	10	6	0
Vino Tinto - - - - -	3	0	0	6	4	0	1	6	0	2	0	6	0
Tokay - - - - - -	2	2	0	4	3	0	5	0	0	2	0	3	0
Tyrol red wine - - -	1	4	0	1	2	0	0	4	0	2	8	6	0
Red wine - - - - -	1	6	0	0	4	40	0	2	20	2	9	3	20
White - - - - - -	2	0	0	0	7	0	0	3	0	2	7	0	0

The

The following Table has been given by Mr. Brande, repreſenting the quantity by meaſure of alcohol, ſp. gr. .825, contained in different wines, and other fermented liquors. The wines were all genuine.

	Proportion of Spirit *per Cent.* by Meaſure.
1. Liſſa	26.47
Ditto	24.35
Average	25.41
2. Raiſin wine	26.40
Ditto	25.77
Ditto	23.20
Average	25.12
3. Marſala	26.30
Ditto	25.05
Average	25.09
4. Port	25.83
Ditto	24.29
Ditto	23.71
Ditto	23.39
Ditto	22.30
Ditto	21.40
Ditto	19.00
Average	22.96
5. Madeira	24.42
Ditto	23.93
Ditto (Sercial)	21.40
Ditto	19.24
Average	22.27
6. Currant wine	20.55
7. Sherry	19.81
Ditto	19.83
Ditto	18.79
Ditto	18.25
Average	19.17
8. Teneriffe	19.79
9. Colares	19.75
10. Lacryma Chriſti	19.70
11. Conſtantia white	19.75
12. Ditto red	18.92
13. Liſbon	18.94
14. Malaga kept ſince 1666	18.94
15. Bucellas	18.49
16. Madeira red	22.30
Ditto	18.40
Average	20.35
17. Cape Muſchat	18.25
18. Cape Madeira	22.94
Ditto	20.50
Ditto	18.11
Average	20.51
19. Grape wine	18.11
20. Calcavella	19.20
Ditto	18.10
Average	18.65
21. Vidonia	19.25
22. Alba flora	17.26
23. Malaga	17.26
24. White hermitage	17.43
25. Rouſillon	19.00
Ditto	17.26
Average	18.13
26. Claret Chateau Margot	17.11
Ditto	16.32
Ditto Lafite	14.08
Claret Lafite	12.91
Average	15.10
27. Malmſey Madeira	16.40
28. Lunel	15.52
29. Sheraaz	15.52
30. Syracuſe	15.28
31. Sauterne	14.22
32. Burgundy	16.60
Ditto	15.22
Ditto	14.53
Ditto	11.95
Average	14.57
33. Hock	14.37
Ditto	13.00
Ditto (old in caſk)	8.88
Average	12.08
34. Nice	14.63
35. Barſac	13.86
36. Tent	13.30
37. Champagne (ſtill)	13.80
Ditto (ſparkling)	12.80
Ditto	12.56
Ditto (red)	11.30
Average	12.61
38. Red hermitage	12.32
39. Vin de grave	13.94
Ditto	12.80
Average	13.37
40. Frontignac	12.79
41. Cote Rotie	12.32
42. Gooſeberry wine	11.84
43. Orange wine (average of ſix ſamples made by a London manufacturer)	11.26
44. Tokay	9.88
45. Elder wine	8.79

Other fermented Liquors.

1. Cyder, higheſt average	9.87
Ditto, loweſt average	5.21
2. Perry, average of four ſamples	7.26
3. Mead	7.32
4. Ale (Burton)	8.88
Ditto (Edinburgh)	6.20
Ditto (Dorcheſter)	5.56
Average	6.87
5. Brown ſtout	6.80
6. London porter (average)	4.20
Ditto ſmall beer (ditto)	1.28
7. Brandy	53.39
8. Rum	53.68
9. Gin	51.60
10. Scotch whiſkey	54.32
11. Iriſh ditto	53.90
12. Hollands (genuine)	56.00

On the Uſes of Wine in a Dietetic and Medicinal Point of View.—Mankind in every ſtage of civilization and ſociety betray a propenſity for fermented liquors. This indeed is ſo ſtrongly marked, that ſome have been induced to conſider it as the reſult of an inſtinctive faculty, and conſequently have been led to ſuppoſe that fermented liquors are the proper and natural drink of the human race. Others, on the contrary, have contended that fermented liquors are of no real uſe to mankind, and are often even productive of much poſitive

positive evil, and hence have arrived at a conclusion diametrically opposite to the former. It is difficult to decide between these opinions. We confess, however, that we do not think it necessary, on the one hand, to have recourse to the supposition of an instinctive faculty to account for wine-drinking; nor, on the other, do we believe that the moderate use of natural wines is productive of any bad effects. The propensity for strong drinks seems explicable upon the general principle that all animals feel a pleasure in *living faster*, or, as it were, crowding a greater portion of existence into a shorter space than natural; an effect in some degree produced by the exciting effects of such liquors. As to the bad effects too frequently produced by fermented liquors, they may, in almost every instance, be fairly traced to the badness of their quality, or to an excess in quantity.

While, however, we do not object to the moderate use of what providence has so liberally bestowed upon us, no one can object more strongly than ourselves to its abuse. The melancholy effects of habitual intoxication are too well known to require particular description here. Severely do the victims of this degrading propensity suffer in mind, body, and fortune; nor are their sufferings confined to themselves, but entailed upon their ill-fated posterity. For proofs of these positions, we refer our readers to the articles Gout, Calculus, Apoplexy, Epilepsy, Insanity, &c. &c. in this work, where they will find these and other diseases justly ranked among the most painful and distressing to which humanity is liable, frequently ascribed to habitual intemperance as their cause.

But putting out of the question these effects of drunkenness, what a horrible picture of moral depravity does it present for a man to sit down deliberately, day after day, with the professed object of annihilating his intellectual faculties, and thus degrading himself below the vilest of the brute creation! And even supposing he has arrived at the *enviable point* of being able to swallow two or three bottles without losing his senses, and that this quantity has become necessary to his comfort, nay even perhaps to his very existence, to what a wretched state of dependence has he reduced his bloated carcase; what a tax is such a being upon society, who, to prolong a loathsome existence, is obliged to consume daily in an unnecessary superfluity more than is sufficient to support a whole family for a week! See Drunkenness.

With respect to the operation of different wines upon the animal economy, they vary exceedingly according to their properties. New wines in general are unwholesome, and often prove purgative. Sweet wines are upon the whole perhaps the most wholesome, and, where the taste has not been previously vitiated, doubtless the most agreeable. Weak and acid wines are very apt to disagree with the stomach, especially when that organ has been accustomed to stronger wines. Hence an occasional debauch with such wines is notorious for inducing a fit of the gout, especially in this country, where the usual wines are immoderately strong. The same is true also, though perhaps in a somewhat less degree, with the effervescing wines. Red wines, in general, are of a more astringent and tonic nature than white wines, and commonly contain more spirit. There are, however, many exceptions to this rule.

It will be seen by consulting the above table, that port, Madeira, and sherry, the three wines in most common use in this country, contain from one-fourth to one-fifth of their bulk of alcohol. A person, therefore, who takes his bottle of wine every day, will thus take nearly half a pint of alcohol, or almost a pint of pure brandy! This at first sight will appear almost incredible, especially as the same person would not perhaps be able to take a similar quantity of ardent spirit, either diluted with water, or in any other way. Some have concluded from this circumstance that the above experiments are not to be relied upon; but from the manner in which they were conducted there is no reason to doubt their general accuracy; the fact therefore remains to be explained. The most probable explanation is, that the alcohol in the wine is in some state of combination, which prevents its immediate action upon the stomach, and thus renders it liable to be digested or altered in its properties before it can exert its specific effects. The peculiar nature, however, of this state of combination is at present unknown. What renders this opinion the more probable is, that some bad wines, and especially domestic wines, which are often little better than mere mixtures of brandy and water, exert much more effect upon the animal economy than fine old wines, though they may not contain nearly so much spirit.

With respect to the *medicinal* uses of fermented liquors, when cordials are required, wines are by far the most efficient of the whole tribe, and of these *port wine* is perhaps the best. For full information on this head, we refer our readers to the articles Fever, Gangrene, and *Analogous Diseases of* Debility. See Chaptal's excellent Essay on the Manufacture of Wines, Annales de Chimie, vol. xxxvi. and xxxvii. Dr. Macculloch's Essay on Wine-making. Mr. Brande's Essays in Phil. Transf. for 1811 and 1813, &c.

For the distillation of wines, see Distillation.

Wine being a liquor mostly of foreign produce, the different names, forms, kinds, distinctions, &c. of it are borrowed from the countries where it is produced, particularly France.

Wine, in France, is distinguished, from the several degrees and steps of its preparation, into

Merre-goutte, mother-drop; which is the virgin wine, or that which runs of itself out of a tap of the vat, in which the grapes are laid, before the vintager enters to tread, or stamp, the grapes.

Must, *surmust*, or *stum*, is the wine, or liquor, in the vat, after the grapes have been trodden, or stamped.

Pressed Wine, *Vin de Pressurage*, is that squeezed with a press out of the grapes, when half-bruised by the treading. The husks left of the grapes are called *rape*, *murk*, or *marc*; by throwing water upon which, and pressing them afresh, they make a liquor for servants' use, answerable to our cyder-kin, and called *boisson*; which is also of some use in medicine, for the cure of disorders occasioned by viscid humours.

Sweet Wine, *Vin doux*, is that which has not yet worked, or fermented. This is turbid, and has an agreeable and very saccharine taste. It is very laxative, when drunk too freely, or by persons disposed to diarrhœas, it is apt to occasion these disorders. Its consistence is somewhat less fluid than that of water, and it becomes almost of a pitchy thickness when dried.

Bouru, that which has been prevented working, by casting in cold water.

Cuve, or *worked wine*, that which has been let work in the vat, to give it a colour.

Cuit, or *boiled wine*, that which has had a boiling before it worked; and which, by these means, still retains its native sweetness.

Passé, or *strained wine*, a sort of raisin-wine, made by steeping dry grapes in water, and letting it ferment of itself.

Wines are also distinguished with regard to their colour, into *white wine*, *red wine*, *claret wine*, *pale wine*, *rose* or

black

black wine. And, with regard to their country, or the foil which produces them, into *French wines*, *Spanifh wines*, *Rhenifh wines*, *Hungarian wines*, *Greek wines*, *Canary wines*, &c. And, more particularly, into *Port wine*, *Madeira wine*, *Burgundy wine*, *Champagne wine*, *Falernian wine*, *Tokay wine*, *Schiras* or *Sheraaz wine*, &c.

Wines, again, are diftinguifhed, with regard to their quality, into *fweet wines*, *rough* or *dry wines*, and *rich* or *lufcious wines*, *vins de liqueur;* of which laft fome are exceedingly fweet, others fweet and poignant; and all chiefly ufed by way of a dram after meals, &c.

Such are French, *Frontignac*, *Madeira*, the *Canary*, the *Hungary*, *Tokay*, the Italian *Montefiafcone*, the Perfian *Schiras*, the *Malmfey wines* of Candia, Chio, Lefbos, Tenedos, and other iflands of the Archipelago, which anciently belonged to the Greeks, but now to the Turks. Thefe are fometimes called *Greek wines*, and fometimes *Turkey wines*.

The chief wines drank in Europe are as follow. 1. The Madeira ifland, and Palma, one of the Canaries, afford two kinds: the firft called *Madeira fec*, the latter, which is the richeft and beft of the two, *Canary* or *Palm fec*. The name *fec* (corruptly written *fack*) fignifies dry; thofe wines being made from half-dried grapes. There is another fort of *fec* wine, prepared about Xeres, in Spain, and hence called, according to our orthography, *Sherris*, or *Sherry*. 2. The wines of Candia and Greece are of common ufe in Italy. *Malmfey* was formerly the produce of thofe parts only, but is now brought chiefly from Spain: it is a fweet wine, of a golden or brownifh-yellow colour, and to this is applied an Italian proverb, fignifying, *Manna to the mouth, and balfam to the brain.* Almoft all the wines ufed in the Venetian territories come from Greece and the Morea. 3. Italy produces the *vino Greco*, which is a gold-coloured unctuous wine, of a pungent fweetnefs, the growth of mount Vefuvius, but much fophifticated by the Neapolitans. In the neighbourhood of mount Vefuvius is made the *Mangiaguerra* wine, and a thick, blackifh one, called *Verracia;* and at the foot of the hill the delicious *vino vergine*. The kingdom of Naples affords the *Campania* or *Paufilippo*, *Mufcatel*, *Salernitan*, and other excellent wines, and alfo the *Chiarello*, much drank at Rome. But the principal is the red, fat, fweet, and grateful poignant one, called *Lachryma Chrifti*. 4. The Ecclefiaftical State produces the bright, pleafant *Albano*, and the fweet *Montefiafcone*, a yellowifh not very ftrong wine, refembling good Florence, &c. 5. In Tufcany are the excellent white and red *Florence;* the celebrated hot, ftrong, red wine, *de Monte Pulciano*, &c. 6. In Lombardy, the *Modenefe* and *Montferrat* are tolerable; between Nizza and Savona is produced an incomparable *Mufcadine*. 7. Piedmont and part of Savoy have excellent light wines. 8. The Sicilian, Sardinian, and Corfican wines are alfo good. 9. Moft of the Spanifh wines are compofed of fermented or half-fermented wine mixed with infpiffated muft, and varioufly manufactured, or of an infufion of dry grapes in weak muft. Of thefe wines, there are a few in Germany, as the *Alicant*, which is a thick, ftrong, very fweet, and almoft naufeous wine, *Sherry*, *Spanifh*, *Malmfey*, &c. 10. In Portugal there is plenty of red *Port*, which is much drank in England. The beft *Vino tinto*, a blackifh-red wine ufed by the coopers for colouring other wines, is faid to be the produce of Portugal. This kingdom alfo deals largely in *Madeira*. 11. In France there is a great variety of wines; of which the ftrong, fweet, full-bodied, fpirituous ones, are called *Vins de liqueur*. Languedoc and Provence afford the fweeteft wines, and the fame provinces, with Champagne and Burgundy, the ftrongeft; the wines of the northern parts, as Picardy and Bourdeaux, are the worft, and thofe about the middle of the kingdom, as Paris and Orleans, of a middling kind. The moft celebrated of the French wines are, *Champagne*, *Burgundy*, *Vin de beaune*, or partridge-eye, *Frontiniac*, *Hermitage*, &c. 12. In Switzerland, the beft wines are, the *Neufchatel*, *Valteline*, *Lacote*, and *Reiff:* the *Valteline* ftraw-wine, fo called from the grapes being laid for fome time upon ftraw before they are preffed, is particularly celebrated. 13. The dry-grape wines of the Upper Hungary are in general excellent, and much fuperior to thofe of the Lower. (See Tokay.) 14. Among the German wines, thofe of *Tyrol* are very delicate, but do not keep. 15. Of Auftrian wines, thofe of *Klofter-Newburg* and *Brofenberg* are deemed the beft: and there are alfo good wines in other parts of the Imperial dominions. 16. In the Palatinate, the beft wine is that of *Worms*, efpecially the fort called Women's Milk. 17. Among the more efteemed German wines may be reckoned alfo *Rhenifh*, *Mayne*, *Mofelle*, *Neckar*, and *Elfafs:* a certain writer calls the *Rhenifh* made in Hockheim (Hock) the prince of the wines of Germany.

Wine is alfo varioufly denominated, according to its ftate, circumftances, qualities, &c. *e. g.*

Natural Wine, is fuch as comes from the grape, without farther mixture, or fophiftication.

Brewed Wine, or *Adulterated*, is that in which fome drug is added, to give it ftrength, finenefs, flavour, brifknefs, fweetnefs, or fome other quality which is wanted.

Pricked Wine, or *Eager*, is that turned fourifh.

An eafy method of recovering pricked wines may be learned from the following experiment:—Take a bottle of red port that is pricked, add to it half an ounce of tartarized fpirit of wine; fhake the liquor well together, and fet it by for a few days, and it will be found very remarkably altered for the better.

This experiment depends upon the ufeful doctrine of acids and alkalies. All perfect wines have naturally fome acidity, and when this acidity prevails too much, the wine is faid to be pricked, which is truly a ftate of the wine tending to vinegar: but the introduction of a fine alkaline falt, fuch as that of tartar, imbibed by fpirit of wine, has a direct power of taking off the acidity, and the fpirit of wine alfo contributes to this, as a great prefervative in general of wines. If this operation be dexteroufly performed, pricked wines may be abfolutely recovered by it, and remain faleable for fome time: and the fame method may be ufed to malt-liquors juft turned four. Shaw's Lectures, p. 214.

Flat Wine, is that fallen weak and vapid, for want of being drank in time.

Sulphured Wine, is that put in cafks in which fulphur has been burnt; in order to fit it for keeping, or for carriage by fea.

Colour, is a thick wine, of a very deep colour, ferving to dye the wines that are too pale, &c. as the black wine in ufe among vintners. See Wine *fupra*.

The method of converting white wines into red, fo much practifed by the modern wine-coopers, is this: put four ounces of turnfole rags into an earthen veffel, and pour upon them a pint of boiling water; cover the veffel clofe, and leave it to cool; ftrain off the liquor, which will be of a fine deep red, inclining to purple. A fmall proportion of this colours a large quantity of wine. This tincture might be either made in brandy, or mixed with it, or elfe made into a fyrup, with fugar for keeping. A common way with the wine-coopers is to infufe the rags cold in wine for a night or more, and then wring them out with their hands; but

but the inconveniency of this method is, that it gives the wine a difagreeable tafte, or what is commonly called the tafte of the rag, whence the wines, thus coloured, ufually pafs among judges, for preffed wines, which have all this tafte from the canvas rags in which the lees are preffed.

The way of extracting this tincture, as here directed, is not attended with this inconvenience; but it loads the wine with water; and if made into a fyrup, or mixed in brandy, it would load the wine with things not wanted, fince the colour alone is required. Hence the colouring of wines has always its inconveniences. In thofe countries which do not afford the tinging grape, which affords a blood-red juice, wherewith the wines of France are often ftained, in defect of this, the juice of elderberries is ufed, and fometimes logwood is ufed at Oporto.

The colour, afforded by the method here propofed, gives wines the tinge of the Bourdeaux red, not the Port; whence the foreign coopers are often diftreffed for want of a proper colouring for red wines in bad years. This might perhaps be fupplied by an extract made by boiling ftick-lack in water. The fkins of tinged grapes might alfo be ufed, and the matter of the turnfole procured in a folid form, not imbibed in rags. Shaw's Lectures, p. 211.

Chip Wine, is that poured on chips of beech-wood, to fine or foften it.

Rape Wine, is that put in a cafk half-full of frefh grapes picked for the purpofe, to recover the ftrength, brifknefs, &c. which it had loft by keeping, &c.

Burnt Wine, is that boiled up with fugar, and fometimes with a little fpice.

There is alfo a fort of Malmfey wine made by boiling of mufcadine.

Wines, *Condenfing of*, a phrafe ufed by Stahl, and fome other writers, to exprefs what is more ufually called the concentrating of them, that is, the freeing of them from the fuperfluous humidity which they contain, and by thefe means rendering them more rich and noble, freeing them from their taftelefs part, reducing them to a fmaller bulk, and thus making them fitter for tranfportation, and finally rendering them more durable in their perfect ftate, and much lefs fubject to the various accidents that make them decay. See Concentration.

Various methods have been attempted for the effecting of this, as by means of heat and evaporation, or by percolation, &c. and great objections found in the way of all of them, except the lateft, brought into ufe by Stahl, and fince recommended greatly to the world by Dr. Shaw in his Chemical Effays.

If any kind of wine, but particularly fuch as has never been adulterated, be, in a fufficient quantity, as that of a gallon or more, expofed to a fufficient degree of cold in frofty weather, or be put in any place where ice continues all the year, as in our ice-houfes, and there fuffered to freeze, the fuperfluous water that was originally contained in the wine will be frozen into ice, and will leave the proper and truly-effential part of the wine unfrozen, unlefs the degree of cold fhould be very intenfe, or the wine but weak and poor. This is the principle on which Stahl founds his whole fyftem of condenfing wine by cold.

When the froft is moderate, the experiment has no difficulty, becaufe not above a third or fourth part of the fuperfluous water will be frozen in a whole night; but if the cold be very intenfe, the beft way is, at the end of a few hours, when a tolerable quantity of ice is formed, to pour out the remaining fluid liquor and fet it in another veffel to freeze again by itfelf.

If the veffel, that thus by degrees receives the feveral parcels of the condenfed wine, be fuffered to ftand in the cold freezing place where the operation is performed, the quantity lying thin in the pouring out, or otherwife, will be very apt to freeze anew; and if it be fet in a warm place, fome of this aqueous part thaws again, and fo weakens the reft. The condenfed wine, therefore, fhould be emptied in fome place of moderate degree as to cold or heat, where neither the ice may diffolve, nor the vinous fubftance mixed among it be congealed. But the beft expedient of all is to perform the operation with a large quantity of wine, or that of feveral gallons, where the utmoft exactnefs, or the danger of a trifling wafte, needs not be regarded.

If the wine now once concentrated fhould, by a long continuance in the freezing cold, be again congealed to the utmoft (unlefs the cold were very fevere indeed), and then again be drained from its ice, there, foon after this, falls to the bottom of the veffel a pure white powder or tartar, and even the icy part afterwards depofits alfo a little of the fame fubftance after thawing; and after ftanding two or three days, there is always more and more of this tartar precipitated, and that conftantly the more in proportion as the wine was more auftere, or lefs adulterated with fugar, brandy, or the like; for thefe things contain no tartar.

The ice of the fecond operation on a quantity of wine differs in nothing from that of the firft, provided only that the wine was poured clear off from it, before the ice is fet to melt, by which means it diffolves into a clear phlegm. This fhews the excellency of the operation; as it lofes not its efficacy upon repetition, but brings away mere water as well at laft as at firft, without robbing the wine of any of its genuine or truly valuable parts. The remaining unfrozen liquor is a real concentrated wine, as appears by its colour, confiftence, tafte, and fmell, and is actually become a nobler and richer wine than could have been procured without fuch a contrivance.

This operation, though it be perfect in regard to wine, yet does not fucceed fo well in regard to the malt-liquors. The experiment has been fairly tried by Stahl on a gallon of ftrong malt-drink, and the fuccefs was as follows:—The ice feparated in the firft operation, when thawed by heat, refolved into a liquor of the colour and tafte of fmall-beer; and the fecond concentration afforded an ice of much the fame kind, which might have paffed for ordinary fmall-beer, but for a flafhy watery tafte that manifeftly predominated in it. The liquor unfrozen was but a pint and a half by meafure, but it was extremely rich and thick, and feemed very ftrong and fpirituous, and perfectly aromatic, or highly flavoured. The confiftence was fomething like that of a thin fyrup, and it had a pleafing foftnefs that fheathed the acrimony of the fpirit, and covered the bitter tafte of the hop.

The mucilaginous nature, which is predominant in all malt-liquors, occafions a great inaccuracy in this experiment, as not fuffering the water to run clear, or be feparated from the richer tincture of the malt, nor letting the condenfed liquor be obtained clean from the ice; but as the lofs occafioned by this is not great, and the liquor is much cheaper than wine, if this fhould ever come into ufe in the large way, the thawed liquor of the ice might be ufed again in a new brewing, and fo the lofs of that part of the ftrength which was carried away by the freezing be recovered.

Wines in general may by this method be reduced to any degree of vinofity or perfection. Thus, for example, if a wine of a moderate ftrength hath a third part of its water taken away, in form of ice, by congelation, the remaining part will thereby be doubled in ftrength and goodnefs: for if we allow, in the better forts of wine, that one-third part, which

which is near the truth, is truly good or vinous, and two-third parts are nothing but water, one-third part of the good wine being blended among the two-third parts of water, of no ftrength or value; it follows, that if one of thefe third parts of water be taken away, and all the wine left, that which was before but one-third wine, is now one-half wine, no way reduced in its ftrength, and therefore the whole muft be ftronger in that proportion.

But if this operation of congelation be carried to the utmoft, and be practifed on a large quantity of wine, and with a very intenfe cold, and the ice taken away feveral times, and the wine, thus freed from a part of its water, again and again expofed, it will be found that good wines will be reduced to one-fixth part of their original quantity: and the vintner will eafily find out the ufe of this remaining fixth part, which is a true quinteffence of wine, and will be of the utmoft benefit, by mixing it in fmall quantities with poor and low-flavoured wines, to meliorate and improve them; and even to convert the low-flavoured and leaft valuable ones into thofe very wines from which this condenfed part was procured.

This method is not practicable to advantage in the wine countries alone. Dr. Shaw affures us, that he has himfelf experimented it here, and with the ufe of proper freezing mixtures has reduced wines in England to a much fmaller quantity, in proportion to the whole, than in the ftrongeft of Stahl's experiments. It is evident, that by how much the quantity is fmaller, by fo much it is richer and ftronger, provided that the operation has been properly performed. The doctor affures us, the noble effence or rob, thus prepared, is capable of working almoft miracles, by turning water into wine, and the like; but that, in order to its fucceeding well, there requires great care in the operator, when the congelation is repeated the laft times. Shaw's Chem. Eff. Stahl's Schediafm. de Concentrat. Vin.

Wine, *Clarification of.* See Clarification, and Wine *fupra.*

Wine, *Colouring of.* See Wine *Colour*, and Wine *fupra.*

Wine, *Fining of.* See Fining, and Wine *fupra.*

This operation is practifed in Germany in the following manner: they have in fome vaults three or four ftoves, which they heat very hot: others make fires almoft before every vat; by which means the muft is made to ferment with great vehemence. When the ebullition, fermentation, and working ceafe, they let the wine ftand, and then rack it. This fining is only ufed in cold years, when the wine happens to be green.

Wine, *Forcing of.* See Forcing.

Wine, *Domeftic.* See Wine *fupra.*

In the Mufeum Rufticum we have the following directions for making raifin wine: put thirty gallons of foft water into a veffel at leaft one-third bigger than fufficient to contain that quantity; and add to it one hundred weight of Malaga raifins, grofsly picked from their ftalks. Mix the whole well together, and cover it partly with a linen cloth. When it has ftood a little while in a warm place, it will begin to ferment, and muft be well ftirred about twice in twenty-four hours, for twelve or fourteen days. When the fweetnefs is nearly gone off, and the fermentation much abated, which will be perceived by the fubfiding and reft of the raifins, ftrain off the fluid, preffing it, firft by the hand, and afterwards by a prefs, out of the raifins. Let this liquor be put into a found wine-cafk, well dried and warmed, adding eight pounds of Lifbon fugar, and a little yeaft, and referving part of the liquor to be added from time to time, as the decline of the fermentation will give room. In this ftate, the liquor muft remain for a month, with the bung-hole open; and having filled the veffel with the referved liquor, let it be clofely ftopped, and kept for a year or longer, and then bottled off. At the end of a year and a half it may be drank, but will improve for four or five years.

Some faving may be made in the expence, by diminifhing the quantity of raifins, and increafing that of the fugar, in the proportion of four pounds of raifins for one of fugar; or by diminifhing the proportion of both raifins and fugar, and adding clean malt-fpirits, when the bung of the cafk is clofed up. Any other large raifins may be ufed, as well as the Malaga; but the thinner the fkins and the fweeter the pulp, the ftronger will be the wine.

If this wine be perfectly fermented, and kept a long time, fo that no fweetnefs remain, it will refemble Madeira.

An artificial Frontignac may be made of this wine, in which the proportion of fugar or of malt-fpirits to the raifins is large, and the whole body weaker: the mufcadel flavour being communicated by an infufion of the flowers of meadow-fweet. In the making of this artificial Frontignac, the ferment fhould be ftopped, by clofing the cafk and adding the fpirit, while a confiderable degree of fweetnefs remains, and the wine may be drank after it has been a little while in the bottles.

Cyprus wine may be imitated by the fame means, ufing three or four pounds more of fugar than the quantity above prefcribed, and ftopping the fermentation while a confiderable degree of fweetnefs remains.

Artificial Mountain may be made by preferving a fmall degree of fweetnefs, giving the nut-like flavour, and keeping the beft kind of the above wine to a due age. The flavour may be obtained by the infufion of the Florentine orris-root, powdered, with a very fmall proportion of orange and lemon peel; and the wine may be rendered more dry or fweet, by continuing the fermentation for a greater or lefs time, and adding a correfponding proportion of clean malt-fpirits, when the fermentation is ftopped fooner. The adding of fome of the ftony feeds of the raifins well bruifed will give the nut-like flavour; and the putting in a part of the ftalks will add a fharpnefs, found generally in this kind of wine.

The racy tafte of Canary, commonly called fack, may be counterfeited by the addition of a proper quantity of the juice of white currant-berries to the wine, made with a large proportion of fugar to the raifins, and left very fweet in the fermentation. But it is faid that a fpirit, diftilled from the leaves of clary and clean malt-fpirits, put to the wine, will give it a very ftrong refemblance of fack. It is faid alfo, that the juice of the bramble-berries, added to the mixture of the wine, before the fermentation, will give both the colour and flavour of claret: but in this cafe the quantity of raifins fhould be confiderably diminifhed, and that of the fugar increafed, as the fermentation muft be continued till the fweetnefs be wholly deftroyed.

Wines of this kind fhould be kept at leaft a year before they are drank. See Sweets.

Wine, *Extemporaneous.* A hundred weight of good treacle will produce, according to the art of the diftiller, from four to feven gallons of pure alcohol; that is, from eight to fourteen gallons of the common-proof melaffes fpirit. The ftill-bottoms have many ufes. The diftillers fcald and recover their mufty cafks with them, and they may be ufed for all thofe purpofes of cleanfing where argol is required. Mr. Boyle's acid fpirit of wine, or a fpirit very like it, may alfo be procured from them, and a matter analogous

analogous to that Becher calls the *media fubftantia vini*. This liquor gives a durable extemporaneous wine.

Wine, *Stooming of*. See Stooming.

Wines, *Low*, in *Diftillation*, a term applied to the liquor which firft comes over, when the *wafh* is fubjected to diftillation, and which is concentrated by a fecond operation. See Distillation.

Wines, *Medicinal* or *Medicated*, in *Pharmacy*, a term applied to thofe preparations, confifting of wine holding different active ingredients in folution. They were formerly very numerous, but at prefent their number is very limited. See Vinum, under which article thofe at prefent in ufe are defcribed.

Wine, *Lees of*, are the impurities of it, or the thick fediment remaining at the bottom of the cafks, when the wine is drawn out.

The diftillation of wine-lees into fpirit is conducted very much in the fame manner with that of the malt-wafh, when diftilled with the mealy part in it: the principal difference is on this account, that the oil of the malt being very naufeous and difagreeable, the utmoft care is to be ufed to keep it back in all the proceffes of primary diftillation, and of rectification; whereas, on the other hand, the oil of the wine-lees being a very agreeable and pleafant one, as much care as poffible is to be taken to bring it over with the fpirit. Glauber has written a peculiar treatife on this fubject, in which, without touching upon the moft advantageous production of all, he has proved the work to be fo very profitable, that the whole ufually paffes for one of his wild flights, rather than a folid bufinefs.

The method of diftilling a liquid ley for its fpirit is a thing univerfally known; but the advantageous thing, on this bafis, is the diftilling of a dry ley preffed and preferved, and the managing of the bufinefs in fuch a manner as at firft or laft to procure and feparate all its valuable parts. The folid ley, here mentioned, is that ufually fold to the hatters in England, and is the fame thing that in France and other wine countries the vinegar-makers difpofe of in cakes, after they have preffed out all the wine, and which was afterwards burnt, and makes what Lemery and others call *cineres clavellati;* and the Englifh *gravelled afhes*, a fixed alkaline falt-like potafh.

This ley, when ufed for diftilling, fhould be that of the French wines, and either fuch as is newly preffed, or has been well fecured by packing in a clofe manner in tight cafks, with fome proper contrivance of dry fand, or the like, to keep its external furface from the contact of the air, which is very apt to corrupt or putrefy it.

If this ley is intended to be kept many months, it will be very proper to fecure it by fprinkling the layers as they are packed up with a little brandy. The expence of this is nothing, for the brandy is recovered again in the operation. Shaw.

Wine, *Oil of*, a very precious liquid, kept as a fecret in the hands of fome dealers in fpirits, and ufed to give the brandy flavour to fpirits of lefs price. It is certain that all the fpirits we ufe take their flavour from the effential oil of the fubftance they are made from; that of malt is very naufeous and offenfive, and renders the fpirit horribly difagreeable, if not carefully kept back in the diftillation of it; that of the grape, on the other hand, is extremely agreeable, and is what gives the delicious flavour to French brandy: this, therefore, is to be carefully brought over among the fpirits in diftillation.

This is that oil of wine fo much celebrated among our diftillers, and is for their ufe made feparate, and is of fuch effect, that half an ounce of it will determine a pure and clear malt fpirit to be French brandy, fo as to ftand the teft of the niceft palate, and all the trials that can be invented, provided the oil and the fpirit have both been carefully made.

The manner of making the oil is this: they take fome cakes of dry wine-lees, fuch as are ufed by our hatters, and diffolving them in fix or eight times their weight of water, they diftil the liquor with a flow fire, and feparate the oil by the feparating pot, referving for this nice ufe only that which comes over firft, the oil that follows being coarfer, and more refinous. To render this bufinefs perfectly fuccefsful, there muft be feveral things obferved: 1. The ley muft be of the right kind, that is, of the fame nature with the French brandy propofed to be imitated. 2. The malt-fpirit muft be extremely pure. 3. The dofe of the oil muft be very well proportioned. And, 4. The whole muft be artificially united into one fimple and homogene liquor. Thefe cautions all regard only the tafte, and befides thefe, in order to come up to a nice counterfeit, feveral other particulars muft be attended to; fuch as the colour, proof, tenacity, foftnefs, and the like; fo that, in fhort, the operation has too much nicety in it to be hit off by every ordinary dealer. When this fine oil of wine is procured, it may be mixed into a quinteffence, with pure diftilled alcohol, or the totally inflammable fpirit of wine, to prevent its growing diftafteful, rancid, or refinous; and thus it may be long preferved in full poffeffion of its flavour and virtues.

The ftill-bottoms, or remaining matter after the diftillation of this oil, will yield many productions to advantage, particularly tartar, and falt of tartar, as alfo an empyreumatic oil, and a volatile falt, like that of animals. Some kind of lees afford all thefe in much greater quantity than others; the lees of Canary and Mountain wines yield very little of them; and, indeed, fcarce any tartar or fixed falt at all; but the white French lees of thofe thin wines that afford the ordinary brandies, yield them all very copioufly, infomuch that fometimes a fingle hogfhead of dry and clofe-preffed lees will afford, by this procefs, three gallons of brandy, forty pounds of clean tartar, a large proportion of empyreumatic oil, and volatile falt, befide full four pounds of good falt of tartar. It is not to be expected, however, that every parcel of this ley fhould yield fully in this proportion. Shaw's Effay on Diftillery.

Wine, *Piece of*. See Piece.

Wine-*Prefs*, a machine contrived to fqueeze the juice out of grapes, and confifting of feveral pieces of timber, varioufly difpofed, which compofe three bodies of timber-work, clofely united to the axis, which ferves as a fwing, by which it may be moved by the vice. Of thefe there are different fizes as well as different conftructions.

Wine, *Prifage of*. See Prisage.

Wine, *Racking of*. See Rack, and Wine *fupra*.

Wine, *Spirit of*. See Spirit.

Wine-*Spirit*, a term ufed by our diftillers, and which may feem to mean the fame thing with the phrafe *fpirit of wine;* but they are taken in very different fenfes in the trade.

Spirit of wine is the name given to the common malt-fpirit, when reduced to an alcohol, or totally inflammable ftate; but the phrafe *wine-fpirt* is ufed to exprefs a very clean and fine fpirit, of the ordinary proof-ftrength, and made in England from wines of foreign growth.

The way of producing it is by fimple diftillation; and it is never rectified any higher than common bubble-proof. The feveral wines of different natures, yield very different proportions of fpirit; but in general the ftrongeft yield one-fourth, the weakeft in fpirits one-eighth part of proof-fpirit;

ſpirit ; that is, they contain from a ſixteenth to an eighth part of their quantity of pure alcohol.

Wines that are a little ſour ſerve not at all the worſe for the purpoſes of the diſtiller; they rather give a greater vinoſity to the produce. This vinoſity is a thing of great uſe in the wine-ſpirit, whoſe principal uſe is to mix with another that is tartarized, or with a malt-ſpirit, rendered alkaline by the common method of rectification. All the wine-ſpirits made in England, even thoſe from the French wines, appear very greatly different from the common French brandy; and this has given our diſtillers a notion that there is ſome ſecret art practiſed in France, for giving the agreeable flavour to that ſpirit; but this is without foundation.

When we diſtil Sicilian or Spaniſh wines, we do not produce Sicilian or Spaniſh brandies; and the true reaſon of this is, that the wines which they diſtil on the ſpot into brandy, are very different from thoſe which they export as wines.

Thoſe they diſtil are ſo poor and thin, that they will not keep many months, nor can poſſibly bear exportation. If we had in England thoſe poor wines they diſtil into brandy near Bourdeaux, Cognac, or up the Loire, there is no doubt that the ſpirit we made from them would be univerſally allowed to be French brandy. We have proof of this from ſome of the Scotch diſtilleries, where they, with no peculiar art, or ſecret method, procure from ſome of the poor pricked and damaged wines received here, brandy ſo nearly reſembling that of France, that a good judge will ſcarcely be able to make the diſtinction. Wine-ſpirits and brandies, therefore, are the ſame thing, only with this difference, that the former is the product of a rich wine, and the latter of a poor one; or, at the utmoſt, they differ only as our two home products, the cyder-ſpirit and the crab-ſpirit, do.

The wine-ſpirit, diſtilled in England, is not eaſy to be had pure and unmixed at our diſtillers, nor under a price almoſt equal to that of French brandy; ſo that if it ever be required out of the trade, it is as well to uſe the French brandy, which will, in all caſes, ſerve the ſame purpoſes, unleſs where a high flavour or a copious eſſential oil are required. All other ſpirits are carefully diveſted of their oil in the rectifications; but the wine-ſpirit is coveted only for its oil, and all that can be obtained is preſerved in this, its principal uſe being to give a flavour to a worſe ſpirit, and to cover the taſte of a diſagreeable oil in it.

When a caſk of wine chances to turn ſour in private hands, it is worth while to diſtil it for the ſpirit. The lees, alſo, if in any conſiderable quantity, will yield ſuch a proportion of the ſame ſort of ſpirit, as to render it worth while; and as the high flavour is not required in this intent, it will be beſt to draw off the ſpirit very gently, either by the cold or hot ſtill, and afterwards it may be rectified without any addition, and reduced to the ſtandard-ſtrength of proof. It thus makes a very clean and pleaſant ſpirit, though very different from the brandy from the ſame country whence the wine came. Shaw's Eſſay on Diſtillery. See SPIRIT.

WINE, *Philoſophic Spirit of*, in the writings of ſome chemiſts and phyſicians, a phraſe that often occurs as the name of a liquid prepared from wine, and endued with very remarkable properties.

It is generally ſuppoſed that this was the ſame ſort of liquor, which we at this time call by the name of ſpirit of wine; but this is a very erroneous opinion, and has led many into errors, about the operations in which it was concerned. It was truly no diſtilled liquor, but the ſpirituous parts of wine condenſed and concentrated by the freezing of the more aqueous part.

WINE *Vinegar, Method of making of.* See VINEGAR.

WINE, *Laws relating to.*

Wine may be imported only in Britiſh-built ſhips, or veſſels of the built of that country of which the wine is the produce, legally navigated; or in ſhips the built of the country in Europe under the dominion of the ſovereign or ſtate in Europe, of which the wine is the produce, or of the uſual place of ſhipping. Penalty, forfeiture of the wine and the ſhip. 12 Car. II. c. 18. and 27 Geo. III. c. 19.

No other than Rheniſh wine may be imported from the Netherlands or Germany, on forfeiture of ſhip and goods. 13 & 14 Car. II. c. 11. But wine, the produce of Hungary, may come from Hambro'; alſo wine, the produce of Hungary, the Auſtrian dominions, or any part of Germany, may come from the Auſtrian Netherlands, or any place ſubject to the emperor of Germany or houſe of Auſtria. 1 Ann. ſtat. 1. c. 12. and 22 Geo. III. c. 78. Wine may not be imported in veſſels under ſixty tons burthen: wine and veſſel forfeited. 24 Geo. III. c. 47. 26 Geo. III. c. 59. and 45 Geo. III. c. 121. Spaniſh and Portugal wines may not be imported in any caſk containing leſs than a hogſhead, except for private uſe. 18 Geo. III. c. 27. and 25 Geo. III. c. 69. French wine the ſame; and, except French wine in bottles, from France, Guernſey, Jerſey, or Alderney. 18 Geo. III. c. 27. and 27 Geo. III. c. 13. By the 5 Ann. c. 27. a hogſhead is to contain 63 gallons, or 231 cubical inches of wine. Wine (*i. e.* not Spaniſh nor Portugal) may not be imported in flaſks, bottles, or caſks, containing leſs than 25 gallons, except of the produce of the dominions of the grand duke of Tuſcany, in open flaſks, or any part of the Levant, and alſo wine for private uſe. 1 Geo. II. ſtat. 2. c. 17. and 25 Geo. III. c. 69. Wine may be imported in caſes containing ſix dozen reputed quart bottles at the leaſt. 39 & 40 Geo. III. c. 83. 42 Geo. III. c. 44. and 45 Geo. III. c. 121. Five reputed quart bottles deemed a gallon in charging duty. Wine not to be imported unleſs accompanied by a manifeſt, atteſted by the conſul at the place of ſhipment. 26 Geo. III. c. 40. Wine muſt be entered at the cuſtom-houſe and exciſe-office within 20 days after the ſhip has reported, or it may be ſold for the duties, and muſt be removed from the quays in 10 days. 26 Geo. III. c. 59. and 35 Geo. III. c. 118. Wine landed without payment of duty is forfeited (20 Geo. III. c. 59.); but wine may be warehouſed under ſchedule B, without payment at the time of entry of the duties due on importation, on the importer giving bond to export the ſame, or pay the duties within 12 months. But duty muſt be paid when taken out, on any exceſs or deficiency, from the quantity taken at the time of landing; and no wine to be warehouſed in caſks leſs than 45 gallons. 43 Geo. III. c. 132. Wine that has been warehouſed may be exported, and wine that has paid duty may be ſhipped for drawback; but muſt be packed in the preſence of the proper exciſe-officers, and the caſks to be ſealed with their official ſeals, and if they are afterwards damaged or broken, the party offending to forfeit 50*l.* for each caſk or package. Due notice to be given in writing of the times of packing and ſhipping. 26 Geo. III. c. 59. ſ. 46, 47. The exporter to give bond before ſhipping that the ſame ſhall be exported to the place entered for, and ſhall not be relanded or unſhipped. To be landed in Great Britain, on forfeiture. 26 Geo. III. c. 59. ſ. 48.

 35 Geo.

35 Geo. III. c. 118. Wine may be exported to Douglas, in the Isle of Man, in British vessels of 50 tons, by licence of the commissioners of the customs. 52 Geo. III. c. 140.

All the duties paid upon wine shipped for the actual consumption of officers of the navy on board ship, to be drawn back according to the following proportions. 33 Geo. III. c. 48.

	Tons.
Admiral	6
Vice-admiral	5
Rear-admiral	4
Captain of a first and second rate	3
Captain of a third, fourth, and fifth rate	2
Captain of every inferior ship	1
Lieut. and other officer in commission	$0\frac{1}{2}$

Officers of marines to be allowed half a ton *per annum.* 53 Geo. III. c. 44. But to be shipped only at the ports of London, Rochester, Dover, Dartmouth, Portsmouth, &c. Officers may remove their stock from one ship to another, and dispose of it to other officers. 38 Geo. III. c. 33.

Dealers in foreign wine to enter their premises at the excise-office, on penalty of 100*l.* for every place not entered, and forfeiture of the wine found therein. 26 Geo. III. c. 59. s. 12. Dealers to have the words 'Dealers in foreign Wines' painted over their doors, on penalty of 50*l.* sect. 15. Retailers to have the word 'Wine' exhibited in some conspicuous part of their premises, on penalty of ten shillings. 30 Geo. II. c. 19. and 32 Geo. II. c. 19. Dealers to take out a licence, to be renewed ten days before the expiration of every year, on penalty of 100*l.*; but not to apply to auctioneers selling wine by auction. 26 Geo. III. c. 59. Retailers of foreign wines, and dealers in sweets or British wines, to take out licences also; and selling them after its expiration, and before renewed, subjects them to 50*l.* penalty. 30 Geo. III. c. 18. Retailers not to sell wine in their houses, unless they have a beer licence granted by the magistrates, on penalty of 20*l.* (See ALE-*Houses.*) Officers may enter at any time to take an account of the stock, but if they go in the night they must be attended with a constable. The party refusing them admittance, or obstructing them, forfeits 100*l.* 26 Geo. III. c. 59. s. 17. No wine to be brought into a dealer's possession without a permit, and dealers to mark on a conspicuous part the content of each cask. 26 Geo. III. c. 59. s. 32. Any excess in dealer's stock from the account last taken, after deducting the quantity sold and entered in their books, deemed not to have paid duty, and is forfeited, and double the value. 26 Geo. III. c. 5. s. 59. 27 Geo. III. c. 31. Different kinds of wine and liquors, (cyder, spirits, &c.) to be kept separate. 26 Geo. III. c. 59. 42 Geo. III. c. 93. And no dealer in foreign wine to have any sweets or British wines in his possession. Penalty 10*s.* *per* gallon. 26 Geo. III. Account of wine daily sold to be kept, and no quantity above three gallons to be removed without permit, on forfeiture of the same, and the carriage and horses. 26 Geo. III. c. 59. 42 Geo. III. c. 95. Wine, in possession of persons *not* dealers, may have permits granted for its removal, on proving to the satisfaction of the commissioners of excise, or the collector or supervisor of the district, that the duties have been paid. 26 Geo. III. c. 59. s. 33. Permits not used to be returned to the officer, on penalty of treble the value of the wine. 26 Geo. III. c. 59. s. 37, 38; and persons forging or counterfeiting them to forfeit 500*l.* Ibid. sect. 39.

For the laws relating to low wines and domestic wines, see DISTILLER, and SWEETS.

WINE *of Squills.* See SQUILLS.

WINE-*Measure.* See MEASURE, and *Laws relating to* WINE *supra.*

WINE-*Fly*, in *Natural History*, the name of a small black fly, found in empty wine-casks, and about wine-lees, and called by the Latins, *Bibio.*

It is produced of a small red worm, very common in the sediment of wine.

The drippings of wine or beer vessels, the pressings of the wine or cyder press, the pots in which honey has been kept, and in which a little remains sticking to the sides, and turning sour, all afford vast numbers of a small species of worm or maggot. This is of a white colour, and has two hooks placed near the head; in short, it resembles in all the parts the maggot of the common flesh-fly. Multitudes of these small creatures live and move very briskly about in these substances for several weeks together; but at the end of that time, when they have arrived at their full growth, they enter into the nymph-state under a covering or case made of their own skin, which dries, and becomes of a brown colour. After eight or ten days in this state, the case is opened by the falling off of a small piece at the end, and the fly makes its way out. The fly is extremely small when its wings are not extended.

It does not exceed the size of the head of a middling pin; it is however very beautiful; the breast and body are yellow, the reticulated eyes are red, and the wings have all the rainbow-colours. The best way of procuring these little flies, which make a very beautiful microscope object, is to keep the matter, in which the worms are placed, in a glass, covered down with a paper; as soon as the cover is taken off, at the time of their being in the fly-state, they rise up at once in the form of a cloud; enough of them for observation will however remain about the sides of the vessel. When examined, they are found to have all the regular parts of the larger flies; their antennæ are oval and flatted, and their legs, and every other part, are as elegantly perfect, as they are seen to be in the most elegant large fly.

It is not known whether they are oviparous or viviparous; but this is to be observed, that they give us great light into the origin of animalcules in different fluids.

Since we see in these the evident course of nature in their origin, what prevents but that there may be numbers of flies yet smaller then these, whose eggs may be deposited in the fluids in which we find our microscope animalcules. Reaum. Hist. Inf. vol. ix. p. 82.

WINEBAGO, in *Geography*, a lake of North America. N. lat. 43° 50′. W. long. 87° 46′.

WINEBAGO *River*, a river of America, which runs from Winebago lake to Green bay into lake Michigan. The Winebago Indians inhabit near this river and lake, in about N. lat. 43° to 44°. W. long. 84° to 89°.

WINEBAGOES CASTLE, an Indian settlement in North America, near Winebago lake.

WINEE or BLACK RIVER, a river of South Carolina. See BLACK *River.*

WINERSTA, a town of Sweden, in East Gothland; 18 miles N.W. of Linkioping.

WING, in *Botany* and *Vegetable Physiology*, is generally used for any appendage to a seed, which serves to assist in its flight through the air. In this sense, the feathery crown of the Dandelion, and other syngenesious plants; the membranous expansion at the top of the scabious seed, so curiously and variously constructed in different species; the long feathery awn of the *Stipa;* and the delicate silky plumage

plumage of many feeds among the order of *Contortæ*, are juftly denominated wings. In a more limited and technical fenfe, the *Ala*, or wing, properly fo called, is a thin membranous expanfion, enabling the feeds to flutter to a fmall diftance from their native capfule, rather than to fly very far. Such is found in EMBOTHRIUM, GREVILLEA, BANKSIA, CONCHIUM, (fee thofe articles,) as well as in our Englifh genera RHINANTHUS and SPERGULA; in the latter we believe this part to vary, in degree at leaft. Gærtner meant to confine the term *ala* to a membranous expanfion of the upper part of a feed, or feed-veffel, but he has not adhered to this intention. Winged capfules, which do not burft, are feen in the Afh and the Maple. One which does burft occurs in the curious exotic genus BEGONIA. The feeds of fome umbelliferous plants, as THAPSIA, have feveral wings; thefe are always lateral and longitudinal in that natural order; but it is far more general for them to be folitary. When the wing encompaffes the feed, as in the beautiful inftance of *Bignonia echinata*, figured in Gærtner, t. 52, that author properly adopts the term *ala*, and yet the expanfion to which it applies is really a *margo membranaceus*, (membranous expanfion,) furrounding the feed entirely, except at the very bafe.

The appellation of wing is given alfo to any membranous or leafy dilatation of a footftalk, or of the angles of a ftem, branch, or flower-ftalk, as well as of a calyx. The wings of a papilionaceous *corolla* are the two lateral petals, both alike, which embrace the bafe of the keel, and are fheltered by the ftandard. Thefe fpread remarkably in fine weather. They differ greatly in fize and fhape in different genera. See PAPILIONACEÆ.

WING, in *Geography*, a village of England, in Buckinghamfhire, with 993 inhabitants; 7 miles N.E. of Aylefbury.—Alfo, a town of Sweden, in Weft Gothland; 40 miles E. of Gotheburg.

WING, in *Ornithology*. See FEATHER, and FLYING.

The wings are adapted for flight in all birds, except the dodo, oftriches, great awk, and the penguins, whofe wings are too fhort for the ufe of flying: but in the dodo and oftrich, when extended, they ferve to accelerate their motion in running; and in penguins perform the office of fins, in fwimming or diving. The wings have near their end an appendage covered with four or five feathers, called the *baftard* wings: the leffer coverts are the *tectrices:* the greater coverts are thofe which lie beneath the former, and cover the quill-feathers and the fecondaries. The quill-feathers, or *primores*, fpring from the firft bones of the wings, are ten in number, and broader on their inner than exterior fides: the fecondaries are thofe that arife from the fecond part, or cubitus, are about eighteen in number, and equally broad on both fides. The primary and fecondary wing-feathers are called *remiges*. The tertials are a tuft of feathers placed beyond the fecondaries, near the junction of the wings with the body. This, in water-fowl, is generally longer than the fecondaries, and cuneiform. The fcapulars are a tuft of long feathers arifing near the junction of the wings with the body, and lie along the fides of the back, but may be eafily diftinguifhed, and raifed with one's finger. The inner coverts are thofe that clothe the under fide of the wing.

The wings of fome birds are inftruments of offence: the anhima of Marcgrave has two ftrong fpines in the front of each wing; a fpecies of plover has a fingle one on each; as have alfo the whole tribe of jacana, and the gambo, or fpur-winged goofe of Willughby. Pennant's Genera of Birds, pref. p. 4.

WINGS, among the *Fly-clafs*, afford feveral fubordinate diftinctions of the genera of thofe animals, under the ancient general claffes.

Several fpecies of flies, while they are in a ftate of reft, or only walking, fhew feveral regularly diftinct manners of carrying their wings. The much greater numbers, however, carry them in a parallel or plain pofition: fome being perpendicular to the length of the body without covering it, others covering the body without covering one another: the wings of others crofs one another on the body of the animal, fome of which round themfelves there, the upper wing being more elevated on the middle of the body than on the fides. Some flies have their wings placed on their backs, and applied againft one another, in a perpendicular pofition: the wings of others are applied obliquely againft their fides, and meet above the body of their inner edges, forming a kind of hollow roof under which the body is placed; others form at their junction on the back a flat depreffed roof, and others have them meeting under their bellies.

The ftructure of the wings of different flies might alfo furnifh matter of farther diftinctions. The greater part of them are of a fine ftructure, and reprefent the fineft gauze, and are equally tranfparent, or nearly fo, in all parts. Some flies, however, have wings of a lefs degree of tranfparence, and fome even opaque ones. Others of the four-winged flies have obfcure fpots alfo diftributed near their very tranfparent texture; fuch are the wings of the fcorpion-fly; and fome of the two-winged flies have wings partly opaque, partly pellucid, the opaque fpots being feparated by tranfparent lines. Reaumur's Hift. Inf. vol. iv. p. 136, &c.

WINGS *of Butterflies*. The beautiful wings of this genus of infects are diftinguifhed from thofe of the fly-kind, by their not being thin and tranfparent, like them, but thicker and opaque. This opacity in them is owing only to the duft which comes off from them, and fticks to the fingers in handling them, and it is alfo to this duft that they owe all their beautiful variety of colours. The earlier naturalifts, for this reafon, diftinguifhed thefe infects by the appellation of fuch as had farinaceous wings. The ufe of the microfcope has taught us, that this duft is not the refult of fome other fubftance broken into fragments; but every particle of it is a regularly figured body, made for the place and order it has in the covering of the wing.

The feveral fpecies of butterflies, and even the different parts of the fame wing, afford thefe bodies of different fhapes and figures. Moft of the authors who have written of microfcopic objects, have given the figures of the principal varieties of thefe; but no one has given fo many as Bonani in his Micrographia, in which work the figures of the various kinds take up four quarto plates.

It has been the general cuftom of authors to call thefe feathers; but they are by M. Reaumur, with much greater juftice, called fcales. Their ftructure has no refemblance to that of feathers, for they are little flat and thin bodies, of more or lefs length, and always having a fhort pedicle which enters into the fubftance of the wing.

When the wing of a butterfly is viewed by a microfcope, the arrangement of thefe feveral bodies in it is feen to be extremely beautiful and regular. The fcales lie as regularly and evenly one over another, as the tiles on a houfe or the fcales on the fifh-kind, every feries of them covering a fmall part of that feries which runs below it. The upper and under part of the wing are equally furnifhed with thefe, and there is no fpecies of this creature, in every wing of which there are not feveral figures of thefe fcales in feveral parts.

The

The ſtructure of the wing itſelf which ſupports theſe ſeveral ſcales, hairs, &c. is very worthy our attention. In order to examine this, it is neceſſary to rub off all the duſt or ſcales. We then find that the wing itſelf is framed of ſeveral large and ſtrong ribs, which all take their origin at that part where the wing is fixed to the body, and thence extend themſelves along the ſeveral ſides of the wing. The largeſt and thickeſt of theſe ſurrounds the outer edge of the wing, the largeſt next to this extends itſelf round the interior edge, and the others direct their courſe along the middle of the wing, and then divaricate, and become ramified in the manner of the ribs in the leaves of plants. The ſubſtance which connects and fills up the ſpaces between theſe ribs, is of ſo peculiar a nature, that it is not eaſy to find any name to deſign it by, at leaſt there is no ſubſtance that enters the compoſition of the bodies of the larger animals, that is at all analogous to it: it is a white ſubſtance, tranſparent and friable, and ſeems indeed to differ in nothing from that of the large and thick ribs, but in that it is extended into thin plates; but this is ſaying but little toward the determining what it really is, ſince we are as much at a loſs to know by what name to call the ſubſtance they are compoſed of. Malpighi, indeed, calls them bones; but though they do ſerve in the place of bones, rendering the wing firm and ſtrong, without making it heavy, and are, when cut tranſverſely, found to be hollow; yet, when ſtrictly examined, they do not appear to have any thing of the ſtructure of bones, but appear rather of the ſubſtance of ſcales, or of that ſort of imperfect ſcales, of which the covering of thoſe inſects which we call cruſtaceous is compoſed.

The wings of butterflies, thus large, and thus light, are very well able to ſuſtain them a long time in the air, and thus they might be expected to fly better than moſt other inſects; but many people have obſerved the irregular manner in which theſe inſects uſually fly, which is not ſtraight forward, but up and down, and to one ſide and the other: this has been ſuppoſed owing to ſome imperfection of the wings; but, in reality, it is their great perfection that enables the creatures to do this, and this manner of flying is abſolutely neceſſary to the preſervation of their life, as birds of many kinds are continually after them while they are on the wing; and it is a pleaſant ſight to obſerve in what manner this ſort of dodging motion in the butterfly diſappoints the bird that flies ſtraight at it, and often preſerves it ſafely for a long way together.

The beautiful variety of colours, ſeen in the wings of theſe inſects, is owing to the ſcales and feathers. Reaumur's Hiſt. Inſ. vol. i. part i. p. 255, &c.

Wings *of Gnats*. Theſe are of a very curious ſtructure, and well worthy the uſe of the microſcope, to ſee them diſtinctly.

It is well known that on touching the wings of butterflies, a coloured powder is left on the fingers, which, though to the naked eye it appear a mere ſhapeleſs duſt, yet when examined by the microſcope, it is found to be very regularly-figured beautiful bodies, encompaſſed with a furbelow of long feathers, and with veins or ribs that ſeem to ſtrengthen them, in form of feathers or ſcales, or ſometimes beſet with prickles: theſe are of various figures, and all of them very elegant. The generality of flies have nothing of this kind; but the cloſe examination of the wings of the gnat will ſhew, that they are not wholly deſtitute of them; they are much more ſparingly beſtowed indeed upon the gnat than on the butterfly, but then they are arranged with great regularity. Between the ribs of the wings there is extended a very thin tranſparent membrane, full of little black ſharp-pointed hairs, ranged throughout with the utmoſt regularity. The wings in different ſorts of gnats are very different: ſome have a border of long feathers, others of ſhort ones, and others have none at all. Reaumur's Hiſt. Inſ. vol. iv. p. 577. Baker's Microſc. 8vo. 1743, p. 204.

Wings, *Warbling of the*. See Warbling.

Wings, in *Heraldry*, are borne ſometimes ſingle, ſometimes in pairs, in which caſe they are called *conjoined;* when the points are downward, they are ſaid to be *inverted;* when up, *elevated.*

Wings, in *Gardening*, &c. denote ſuch branches of trees, or other plants, as grow up aſide of each other.

Quintiny ſays, the term is particularly applied to artichokes, whoſe wings, or *alæ*, are the leſſer heads, or fruits, that grow up with the principal one on the ſame ſtalk.

Wings, *Alæ*, in the *Military Art*, are the two flanks, or extremes of an army, ranged in form of battle; being the right and left ſides thereof, and including the main body.

The cavalry are always poſted in the wings, *i. e.* on the flanks, on the right and left ſides of each line; to cover the foot in the middle.

Pan, one of Bacchus's captains, is ſaid to have been the firſt inventor of this method of ranging an army; whence, ſay they, it is, that the ancients painted him with horns on his head; what we call wings, being by them called *cornua*, *horns*. This at leaſt is certain, that the method of arranging in wings is very ancient. The Romans, we know, uſed the term *alæ*, or wings, for two bodies of men in their army; one on the right, the other on the left, conſiſting each of four hundred horſe, and four thouſand two hundred foot uſually, and wholly made up of confederate troops. Theſe were deſigned to cover the Roman army, as the wings of a bird cover its body.

The troops in theſe wings they called *alares*, and *alares copiæ;* and we, at this day, diſtinguiſh our armies into the *main body*, the *right* and *left* wings.

Wings are alſo uſed for two files, that terminate each battalion, or ſquadron, on the right and left. The pikes uſed to be ranged in the middle, and the muſqueteers in the wings.

Wings, in *Fortification*, denote the longer ſides of hornworks, crown-works, tenailles, and the like outworks, including the ramparts and parapets, with which they are bounded on the right and left, from the gorge to their front.

Theſe wings, or ſides, are capable of being flanked, either with the body of the place, if they ſtand not too far diſtant, or with certain redoubts; or with a traverſe made in the ditch.

Wings, in a *Ship*, the places next the ſide upon the orlop, uſually parted off in ſhips of war, that the carpenter and his crew may have free acceſs round the ſhip in time of action, to plug up ſhot-holes, &c.

Wings are alſo the ſkirts or extremities of a fleet, when it is ranged into a line a-breaſt, or when bearing away upon two ſides of an angle.

It is uſual alſo to extend the wings of a fleet in the daytime, in order to diſcover any enemy which may fall into their track. To prevent ſeparation, however, they are commonly ſummoned to draw nearer to the centre of the ſquadron before night, by a ſignal from the commander-in-chief, which is afterwards repeated by ſhips in the intervals. Falconer.

Wing-*Tranſom*, the uppermoſt tranſom in the ſtern-frame of a ſhip, &c., upon which the heels of the counter-timbers are reſted. It is by ſome called the main-tranſom.

Wings,

WINGS, *Goofe.* See GOOSE.

WING, *St. Michael's*, is the name of a military order in Portugal, inftituted, according to the Jefuit Mendo, in 1165; or, according to di Michieli, in his Teforo Militar. de Cavalleria, in 1171. Its inftitutor was Alphonfus Henry I. king of Portugal; and the occafion was a victory gained by him over the king of Savil, and his Saracens; for which he thought himfelf beholden to St. Michael, whom he had chofen for his patron in the war againft the infidels.

The banner they bore was a wing refembling that of the archangel, of a purple colour, encompaffed with rays of gold. Their rule was that of St. Benedict; the vow they made was to defend the Chriftian religion, and the borders of the kingdom, and to protect orphans. Their motto, *Quis ut Deus!*

WING-*Walls*, of a bridge or lock, are fplaying-walls for diminifhing the width of the canal to fuch bridge or lock, and for keeping up the banks.

WINGE, in *Geography*, a river of France, which runs into the Demer, 2 miles W. of Arfchot.

WINGED, in *Botany*, a term applied to fuch ftems of plants as are furnifhed, all their length, with a fort of membranous appendage.

Several kinds of thiftles have winged ftalks and branches.

WINGED *Leaves* are fuch as confift of divers little leaves, ranged in the fame direction, on each fide of a rib or ftalk, fo as to appear no more than one and the fame leaf. Such are the leaves of agrimony, acacia, afh, &c. See WING.

WINGED *Seeds* are fuch as have down or hairs on them, by which the wind taking hold blows them to a diftance.

WINGED *Stalk.* See STALK.

WINGED, in *Heraldry*, is applied to a bird when its wings are of a different colour, or metal, from the body.

Winged is alfo applied to any thing reprefented with wings, though contrary to its nature; as *winged* or *flying hart*, &c.

WINGER, in *Geography*, a town of Norway, in the province of Aggerhuus; 2 miles S. of Kongfwinger.

WINGHAM, a village and parifh in the hundred of its own name, and lathe of St. Auguftine, in the county of Kent, England, is fituated 34 miles E. from Maidftone, and 62 E. by S. from London. A college of a provoft and fix fecular canons was projected here by Kilwardby, archbifhop of Canterbury, but fettled and endowed by his fucceffor, Peckham, in 1286. It was valued at 84*l. per annum* at the general fuppreffion. By Edward VI. the college, with the patronage of the church and all tythes, were granted to fir Henry Palmer. The building, now called the college, and which formed the manfion of the Palmers, appears to have been the provoft's lodge. The church contains memorials of the Palmers and the Oxendens, who have a feat at Deane, in the parifh. A double row of ftalls ftill exifts in the chancel. Wingham gives a title to earl Cowper, who, however, has no eftate in the parifh. It gave birth to Henry de Wingham, chancellor of England, bifhop of Winchefter, and afterwards of London. In 1811 the inhabitants of the parifh were 859, who occupied 162 houfes.—Beauties of England, Kent, by E. W. Brayley.

WINGHAM'*s Ifland*, a fmall ifland in the North Pacific ocean, near the W. coaft of North America; 3 miles N.W. of Kaye's ifland. N. lat. 60° 4′. E. long. 215° 46′.

WINGROD, a town of Auftrian Poland, in Galicia; 16 miles N.W. of Sniatyn.

WINHALL, a townfhip of Vermont, in the county of Bennington, with 429 inhabitants; 30 miles N.E. of Bennington.

WININGEN, a town of France, in the department of the Rhine and Mofelle, on the N. fide of the Mofelle; 5 miles W. of Coblentz.

WINKEL, a town of France, in the department of Mont Tonnerre; 14 miles W. of Mentz.

WINKELMAN, *Abbé* JOHN, in *Biography*, a German antiquary, was born at Stendal, in the Mark of Brandenburg, in 1718. Although born in very humble life, he fortunately enjoyed favourable opportunities of cultivating his talents in that department in which he afterwards attained to eminence. He had arrived at the age of 37 years before he was known to the public as an author. His firft work was "Reflections on the Imitation of the Greeks in Painting and Sculpture;" and it was received in a manner that very much contributed to eftablifh his reputation. At the court of Auguftus, king of Poland, he was profelyted to the Catholic faith, more, as fome have faid, by arguments addreffed to his worldly intereft, than to his fpiritual welfare. It is certain, however, that he much wifhed to vifit Italy for the fake of examining thofe mafterpieces of art that were to be found in that country. With this view he left Drefden, and in paffing through Florence in 1756, he made a defcriptive catalogue of the antiquities in the collection of the celebrated baron de Stofch, which feemed to introduce him with advantage to Rome, whither he proceeded towards the clofe of this year. His acquaintance with the famous painter Mengs, Bianconi, and feveral other ingenious artifts, forwarded his accefs to two of the moft celebrated literary men at Rome, cardinal Paffionei and the prelate Giaconelli; from whofe library and learning he derived much ufeful information, fo that he was foon acknowledged as a man of fine tafte, and a diftinguifhed connoiffeur in works of art. Affuming the ecclefiaftical habit, he fucceeded the abbé Venuti as keeper of the pope's cabinet of antiquities; and he was alfo appointed copyift in the library of the Vatican. Under the patronage of the pope, who increafed his income out of his privy-purfe, he completed his Hiftory of Art among the Ancients, and then left Rome in 1768 to vifit his friends in Germany, and to revife his work to be tranflated into French by M. Touffaint of Berlin. On his return to Rome by way of Triefte, he was affaffinated, in June 1768, by a wretch who had joined him on the road, and who had fo far gained his confidence, that he had fhewn him fome gold medals and valuable prefents which he had received at Vienna. "Abbé Winkelman," fays one of his biographers, "was of the middle fize, with a very low forehead, a fharp nofe, and black hollow eyes, which gave him rather a gloomy appearance. An ardent and impetuous difpofition often hurried him into extremes. Naturally enthufiaftic, he frequently indulged an extravagant imagination; but as he poffeffed a ftrong and folid judgment, he knew how to give things their juft value. In confequence of this turn of mind, as well as a neglected education, he was a ftranger to cautious referve. If he was bold in his decifions as an author, he was ftill more fo in his converfation, and often made his friends tremble for his temerity." The tranflation of his Hiftory of the Arts was completed only in part by Touffaint. Another French tranflation was publifhed by Huber, profeffor at Leipfic. It is faid that the laft French tranflation is far preferable to the firft, as it was made from an enlarged edition of the original, printed at Vienna in 1776, after a MS. left by the author. Among the other works of Winkelman were, "Letters on the Difcoveries made at Herculaneum," tranflated into Englifh by Mr. Gough; "Unpublifhed Monuments of Antiquity, fuch as Statues, ancient Paintings, engraved Stones, Bas-Reliefs, in Marble and

and Terra Cotta," of which there is a French tranflation from the Italian, Paris, 1808, 3 vols. 4to. with plates; "On Allegory, or Treatifes on that Subject," 2 vols. 8vo.; and "Remarks on the Architecture of the Ancients," 8vo. Winkelman's "Letters to his Friends" were publifhed in German, in 2 vols. 8vo., with an account of his life prefixed by Heyne. Nouv. Dict. Hift. Gen. Biog.

WINKOOP'S BAY, or *Wine Cooper's Bay*, in *Geography*, a large bay on the fouth coaft of Java. S. lat. 7° 5'. E. long. 106° 38'.

WINKOOP'*s Ifland*, a fmall ifland near the fouth coaft of Java. S. lat. 7° 28'. E. long. 106° 36'.

WINKOOP'*s Point*, a cape on the fouth coaft of Java. S. lat. 7° 25'. E. long. 106° 36'.

WINLATON, a townfhip of Durham; 6 miles W. of Newcaftle.

WINNEBAGO. See WINEBAGO.

WINNENBURG, a citadel of France, in the department of the Sarre, which heretofore gave name to a lordfhip within the archbifhopric of Treves; 1 mile N.W. of Cocheim.

WINNENDEN, a town of Wurtemberg. In the year 1693, this town was laid in afhes by the French; 12 miles E.N.E. of Stuttgart. N. lat. 48° 53'. E. long. 9° 30'.

WINNICZA, a town of Poland, in the palatinate of Braclaw; 32 miles N.N.W. of Braclaw.

WINNING OF HAY, in *Agriculture*, a term fometimes applied to the operation of making hay in certain ftates of the weather. See HAY-*Making*.

WINNINGE, in *Geography*, a river of Lancafhire, which runs into the Lune, 6 miles N.E. of Lancafter.

WINNINGEN, a town of Weftphalia, in the principality of Halberftadt; 4 miles N. of Afcherfleben.

WINNIPEG, or WINIPIC, a lake of Upper Louifiana, being the great refervoir of feveral large rivers, and fuppofed to be the largeft of the inland feas, near the heads of the Miffiffippi, which difcharges itfelf by the river Nelfon into Hudfon's bay. It is connected with other lakes to the N.W., and has, from the rivers entering into it, an inconfiderable portage to the waters of lake Superior. This lake is faid to be 240 miles in length, and from 50 to 100 in breadth, though in fome places it is hardly five. N. lat. 52° 10'. W. long. 97° 30'.

WINNIPEG or *Winipic River*, a large body of water, interfperfed with numerous iflands, caufing various channels, and interruptions of portages and rapids. The lake Du Bois difcharges itfelf at both ends of an ifland, on which is the carrying-place out of the lake, and which is named Portage du Rat, in N. lat. 49° 37', and W. long. 94° 25', about 50 paces long, and forms this river. In fome parts, the river has the appearance of lakes, with fteady currents: its winding courfe to the Dalles is eftimated at 8 miles; to the Great Décharge $25\frac{1}{2}$ miles, which is a long carrying-place for the goods; from thence to the Little Décharge $1\frac{1}{2}$ mile; to the Tunejaûne Portage $2\frac{1}{2}$ miles; then to its galet or rocky portage, 70 yards; $2\frac{3}{4}$ miles to the Tune Blanche, near which is a fall of from four to five feet; $3\frac{1}{2}$ miles to Portage de l'Ifle, where is a trading port, and about 11 miles on the N. fhore a trading eftablifhment, which is the road, in boats, to Albany river, and from thence to Hudfon's bay. There is alfo a communication with lake Superior, through what is called the Nipigoes country, that enters the lake Winipic above 35 leagues E. of the Grande Portage. Mackenzie's Voyages, &c. Introd. p. 60.

WINNIPEG, *Little*, a lake of North America, 80 miles long and 15 wide. N. lat. 52° 10'. W. long. 100° 15'.

WINNIPISIOGEE, or WINNIPISSIOKEE, a lake of New Hampfhire; 80 miles N. of Bofton. N. lat. 43° 35'. W. long. 71° 18'.

WINNOW, in *Agriculture*, fignifies to fan, or feparate corn from the chaff by wind.

WINNOWING, and WINNOWING-*Machine*. See FAN-*Machine*, and THRESHING-*Machine*.

WINNSBOROUGH, in *Geography*, a town of South Carolina; 30 miles N. of Columbia. N. lat. 34° 28'. W. long. 81° 15'.

WINNY HAY, in *Agriculture*, a term applied to hay in fome conditions of it. See HAY.

WINSCHOTE, or WINSCHOTTEN, in *Geography*, a town of Holland, in the department of Groningen, near which the Spaniards were defeated by Louis, brother to the prince of Orange, on the 24th of May 1568. The Spaniards loft 2500 men, all their baggage, and fix pieces of cannon. This was the firft battle fought on account of the Revolution, and gave the prince a happy prefage of fuccefs; 19 miles E. of Groningen.

WINSDER, a river of Norfolk, which runs into the Yare, 12 miles W.N.W. of Norwich.

WINSEN AM DER ALLER, a town of Weftphalia, in the principality of Luneburg, on the Aller; 6 miles below Zell.

WINSEN *am der Luhe*, a town of Weftphalia, in the principality of Luneburg, on an ifland in the lake; 12 miles S.E. of Hamburg.

WINSLOW, JAMES BENIGNUS, in *Biography*, an eminent anatomift, was born in 1669 at Odenfee, in the ifle of Funen, and having ftudied a year under Borrichius, was fent with a penfion from the king of Denmark to feek improvement in the principal univerfities of Europe. In 1698 he became a pupil of the celebrated anatomift Duverney at Paris, and during his refidence in this capital, he abjured Proteftantifm, and was confirmed by Boffuet, affuming in addition to his own baptifmal name that of his converter, Benignus. Haller denominates Winflow "fimple and fuperftitious," and of courfe his converfion to the Catholic faith afforded no great occafion for triumph. This event, however, detached him from his family and native country, and was the means of fixing his abode in France, where the patronage of Boffuet was highly favourable to his advancement, and ferved to obtain for him the degree of doctor in 1705. In 1707 Duverney recommended him to be an elève of anatomy in the Academy of Sciences. He afterwards read lectures of anatomy and furgery for Duverney at the royal garden; and in 1743 was promoted to the profefforfhip in this inftitution. In the meanwhile, he communicated feveral papers on anatomical and phyfiological fubjects to the Academy of Sciences, by which body, as well as by the Royal Society of Berlin, he was admitted into the number of affociates. His great work, mentioned by Haller as fuperfeding all former compofitions of anatomy, and entitled "Expofition Anatomique de la Structure du Corps Humain," firft appeared at Paris in 1732, 4to. It was frequently reprinted, and tranflated into various languages; and is ftill regarded as of ftandard authority. Winflow planned, but never finifhed, a larger work, of which this was merely an abridgment, and he was alfo the author of difputations and treatifes on particular topics. He died in 1760 at the advanced age of 91. Haller. Eloy. Gen. Biog.

WINSLOW, in *Geography*, a market-town in the county of Buckingham, England, $6\frac{3}{4}$ miles from Buckingham, and 51 N.W. from London. The market, now inconfiderable, was granted in 1235 to the abbot of St. Alban's, lord of the manor,

manor, by king Offa. The manor is now the property of William Selby, efq., who has a feat in the town. The parifh-church, a fpacious ftructure confifting of a nave, two aifles, a chancel, and a tower, contains no monuments of note. According to the population return of 1811, the houfes in the parifh were 223, and the inhabitants 1222. Here is a fmall market on Thurfdays, and five annual fairs.—Magna Britannia, by the Rev. D. Lyfons and S. Lyfons, efq. 4to. 1806.

WINSLOW, a town of the province of Maine, on the Kennebeck, in the county of the fame name, containing 658 inhabitants; 88 miles N.N.E. of Portland.

WINSTER, a fmall market-town in the hundred of High Peak, and county of Derby, England, is fituated 5 miles W. by N. from Matlock, and 152 miles N.N.W. from London. The manor belonged to Henry de Ferrars when the Domefday-furvey was taken. At a later period it was held by the Mountjoys, who were fucceeded by the Meynells. The latter fold it to the freeholders in the reign of queen Elizabeth. The town affords nothing worthy of particular notice. It has a chapel of eafe to the parifh of Youlgrave, of which Winfter forms a part; and alfo a chapel for the Wefleyan Methodifts. A market is held on Saturdays, which appears to be by prefcription; for there is no grant of it on record: till lately here was an annual fair, but it is now difcontinued. The population return of the year 1811 ftates Winfter to contain 217 houfes, and 852 inhabitants; the latter are chiefly employed in the mining bufinefs, and in the inferior branches of the cotton trade. On the commons, in the vicinity of the town, are feveral cairns, or ftone barrows, and alfo two or three barrows of earth: in one of the latter, which was opened in the year 1768, two glafs veffels were difcovered, about nine inches in height, containing a pint of water, of a light green colour, and very limpid. With thefe a filver collar or bracelet was found, together with fome fmall well-wrought ornaments, feveral beads of glafs and earth, and remains of brafs clafps and hinges, with pieces of wood, that feemed to have belonged to a box in which the ornaments had been depofited. Thefe antiquities induced Mr. King to fuppofe the barrow to have been raifed over fome Briton of diftinction, though long after the Romans were in poffeffion of the ifland.—Beauties of England and Wales, vol. iii. Derbyfhire; by J. Britton and E. W. Brayley, 1803. Lyfons' Magna Britannia, vol. v. Derbyfhire, 1817.

WINSTER, a river of the county of Lancafter, which runs into the Ken, at its mouth.

WINTBERG, a town of Pruffia, on the Curifch Haff; 14 miles N. of Preckol.

WINTENAU, a town of the duchy of Stiria; 2 miles S. of Marburg.

WINTER, ——, in *Biography*, a German opera compofer, of great abilities, who fucceeded Bianchi at our Lyric theatre in 1803; during which year he produced, in 1803-4, the mufic of the ballet of Achille and Deidamia, and for Mrs. Billington's benefit.

WINTER, one of the four feafons or quarters of the year.

Winter properly commences on the day when the fun's diftance from the zenith of the place is the greateft, and ends on the day when its diftance is at a mean between the greateft and leaft.

Notwithftanding the coldnefs of this feafon, it is proved, in aftronomy, that the fun is really nearer to the earth in winter than in fummer. The reafon of the decay of heat, &c. fee under HEAT.

Under the equator, the winter, as well as the other feafons, return twice every year; but all other places have only one winter in the year; which, in the northern hemifphere, begins when the fun is in the tropic of Capricorn; and in the fouthern hemifphere, when in the tropic of Cancer: fo that all places in the fame hemifphere have their winter at the fame time.

WINTER *Management of Flowers*, in *Gardening*, among florifts, moftly confifts in placing them in proper fituations and expofures, in properly protecting them, in duly earthing them on the approach of the fpring feafon, and fome other matters of lefs confequence. Different kinds of flower-plants require different forts of management in thefe refpects; but in thofe of the primrofe kind, efpecially in the auricula, (fee AURICULA and PRIMULA,) the plants, after being placed out in proper frames, in a full fouthern expofure, from about the middle of October throughout the winter, and having a rather warm protection given them the whole of that time, when the weather is fevere, fhould in all the autumnal and winter months, until the beginning of April, or later, be expofed during the day to the full open air, by wholly removing the glaffes, except in the time of very heavy rains, and fevere frofts or ftorms, though the common practice is that of keeping them on, and only letting in air by raifing the lights behind. In the mid-winter feafon they fhould be kept very dry, as fevere froft has in that cafe lefs effect on the roots; confequently, when rain obliges the lights to be kept on, they fhould be raifed behind. Heavy rain, or much wet, is very prejudicial and fometimes deftructive to thefe plants, which are otherwife hardy. Much expofure to the free air in dry weather has likewife great effect on the richnefs and brilliancy of their ground colours and good fpring bloom, as well as on their health, vigour, and hardinefs. In the afternoon, as about four o'clock, however, the plants fhould be covered by the lights at this feafon in a clofe manner, and have two or three thickneffes of mats thrown over them, to remain until about nine o'clock on the morning following, when, fhould there not be rain, hail, or fnow, they may be expofed to the full open air as above; but in the contrary circumftances, the mats fhould only be removed fo as to give light, air being plentifully let in behind. In the two beginning months of the year much muft depend on the ftate of the weather; when mild and open, the plants may be managed nearly as above; but in fevere froft and fnow much more caution muft be ufed in regard to expofure, fo as not to have the mould of the pots much frozen, as the bloom is now beginning to form, and would be injured thereby; but in long frofts air fhould be let in as much as poffible in the above manner, and light be given, with the influence of the fun, when there is any, in the middle of the day; the plants being always clofely fhut and covered up by three o'clock in the afternoon. Though the plants fhould be very dry, they fhould have but little water, either in rain, or from the watering-pot, in the two preceding months, and only a fmall quantity, or fome fmall light foutherly fhowers in thefe, fo as to render the ground in a moderately moift condition. Towards the middle or end of February, the plants fhould be dreffed, cleaned, and new-earthed with frefh mould for the fpring, when there is mild open weather, removing thofe from the fmall pots into larger, and expofing them fully to the gentle rains and fhowers, but conftantly defending them well from frofts, hail, and ftorms, as they now begin to fhoot new fibres more quickly, and to grow faft. This manner of managing them fhould be continued until nearly the middle of March, after which they fhould be covered more warmly in the nights, for fear of frofts, and that they may be bloomed very fine.

From the middle period of the above month, and through the following, they muſt alſo be defended from froſt, in order to promote the coming bloom. Great care and attention are eſpecially neceſſary for blooming the plants well from the above time in March to near the end of the ſucceeding month, as in this time they will moſtly attain their greateſt perfection and beauty. It is only neceſſary, as it is thought, for blooming ſuch flower-plants in the greateſt perfection, to have them continually under glaſs, night and day, for about twenty-four of the laſt days, as they will then have their middle pips well expanded. In very ſtrong ſun they muſt be ſlightly ſhaded by a thin mat, but in other caſes they may be thrown open and expoſed to the full free air.

After the beginning of April, as the fifth or ſixth, the glaſſes of the frames are to be kept completely over the plants night and day, until they are in full bloom, only letting in proper ſupplies of air from behind the frames, and giving the ſhade of old thin mats when neceſſary. This mode is to be purſued to about the middle of this month; but the plants are not to be over-haſtened in their bloom by too much ſun, as that may fade their fine colours; but in ſuch caſes they muſt be removed from the full ſouthern expoſure to a full eaſtern one, though by no means yet to a northern aſpect, as that would endanger their bloom; if the ſeaſon be ſuitable, the protection of a privet-hedge, wall, or paling-fence, is the moſt proper, being covered by hand-glaſſes; when about the end of the month, they may be removed to a northern expoſure on ſtages, or in other proper places.

In this finiſhing blooming eaſtern expoſure, all the mats and other coverings ſhould be taken off from the glaſſes that are placed over the flowers, about ſeven o'clock in the morning, and in ſunny weather the plants be ſhaded from about nine to twelve or one, the thin mats being then removed. The covering-glaſſes are to be prepared by well waſhing, and other means.

The flowers in blooming are moſtly much benefited by having a ſouth-weſt expoſure as much as poſſible, and by carefully attending to the north and north-eaſt winds, as well as by receiving all mild moderate rains from about the beginning of February until towards the end of March. In the latter part of this time, before the truſſes are too forward, and the bloſſoms open, three or four hours rather heavy mild rain greatly promotes the ſwelling of the pips, and much increaſes the ſize of the foliage, eſpecially if care be taken immediately after it is over to ſhut the flowers cloſe down, and cover them up in a warm manner, as below. Watering them from a pot with a fine roſe in a warm ſunny day all over the leaves in the afternoon, in the manner of rain, and directly covering them up warmly while the ſun is upon them, has likewiſe been found beneficial. They are now, too, to be well guarded from late froſts, as they are ſo ſoon deſtroyed by them.

In the late winter, or early ſpring, night-covering, as from the middle of the above month, the following mode has been found highly beneficial, in not only repelling the cold froſty night-air, but in aſſiſting the bloom, and preventing its being checked in any way thereby.

The heat at this period being uſually from about forty-five to fifty degrees in the day-time, the flowers may be expoſed to the open air in it, and in covering them in for the night, be kept nearly to that ſtate; which is only to be effected by an artificial covering of ſome ſort or other, for other ſorts of heat do not anſwer the purpoſe; as thoſe of the warm blanket, horſe-cloth, ſheep-ſkin, and other ſimilar kinds, laid next to the glaſſes, over which mats may be placed ſo as fully to protect the flowers, and keep the other coverings from being injured by rain or other wetneſs. Where wood-frames and not brick ones are uſed, it is alſo often neceſſary to have hay, fern, ſtraw, or ſome other ſuch material, applied on the outſides of them, to guard againſt the penetration of the cold froſty air, as is otherwiſe liable to be the caſe in ſevere ſeaſons. But ſuch full coverings ſhould not be had recourſe to in the winter ſeaſon ſooner than about the middle of March, as they might not only injure the fine ſtrong blooming plants, but counteract the good effect they are intended to have in aſſiſting nature to gradually bloom the flowers in fine condition as the ſeaſon approaches. The keeping the flowers ſo warm on the nights at this period of the ſeaſon is ſuppoſed to prevent any check to the vegetation of the plants; and another great effect which it has is, that as ſoon as the pips open, they proceed vigorouſly, expand freely, and come out level, fine, and nearly flat; while, if they once get a complete *chill* by cold night air, their bloſſoms will not expand flat, but on the contrary, ruffle or furbelow.

In the leaves of the auricula and ſome other kinds of plants, there is as much variety produced by theſe means in the ſhades of their green as in the colours of their flowers. The green of the leaves, or *graſs*, as it is termed, in this ſort of flower-plants, ſhould conſtantly be that which affords the beſt contraſt, and has the moſt power in ſetting off the flower to which it belongs. Different varieties in the ſhape of the leaves alſo proceed from the nature of the culture and management, as well as from the raiſing them from ſeed. They have from theſe cauſes leaves with ſmooth even edges, with thick and fleſhy edges, and with thin edges. Theſe varieties in the leaves of ſuch plants are often of importance to the floriſt in different ways. In the graſs or green leaves of theſe plants, there is likewiſe ſome variety in the mealy duſt or farina which is upon them: in ſome the whole plant is nearly covered with it; but thoſe with blueiſh or pea-green leaves are commonly the moſt powdered with this ſort of duſt, which contributes not only to the beauty of the plants, but ſerves in ſome degree to preſerve them from the effects of the ſcorching heat of the ſun during the ſummer ſeaſon.

The different other fine flower-plants are to have ſomething of the ſame ſort of winter-management purſued for them, only making proper allowances and diſtinctions, in ſo far as their differences in the nature of their growths or other habits are concerned.

The diverſities of the auricula, as well as moſt other flower-plants, owe their preſent perfection, in a great meaſure, to the care, ingenuity, cultivation, and management of the floriſt-gardener, and ſome of thoſe private individuals who cultivate flowers for the amuſement and delight which they afford. By theſe means, this and many other ſorts have been wonderfully improved, which were at firſt ſingle and ſimple, and their variety, ſize, and beauty, have been increaſed in an aſtoniſhing manner. The ſportiveneſs of nature has likewiſe done much, as is evident in ſo many flower-plants; as in the daiſy, ranunculus, the anemone, the ſtock, the wall-flower, the pink, the carnation, the Siberian larkſpur, and a vaſt many more.

There is, indeed, ſomething extraordinary in the great and uncommon diverſity of the colours, and the differences of the ſhades and hues of this as well as ſome other flowers; and it is not leſs ſingular or true that out of more than an hundred flowers of this ſort, which are raiſed from ſeed in this way, there will not, perhaps, be two which are exactly alike; and that yet, in all theſe deviations, the changes take place in the moſt naturally pleaſing, agreeable, and unthought-of manner poſſible.

By attention to proper winter and other management, ftill more diverfity and variety may moft probably be produced in this and different other flowers.

WINTER, among *Printers*, that part of the printing-prefs, ferving to fuftain the carriage, &c. See PRINTING-*Prefs*.

WINTER'*s-Bark*, *Cortex* WINTERI, or WINTERANUS, WINTERA *Aromatica*; which fee. See CORTEX.

This is one of the largeft foreft-trees upon Terra del Fuego, often rifing to the height of fifty feet. Dr. Solander has given an accurate botanical defcription of it, illuftrated by a figure, in Med. Obf. and Inq. vol. v. p. 46, &c. Its leaves are ever-green, fmooth, oval, and entire; the flowers confift of feven petals, with from fifteen to thirty ftamina, and from three to fix germina, terminating in as many ftigmata; each germen becomes a feed-veffel, containing feveral feeds: the bark of the trunk of the tree is externally grey, and very little wrinkled. The pieces of this bark brought over by the Dolphin are about three or four inches fquare, of different degrees of thicknefs, from one-fourth to three-fourths of an inch. It is of a dark brown cinnamon colour, an aromatic fmell if rubbed, and of a hot, pungent, fpicy tafte, which is lafting on the palate, though imparted flowly. A watery infufion of it ftruck a black colour with a folution of green vitriol. An infufion of two ounces, coarfely powdered, yielded on evaporation two drachms and twenty-four grains of extract: the fame quantity, with rectified fpirit, afforded two drachms of extract.

This bark, though much celebrated as an antifcorbutic by the firft difcoverers, is unknown in the practice of phyfic; the *canella alba*, (fee CANELLA,) which is totally different from it, having been confounded with it in the fhops; and no quantity having been brought to Europe, except as a curiofity, till the return of the fhips fent out on an expedition to the South feas. It has been thought to be a ufeful antifcorbutic; but it feems to poffefs in this refpect no advantage over the other pungent aromatics, and it is now generally fuperfeded by the canella alba.

From fome experiments on this bark by Dr. Morris, it appears to be an aftringent of a particular kind, and therefore likely to be of ufe in feveral manufactures; and that water is the proper diffolvent of it.

It is hoped that this tree, no lefs ufeful than elegant, may be cultivated in our country, where it would probably grow luxuriantly, as in a much warmer region than its own, and furnifh, not only a valuable ever-green, bearing our fevereft winters, but alfo a valuable medicine. Med. Obferv. *ubi fupra*.

WINTER-*Barley*, in *Agriculture*, a term applied to an excellent fort, which is put into the ground in the autumn, and which ftands the winter. It is found by fome farmers to be very productive in its nature, and when made into malt to form a much ftronger fort than that which is produced from common barley.

In fome diftricts, it is a good deal fown and cultivated as an early fheep-feed, in which intention it often anfwers very well. See BARLEY.

WINTER-*Berry*. See PRINOS.

WINTER-*Bloom*. See AZALEA.

WINTER-*Cherry*. See PHYSALIS *Alkekengi*.

WINTER-*Creffes*. See ERYSIMUM *Barbarea*.

WINTER-*Crops*, in *Agriculture*, a term ufed to fignify all fuch as are put into the foil to grow or rife at that time of the year, which are capable of withftanding that fevere feafon, or which can be converted to the purpofe of fodder for animals at that inclement and neceffitous period.

WINTER-*Fallow*. See FALLOW.

WINTER-*Garden*, a term often applied to that kind of ornamental garden which is chiefly for ufe and amufement at that feafon of the year. It has been advifed by Mr. Loudon, that a winter-garden fhould contain all fuch trees, fhrubs, plants, and other vegetable productions, as are in a ftate of perfection, or retaining their beauty and verdure, at and during this feafon, in the moft complete manner; as moft of the ever-green tribe or clafs of trees and fhrubs, many flowering plants, as the aconite, fnow-drop, Chriftmas-rofe, and feveral others of fimilar kinds; that thefe fhould be *grouped* and *arranged* in the *natural* manner in fuch garden-grounds; and that a dry gravel or other fimilar kind of walk fhould be conducted throughout, or carried round-about the whole, in the view of being walked upon at this feafon without inconvenience; that thefe forts of gardens fhould be fituated near the manfion or refidence, in order that they may be comfortably and conveniently approached in the different winter months; and that the confervatory too, as well as fome other fuch houfes, fhould be placed in them.

WINTER-*Green*, in *Botany*. See PYROLA.

The greater round-leaved winter-green, or *pyrola rotundifolia major*, is generally brought over from Switzerland with other vulnerary plants, in which clafs it is ranged, and by fome greatly commended. Miller.

WINTER-*Green*, *Ivy-flowering*. See KALMIA.

WINTER-*Green*, with *Chickweed Flowers*. See TRIENTALIS.

WINTER-*Heyning*, in our *Statutes*, a feafon between the eleventh day of November, and the three-and-twentieth of April, which is excepted from the liberty of commoning in the foreft of Dean, &c. Stat. 20 Car. II. cap. 3. Blount.

WINTER-*Pears*, in *Gardening*, fuch as will keep, and are ready for ufe in that feafon. It has been fuggefted in a paper in the fecond volume of the "Memoirs of the Caledonian Horticultural Society," that in the cultivation of pears of this fort, thofe of the *fhy*-bearing forts fhould be carefully avoided; that they fhould be fuited as much as poffible to the nature of the climate or region where they are to be grown; that they fhould have their fituation in a proper expofure, and in a proper foil; that they fhould be well pruned, trained, and managed, in all other refpects; that thofe kinds which can be moft depended on be had recourfe to; that new varieties may probably be raifed from feed with advantage in this view; and that endeavours fhould be made to bring into ufe any good late forts of this fruit.

The number of winter-pears in the northern parts of this ifland are fuppofed to be fcanty indeed. That if the few that have been favourably fpoken of by fome cannot be had, there are not, it is believed, above five more to be depended on in thefe fituations; which are thefe, the fwan-egg, achan, brier-bufh, the John Monteth, and to which may be added the muirfowl-egg, which keeps there much longer than the fwan-egg, and muft be allowed to be a winter-pear, though commonly fet down as an autumn fruit. The fwan-egg has there, it is faid, never kept good longer than the end of November, while the muirfowl has fometimes remained in good prefervation until towards the end of April. In the then laft feafon they were taken from the tree, it is faid, fooner than ufual; confequently were earlier ripe or fit to eat, and of courfe have decayed more fpeedily, than ordinary. They were, however, perfectly good until towards the end of January in the following year, after which they fpoiled in a very fudden manner. The muirfowl-egg

 may

may alſo, however, with great ſafety, be allowed to remain on the tree ten or twelve days longer than the ſwan-egg; the leaves of the latter, too, fall, it is ſaid, much ſooner than thoſe of the former.

On walls, in different proper aſpects, the following ſorts of winter-pears have, it is ſaid, been recommended to be planted: the creſſanne, the colmar, the boncretien d'hyver, the chaumontelle, and ſome others, which are certainly excellent pears, but that ſome of them are *ſhy*-bearers, and others do not ripen well in theſe parts, except in the moſt favourable ſituations. Some have found the four following ſorts particularly uſeful on walls, eſpecially in high ſituations in thoſe northern parts of the country where the other finer ſorts do not ripen in a proper manner: the green yair, muirfowl-egg, ſwan-egg, and winter achan. But it is noticed, that the ſecond and the laſt of theſe ſorts of pears, when planted as ſtandards, produce not only better crops, but fruit of a higher flavour. Many other ſorts are mentioned by different writers as very good winter-pears for the purpoſe of cultivation in theſe and other places; as may be ſeen in the above uſeful paper.

WINTER-*Proud*, in *Agriculture*, a term applied provincially to ſuch winter-wheat, or other crop, as puts on a more green and luxuriant growth and appearance than it is able to maintain and ſupport in the following ſummer ſeaſon; or in which the tillering ſhoots, branches, or ramifications of the ſeed-grain, become too numerous to be nouriſhed and brought to maturity in conſequence of the previous over-exertion of the ſoil or land. In theſe caſes, the crops decline during the ſpring and ſummer months, and at the harveſt time yield imperfectly, falling much below the quantity afforded by ſuch crops as had a more backward appearance in the winter ſeaſon.

It is of courſe always of advantage to have theſe ſorts of crops in rather a backward ſtate in the winter period of the year.

WINTER-*Quarters*. See QUARTERS.

WINTER-*Rig*, among *Huſbandmen*, ſignifies to fallow or till the land in winter.

WINTER-*Solſtice*. See SOLSTICE.

WINTERA, in *Botany*, is ſo called in memory of the companion of ſir Francis Drake, captain William Winter, who brought the bark, of the firſt ſpecies, from the ſtraits of Magellan in 1579, and introduced it to the knowledge of European phyſicians, as a valuable tonic, more eſpecially uſeful in the ſcurvy. Linnæus, meaning to commemorate this diſcovery, eſtabliſhed a genus by the name of *Winterana*, G. Pl. 238, the bark of which he conceived to be what captain Winter introduced. But the Linnæan plant is the *Canella alba*, to the fructification of which alone the deſcription applies. Browne had already founded this genus, by the name of CANELLA, (ſee that article,) and Swartz, as well as Murray, have confirmed it. Meanwhile Forſter, having found and inveſtigated the fructification of the Winter's-bark tree, deſcribed it by the name of *Drimys*, alluding to its hot and pungent flavour. This is retained by the younger Linnæus in his *Supplementum*, with a remark properly diſtinguiſhing it from the *Canella alba*, though his father, like prof. Bergius, *Mat. Med.* v. 1. 381, had confounded them. Finally Murray, in *Linn. Syſt. Veg. ed.* 14, aware of theſe various errors and miſconceptions, very properly eſtabliſhes Browne's genus, by its right denomination, *Canella*, and reſtores Winter's name to the plant to which it properly belongs, and with which Linnæus intended to aſſociate it. Murray, however, prefers *Wintera* to *Winterana*, which is the more judicious, as his genus is not really the *Winterana* of Linnæus. The name he has choſen is now, except by an accidental miſtake of De Candolle in chronology, univerſally adopted. Perhaps *Winteria* would have been better; but we refrain from embroiling the ſubject with any further alteration, of what has received the ſanction of ſuch men as Murray and Schreber.—Murr. in Linn. Syſt. Veg. ed. 14. 507. Forſt. Prodr. 86. Schreb. Gen. 368. Willd. Sp. Pl. v. 2. 1239. Mart. Mill. Dict. v. 4. (Drimys; Forſt. Nov. Gen. t. 42. G. Forſt. Nov. Act. Upſ. v. 3. 181. Linn. Suppl. 43. Lamarck Illuſtr. t. 494. De Cand. Syſt. v. 1. 442. Drymis; Juſſ. 280. Lamarck Dict. v. 2. 330.)—Claſs and order, *Polyandria Tetragynia*. Nat. Ord. *Magnoliæ*, Juſſ.

Gen. Ch. *Cal.* Perianth inferior, of one leaf, ſplitting into two or three ſegments. *Cor.* Petals ſix, or more, ovate, ſpreading. *Stam.* Filaments numerous, ſhorter than the corolla, dilated upwards; anthers terminal, of two lateral ovate cells, ſeparate at the baſe, converging at their points. *Piſt.* Germens four to eight, crowded, obovate; ſtyles none; ſtigmas depreſſed, flat. *Peric.* Berries four to eight, ovate, ſomewhat triangular. *Seeds* ſeveral, diſpoſed in two rows.

Eſſ. Ch. Calyx ſplitting unequally. Petals numerous. Stamens club-ſhaped, with terminal two-lobed anthers. Styles none. Berries ſuperior, aggregate. Seeds ſeveral, in a double row.

Obſ. Willdenow copies what we ſuſpect may be a caſual error of the younger Linnæus, *germina clavata*, for *ſtamina clavata*. De Candolle, who deſcribes two new ſpecies, firſt gave a correct account of the arrangement of the ſeeds, an important circumſtance in this natural order. His obſervations, confirming thoſe of Linnæus, ſhew the *petals* to be indeterminate in number. Poſſibly the line is not drawn diſtinctly between them and the *ſtamens*, of which *Nymphæa* affords another inſtance, ſo that an inner ſeries of ſmaller petals may occaſionally occur.

1. W. *aromatica*. Officinal Winter's-bark. Murray n. 1. Willd. n. 1. Mart. n. 1. Forſt. Pl. Magell. 24. t. 7. Comm. Goett. v. 9. 34. t. 7. Soland. in Med. Obſ. and Enq. v. 5. 41. t. 1. Woodv. Med. Bot. t. 257. (Drimys Winteri; Forſt. Act. Upſ. v. 3. 181. Linn. Suppl. 269. Winteranus cortex; Cluſ. Exot. 75. Dale Pharmac. 324. Laurifolia magellanica, cortice acri; Bauh. Pin. 461. "Periclymenum rectum, foliis laurinis, cortice aromatico acri; Sloane in Phil. Tranſ. v. 17. 923. t. 1. f. 1, 2.")—Leaves elliptical, obtuſe, coriaceous. Flower-ſtalks aggregate, terminal. Piſtils about four.—Native of the country on both ſides of the ſtraits of Magellan, in valleys expoſed to the ſun, where it was firſt obſerved by captain Winter, and has ſince been found by ſeveral following navigators, but no one has brought living plants or ſeeds to Europe. This is a *tree* of conſiderable ſize, often 50 feet high, with twiſted knotty branches, and a thick rugged bark, of an aromatic ſmell, and pungent permanent flavour. This bark is not much uſed in practice at preſent, there being many drugs of equal, or ſuperior, powers; as the *Canella alba*, which has taken its place, and cauſed the botanical miſtake above-mentioned. (See WINTER'*s Bark*.) The *leaves* are alternate, crowded about the ends of the branches, ever-green, two or three inches long, and one and a half wide, thick and rigid, entire, ſomewhat revolute, with a ſtout midrib, and ſcarcely viſible veins, very ſmooth on both ſides; ſomewhat glaucous, but not invariably or permanently ſo, beneath. *Footſtalks* broad and thick, ſmooth, half or three-quarters of an inch long. *Stipulas* none. *Flower-ſtalks* at the ends of the branches, two or three together, ſimple or three-cleft, ſmooth, not half the length of the leaves, accompanied at their baſe by ſeveral ovate, pale, deciduous *bracteas*. *Flowers* ſmaller

fmaller than a hawthorn bloffom, white. *Calyx* reddifh, unequally three-lobed. *Berries* from three to fix, each with four triangular *feeds*. By the above fynonyms to this fpecies it appears, that even G. Forfter, who with his father eftablifhed the genus and unexceptionable name of *Drimys*, gave way to thofe eminent botanifts who wifhed to retain the memory of the original difcoverer. Indeed the name of Winter may claim even a right of priority, though a miftake attended its commemoration and publication by Linnæus, in his Gen. Pl. We truft our amiable friend M. De Candolle will forgive our not joining with him, in overturning what has been finally fettled, with the approbation of all the world. If chronology is to be our abfolute guide, without attention to fenfe, or expediency, the nomenclature of botany muft relapfe into its priftine barbarifm, and in this cafe Bauhin's name *Laurifolia* fhould have been adopted. Even on this ground, weak as it is, we can however defend the name we have retained; for Clufius's *Winteranus cortex*, erroneoufly printed *Cortex Winteranus* by De Candolle, may be confidered as the firft commemoration of captain Winter, being the firft publication of any thing relating to the genus in queftion.

2. W. *granadenfis*. New Granada Winter's-bark. Murr. n. 2. Willd. n. 2. Mart. n. 2. "Humb. et Bonpl. Pl. Æquinox. v. 1. 205. t. 58. Lozano in Sem. Nov. Gran. for 1809, 180." (Drimys granadenfis; Linn. Suppl. 269. De Cand. n. 3.)—Leaves elliptic-lanceolate, obtufe. Flower-ftalks axillary, folitary. Piftils eight.—Sent by Mutis from New Granada. It grows on the moft lofty mountains of that country, Quito, &c. The *tree* is 18 or 20 feet high, with round branches, more ftraight, and lefs rugged, than the foregoing. *Leaves* four or five inches long, and near one inch and a half broad, obtufe, not acute, fcarcely revolute, perfectly fmooth; very glaucous beneath, like thofe of *Magnolia glauca*, the longer-leaved variety of which they greatly refemble. *Footftalks* fmooth, an inch long. *Flower-ftalks* fometimes nearly the length of the leaves, always half as long, fimple, divided, or three-cleft. *Flowers* twice the fize of *W. aromatica*, with about 12 *petals*, and a deeply three-cleft *calyx*. *Berries* fix or eight, obovate, fometimes confluent, each with from four to fix *feeds*. The *bark* is aromatic, like the former. The younger Linnæus imagined this to be a variety of that fpecies, caufed by a warmer climate. They are indeed more nearly related than appears at firft fight, and yet we can fcarcely think they belong to one fpecies, though well aware that the *leaves*, in this natural order, are liable to vary confiderably in fhape; witnefs the *Magnolia* juft mentioned, if more than one fpecies be not confounded under that name.

3. W. *chilenfis*. Chili Winter's-bark. (Drimys chilenfis; De Cand. n. 4.)—Leaves oblong-obovate; glaucous beneath. Flower-ftalks either aggregate or compound, axillary. Piftils five or fix.—Gathered by Dombey, in marfhy fituations in Chili. A tall *fhrub*, with a very aromatic bark, and round branches. *Leaves* nearly obovate, coriaceous, very fmooth, tapering at the bafe, on fhort ftalks, refembling the foliage of *Magnolia glauca*. *Flower-ftalks* axillary; fometimes very fhort, bearing an umbel of four or five elongated fimple ftalks; fometimes four or five fimple ones all together, each an inch long at moft, fingle-flowered. *Calyx* in two or three ovate blunt divifions, not foon deciduous, and perhaps lafting till the fruit is ripe. *Petals* fix to nine, oblong, bluntifh, twice the length of the calyx. *Stamens* very fhort. *Germens* five or fix, ovate, crowded, on a fmall globofe receptacle. *Berries* oval, rather compreffed, obtufe. *De Candolle.*

4. W. *mexicana*. Mexican Winter's-bark. (Drimys mexicana; De Cand. n. 5. "Moç. et Seffé Pl. Mex. ined. t....") — Leaves oblong-lanceolate, pointed at each end. Flower-ftalks elongated, umbellate, four-flowered. Petals twenty to twenty-four, acute. Germens four.—Native of Mexico. A *fhrub*, with round branches, terminating in a fharp bud, as in the *Magnoliæ*. *Leaves* ftalked, tapering at each end. *Common flower-ftalks* an inch, or an inch and a half long, divided at the top into an umbel of four long, fingle-flowered, *partial ftalks*. *Calyx* divided, permanent, concave. *Petals* white, fpreading, oblong, in a double row. *Stamens* very fhort. *Berries* four, or, from occafional abortion, only two or three, obovate, tapering at the bafe, of a blueifh-violet colour. *De Candolle from a coloured drawing.*

5. W. *axillaris*. Small-flowered Winter's-bark. Forft. Prodr. 42. Willd. n. 3. Mart. n. 3. (Drimys axillaris; Linn. Suppl. 270. Forft. Act. Upf. v. 3. 182. De Cand. n. 1. Lamarck f. 2, copied from Forft. Nov. Gen. t. 42. f. *a*—*l*.)—Leaves obovate, pointed, reticulated with veins. Flower-ftalks fimple, aggregate, thread-fhaped. Calyx orbicular, lobed, reflexed.—Native of woods in New Zealand. A *tree*, with round branches, rough to the touch, but not warty. *Leaves* on ftalks rather above half an inch long, broadly obovate, tapering to a bluntifh point, fmooth, more thin and membranous than in any of the other fpecies, copioufly reticulated with innumerable veins, not obfervable in any of thofe; their length three or four inches, breadth two; their under fide glaucous when young only. *Flower-ftalks* two or three together, feldom folitary, from the bofoms of moft of the leaves, fimple, very flender, each bearing a fmall green *flower*. *Calyx* difcoid, foon reflexed, about a line broad, fplitting into two principal, and two fmaller, lobes, not differing in any particular refpect from the divifions of the calyx of the other fpecies, though Forfter's figure has mifled De Candolle to fuppofe otherwife. *Petals* fix, oblong, flat, equal, four times the length of the calyx. *Stamens* about fixteen. *Germens* four, turbinate, all perfectly and evidently diftinct, in the numerous flowers of the Linnæan fpecimen; fo that Forfter might well wonder how the younger Linnæus, who had this very fpecimen before him, could make a "folitary piftil" a part of the fpecific character. *Stigmas* dilated, peltate, terminal. *Berries* four, globofe, black, with a tawny pulp, lodging four ovate, acute, fomewhat triangular, gibbous *feeds*. The flavour of the whole plant, efpecially of the bark, is extremely acrid and pungent. *G. Forfter.*

WINTERANA. See CANELLA, and WINTERA *fupra*.

WINTERBERG, in *Geography*, a town of the duchy of Weftphalia; 37 miles S. of Paderborn. N. lat. 51° 11'. E. long. 8° 39'.

WINTERBERG, or *Winberg*, a town of Bohemia, in the circle of Prachatitz; 10 miles W. of Prachatitz. N. lat. 49° 2'. E. long. 13° 39'.

WINTERBURG, a town of France, in the department of the Rhine and Mofelle; 10 miles W.N.W. of Creutznach.

WINTERHAM, a place in Virginia, where black-lead is found; 30 miles N. of Richmond.

WINTERHAUSEN, a town of the duchy of Wurzburg, on the Maine; 4 miles S. of Wurzburg.

WINTERINGHAM, a town of England, in the county of Lincoln; 166 miles N. of London.

WINTERTHUR, a town of Switzerland, in the canton of Zurich. This was formerly an imperial town. In the year 1467, it was mortgaged to the canton of Zurich, and by fubfequent treaties entirely ceded, fince which Winterthur has acknowledged Zurich for its sovereign. It is governed, however, by a magistracy and police of its own. The government is aristocratical; the supreme power, in all things not interfering with the claims of Zurich, residing in the Great and Little council, in all criminal proceedings these two tribunals unite, and pass sentence of death without appeal. In civil causes, an appeal lies from the Little to the Great council. In all cases respecting the burghers, appeals may be carried from the town-court to the council of magistracy, and no farther; but if either of the parties be a foreigner, an appeal lies from the council to the senate of Zurich. A bailiff from this latter place likewise resides here, but without any authority over the town, excepting that of assisting at the ceremony of an annual homage paid to Zurich by the burghers on St. Alban's day. In case of a war, Winterthur furnishes Zurich with 200 men, either burghers or dependents, but to serve under its own colours. Except in the articles of silk manufacture, and the establishment of a printing-press so profitable to Zurich, the commerce of Winterthur is under no restraint. The principal manufactures are, muslin, printed cottons, and cloth: it has some vitriol works; and the earthen-ware made here, particularly the white, together with its painted stoves, are in great repute for their beauty and durableness. The town is small, and the inhabitants, who are about 2000, are very industrious. The schools are well endowed and regulated. Ober Winterthur, or Upper Winterthur, is a small village near the town, on the high road leading to Frauenfeld, on the scite of the ancient Vitodurum, which was a Roman station. Here are found the foundations of ancient walls and numerous Roman coins and medals. The castle of Kyburgh, seated on an eminence overlooking Winterthur, is a picturesque object; 14 miles N.E. of Zurich.

WINTERTON, a town of England, in Lincolnshire; 9 miles N.N.W. of Glanford Brigs.—Also, a town of England, in the county of Norfolk, near the coast. The market is discontinued; 7 miles N. of Yarmouth.

WINTERTON *Ness*, a cape on the E. coast of the county of Norfolk, on which is a light-house; 10 miles N. of Yarmouth. N. lat. 52° 44′. E. long. 1° 41′.

WINTFELDEN, a town of France, in the department of the Upper Rhine; 10 miles S.W. of Colmar.

WINTHAG, a town of Austria; 6 miles N.E. of Freystadt.

WINTHROP, a post-town of the province of Maine, in the county of Kennebeck, with 1444 inhabitants; 57 miles N. of Portland.

WINTHROP's *Bay*, a bay on the N. coast of Antigua.

WINTON, a county of United America, in the state of South Carolina.—Also, a post-town of North Carolina; 30 miles E. of Halifax.

WINTONIÆ ROTULUS. See ROTULUS.

WINTZENBERG, in *Geography*, a town of Silesia, in the principality of Neisse; 5 miles S.E. of Grotkau.

WINTZENHEIM, a town of France, in the department of the Upper Rhine; 3 miles W. of Colmar.

WINTZIG, a town of Silesia, in the principality of Wohlau; 9 miles E.N.E. of Steinau. N. lat. 51° 27′. E. long. 16° 36′.

WINWEILER, a town of France, in the department of Mont Tonnerre; 24 miles N.E. of Deux Ponts.

WINWOOD, *Sir* RALPH, in *Biography*, a statesman in the reign of James I., was born at Aynho in Northamptonshire, about the year 1564, educated at St. John's college, Oxford, and having passed through several stages of preferment, was chosen proctor of the university in 1592. After having sustained several diplomatic characters and missions, he was made secretary of state in 1614, which office he occupied till his death in 1617. "He was married, and left one son. Sir Ralph was an accomplished gentleman, well acquainted with business, and particularly conversant with commercial and military affairs." A work, intitled "Memorials of Affairs of State in the Reign of Queen Elizabeth and King James I., collected chiefly from the Original Papers of the Right Honourable Sir Ralph Winwood, Knt. &c. &c." was published in 1725 by Edmund Sawyer, esq. in 3 vols. fol., and contained a valuable record of the political transactions of those times. Biog. Brit.

WINYAH, in *Geography*, a county of South Carolina.

WINZAH HARBOUR, a bay on the coast of South Carolina, a little to the N. of the mouth of the Santee. N. lat. 33° 12′.

WINZER, a town of Bavaria, on the Danube; 9 miles S.S.E. of Deckendorf.

WIOCHIST, among the *Indian Natives of Virginia*, is their priest, who is also generally their physician; and is the person in the greatest honour amongst them, next to their king, or great war-captain. Phil. Trans. N° 454. sect. 1.

WIOGRODEK, in *Geography*, a town of Poland, in Volhynia; 14 miles E.S.E. of Kreminiek.

WIP, a town of Prussia, on the Curisch Haff; 23 miles S.W. of Tilsit.

WIPACH, a town of the duchy of Carniola; 5 miles S. of Hydria.

WIPE, a town of Prussia, in the province of Smaland; 28 miles N.E. of Königsberg.—Also, a river of Prussia, which runs into the Curisch Haff, 10 miles E.N.E. of Labiau.

WIPFELN, a town of the duchy of Wurzburg; 5 miles N.N.W. of Volckach.

WIPPELSPACH, a town of the duchy of Stiria; 17 miles S.W. of Voitsberg.

WIPPER, a river of Germany, which rises in the county of Mark, about 6 miles S.S.W. of Lunschede, passes by Wipperfurt, Elberfeld, Solingen, &c. and runs into the Rhine, between Cologn and Zons.—Also, a river of Thuringia, which rises 2 miles N. of Dingelstadt, and runs into the Unstrutt, 4 miles N.E. of Kindelbrucken.—Also, a river of Pomerania, which runs into the Baltic below Rugerwalde.—Also, a river of Saxony, which runs into the Saal, near Bernberg.

WIPPERAU, a river of Westphalia, which runs into the Ilmenau, near Ultzen.

WIPPERFURT, a town of the duchy of Berg; 27 miles S.E. of Dusseldorf. N. lat. 51° 5′. E. long. 7° 27′.

WIPPINGEN, a town of Switzerland, in the canton of Friburg; 12 miles S.S.W. of Friburg.

WIPPRA, a town of Westphalia, in the county of Mansfeld, on the Wipper; 10 miles W.N.W. of Eisleben. N. lat. 51° 30′. E. long. 11° 30′.

WIRBEN, a town of Westphalia, late in the Old Mark of Brandenburg, on the left side of the Elbe; 12 miles N. of Stendal.

WIRBENTHAL. See WURBENTHAL.

WIRDOIS, a town of Sweden, in North Finland; 65 miles N.N.E. of Biorneborg.

WIRE, in the *Mechanic Arts*, is a very useful preparation of different metals, in form of a regular and even thread, which can be obtained in very great lengths, and of any required size or shape.

Wire is made of any ductile metal, as platina, gold, silver, copper, brass, zinc, iron, or steel. The process of making wire confifts in drawing the piece of metal through a hole in a plate of fteel, by which means the metal is rendered of an equal fize, and either round or of any other figure correfponding with the figure of the hole in the draw-plate; the metal is thus reduced in fize, and at the fame time is lengthened in proportion. From the great regularity of wire, and from its toughnefs and ductility, it is extremely ufeful to all artifts who work in metal.

The operation is called wire-drawing, and the plate of fteel a draw-plate. The machine by which the wire is drawn is called a draw-bench.

The common draw-bench is of a fimple ftructure. A ftrong plank of wood is fixed on legs, like a ftool or bench, *fig.* 1. *Plate Wire.* At one end is a roller or axis, A, fixed in an horizontal pofition, fo that it can be turned round by means of four levers, B B, fixed like radii on the end of the axis of the roller. If the refiftance is great, the workman applies both his hands and his feet to the levers, to turn them round in the fame manner as for a rolling-prefs. It is ufual to have a ftrong ftrap, or chain, C, to wrap and wind up round the roller; and at the end of it a pair of pincers, D, are linked: thefe take hold of the end of the piece of metal, and draw it through the hole in the draw-plate E, which is lodged againft two ftrong iron pins, *a a*, fixed in the bench, and ftanding up perpendicularly, fo that the plate bears againft them.

The pincers are fhewn in *fig.* 2. They are adapted to bite the end of the wire; and the infide of the jaws, *d d*, are cut with teeth like a file, that they may hold the metal very tight. The oppofite ends of the handles are bent in form of hooks at *e e*; and a triangular link of iron *f*, which is faftened to the end of the ftrap or chain C, embraces both hooks *e e*, and from its triangular figure, it tends to approach the two hooks at the ends of the tongs together: by thefe means, the ftrain of drawing the wire clofes the pincers, and makes them bite more forcibly in proportion as the wire makes a greater refiftance, fo that they rarely let the wire flip.

The draw-plate, *figs.* 3 and 4, is a thick plate of fteel, with holes made through it of various fizes, and in a regular gradation from the largeft to the fmalleft. The holes are made large on that fide where the wire enters, and they diminifh with a regular taper to the other fide; the goodnefs of the draw-plate is an object of the firft importance. The different holes muft diminifh by very fmall gradations, or there will be danger of breaking the wire by forcing it too much at once.

In fome draw-benches a rack and pinion are employed, inftead of a ftrap or chain; and a train of wheel-work may be ufed like that of a crane to obtain a fufficient power. (See *fig.* 5.) If the workman turns the machine by a winch or handle, it is preferable to four levers, becaufe the motion is more regular; this is of importance for fome purpofes. Suppofe a piece of elaftic metal is forcibly drawn through a hole in a plate with a tolerably quick motion, it will be compreffed at the moment of paffing through the hole; but after it quits the hole, the metal will expand a little. When it is drawn very flowly, this effect will not take place; for if the compreffion is continued long enough it becomes permanent: hence, if a piece of large wire be drawn with an irregular motion, firft quicker, and then flower, it will be fenfibly larger at all the parts which pafs quickly through the hole, and fmaller where it is drawn flowly: if the motion is fufpended for a few feconds, that part of the wire which remains in the hole will have a ring or indentation round it. This is moft obvious in drawing hollow tubes, or copper-wire, which is plated over with gold or filver.

In the machine which is ufed for drawing ftrong pieces of metal, and for the very largeft, the roller is ufually placed in a vertical pofition, like a capftan, with four levers, at which feveral men pufh, whilft they walk round in a circle to turn the capftan, and wind up the chain which draws the wire through the draw-plate.

A powerful machine of this kind is defcribed in our article PIPES, for drawing lead-pipe through a fteel plate.

We have feen a very powerful wire-drawing machine ufed for forming large hollow tubes of brafs or copper, on which the power to draw the tube was obtained by a fcrew, like that of a prefs. This fcrew was turned by a train of wheel-work, with a fly-wheel to regulate the motion.

Another plan, which is perhaps the beft mode for a very powerful drawing-machine, is to apply the force of the hydroftatic machine originally invented by Pafcal, and revived by the late Mr. Bramah. (See MACHINE, and PRESS.) By this means, very large wires for pifton-rods of fteam-engines, and other fimilar pieces, may be rendered ftraight and true with little expence.

All thefe machines are confined to draw pieces of metal, which are only a few feet in length, that is, the length of the bench. But when the metal by repeated drawing becomes lengthened into a regular wire, if it is required to reduce it to a ftill fmaller fize, it muft be drawn through fucceeding plates, by wrapping the wire itfelf upon the roller or barrel, inftead of employing a long chain. This method is not applicable at firft, becaufe a thick bar of iron could not be made to bend eafily round a roller; but when the wire becomes fmall and flexible, it can be practifed very advantageoufly, and admits of drawing a very great length of wire by a fmall and commodious machine.

The common wire-mills ufed in France do not, however, employ a roller or windlafs, but the pincers are attached to a lever, which draws them backwards and forwards alternately by the power of the water-wheel.

The pincers are fo conftructed, that the jaws open when they move towards the draw-plate, and releafe themfelves from the wire; but when the pincers are drawn back from the draw-plate, the link caufes the pincers to clofe and bite the wire with fuch force, that they will draw it through the plate.

A machine of this kind is fhewn in *fig.* 7. of the plate. The bafe of the machine is a very ftrong log of timber R; one end of it is cut open to receive a wooden lever A B, which moves round an iron pin or bolt *n*, as a centre of motion; this lever is fhaped like the letter L. To the upright arm A of this lever, an iron link C is jointed, and the other end of this link is formed like a ring, to receive the handles of the pincers D. The pincers are fupported upon a plate of iron *d*, which is placed in an inclined pofition, and there is a groove in the plate, into which the end of the pin or joint of the pincers is received, and they are by that means guided in their motion backwards and forwards: *a a* are the pins which fupport the draw-plate E; there are four of them, and the plate is faftened between them by wedges.

The end B of the lever is operated upon by cogs fixed on the axis of the water-wheel, which, as it turns round, depreffes the end B of the lever; and the end A pulls the pincers back, and draws the wire through the draw-plate; but when the cogs quit the end of the lever, it is returned by means of a rope faftened to the end of B, and going up to a ftrong wooden pole fixed on the roof of the building; and it acts as a fpring. When the pincers return, they open to releafe the wire, and flide down the inclined plate *d* by their own weight, till they are near the draw-plate; the wire being all the time included between the jaws, though they do not bite. The next cog which feizes the end of the lever draws back the pincers, which immediately clofe upon the wire, and draw it through the plate.

A wire-mill ufually contains three fuch machines of different fizes: the largeft only draws two inches of the wire at each ftroke, and makes about forty-eight ftrokes in a minute; the fecond machine, four inches; and the third, five inches. This works quicker than the other two, and makes fixty-four ftrokes *per* minute. This is a fimple machine, but very defective, for much time is loft in the returning of the pincers; they fometimes fail to take good hold of the wire, and they always make deep marks upon the wire at every place where they bite, which are not more than two inches diftance in the great wire, and five inches in the fmaller.

Fine wire is always made from large wire, by reducing it and lengthening it out by repeated drawings. The large wire is ufually manufactured at the wire-mills in the country, and fome part of it is reduced to fmall wire at the fame eftablifhments, but more commonly the large wire is bought by thofe who have occafion for it, and they reduce it by drawing until it becomes as fmall as it is wanted.

The hand-machine for this purpofe, reprefented in *fig*. 8, is extremely fimple. A is the roller on which the wire is wound up; it turns round upon a vertical pin, fixed in the bench R, and to the upper end a handle B is fixed, for the workman to turn it round; E is the draw-plate, and *a a* the pins againft which it refts. The wire which is to be drawn is put upon a fmall circular reel F, which turns round upon a vertical pin; this pin is fometimes fixed in the table, or otherwife in a fmall cafk containing ftarch-water, or beer which has become acid. The ufe of this is to loofen the oxyd from the furface of the wire, for it is neceffary to anneal or foften the wire very frequently, by putting it in the fire, and this produces a black coat of oxyd on the furface, which will be removed when the wire is again drawn through the plate, and the wire will come out bright and clean. The removal of this oxyd will be facilitated by fome flightly corrofive menftruum.

Fig. 9. is a very fimple and complete wire-drawing machine, to draw three wires at once. A R are two rollers or barrels with cog-wheels, T V, on the ends of their axis, which wheels are engaged together. S is a pinion, which is turned round by means of a handle B, and gives motion to the wheels T V. Both thefe wheels are fitted upon round parts of the axis of their refpective rollers, fo as to flip or turn freely round upon the fame; but a fquare is formed on the axis outfide of the wheel, and a clutch or catch, *t* or *v*, is fitted on this fquare part, fo as to turn always round with the axis. The catch is at liberty to flide upon the axis in the direction of its length, by means of a lever W, which operates upon both catches at once. When either of them is pufhed back in contact with the wheel, it intercepts two ftuds which project from the face of the wheel, and then compels the axis and roller to turn round with the wheel; but when the catch is drawn away from the wheel, then the wheel will flap round upon its axis, without communicating any motion. By means of the lever W, only one wheel can be engaged at once, and the other muft be free. The draw-plate E is firmly fixed between the two rollers, and it has a great many holes; the rollers are long enough to receive three wires at the fame time. Each roller has a groove in it parallel to the axis, into which a bar of metal is fitted, and will exactly fill it up. When the wires are introduced through the holes in the plate, the ends are laid acrofs this groove; the bar is then put in and faftened by a fimple contrivance, and it faftens the ends of the wires beneath it, fo that they become attached to the roller; then by turning the handle B round, the two wheels are put in motion in contrary directions; and that wheel which is connected with its axle by its catch, will turn its barrel round, and wind up the wires fo as to draw them through the plate E. The other roller being at the fame time detached, its wheel is at liberty to turn round in a contrary direction to the wheel, as faft as the wires are drawn off from it. When the whole length of the wires has been drawn through the plate, they are detached from the roller, the ends introduced through fmaller holes in the plate, and faftened again to the roller; then the lever W is fhifted, to difengage that wheel which operated before, and engage the other. This being done, the rollers will be turned in an oppofite direction, and will wind back the wires, although the handle B is turned the fame way round.

After the wire has been then drawn three or four times, the metal becomes fo hard and fibrous, that it would not draw any more without breaking; it therefore requires to be heated in the fire to reftore its ductility; for this purpofe it muft be taken off the barrels. A roller M is provided to wind the wire upon and draw it off from the barrel; this roller is turned round by a handle *m*, fixed on the extremity of its axis; and the wire which is wound upon it in a coil is flipped off fideways. This machine is well adapted to be worked by a mill, becaufe the handle may always be turned the fame way.

Fig. 10. reprefents the machine ufed at the wire-mills for reducing the wire which is to be ufed for mufical inftruments, or for making cards for wool and cotton. The rollers A are fituated in a vertical pofition, being fitted on the tops of iron fpindles, which are fuftained in a vertical pofition by bearings in the frame of the table or bench. Thefe fpindles are kept in continual motion by wheel-work fituated beneath the bench, but the fpindles are round, fo that the rollers A are not turned with the fpindles, unlefs any one of the rollers is lifted up upon the fpindle. A crofs-bar, which is fixed on the top of the fpindle, then engages with two projecting knobs fixed in the roller, within a hollow recefs made at the top of it, and turns the roller round. The draw-plate E is fupported by two pins, as before defcribed; and the wire which is to be drawn is wound on a reel, which is put into a cafk of ftale-beer grounds, or ftarch-water. The end of the wire, which is put through the draw-plate, is made faft to the roller, which does not turn round as long as it is dropped down upon the fpindle; but when all is ready to begin drawing, the roller muft be lifted up, and the clutch at the top of the fpindle will engage with the two knobs within the hollow at the top of the roller. This puts it in motion, and draws the wire through the draw-plate. The ftrain of drawing is fufficient to keep the roller up upon the fpindle; but as foon as the whole of the wire is drawn through the plate, the refiftance ceafes, and the roller drops down on its fpindle, and becomes difengaged until the workman puts it again in action.

Manufacture of Iron Wire.—Iron is a very ductile metal, but requires a careful treatment in the procefs of wire-drawing, becaufe it becomes very hard and brittle when the fibres are greatly compreffed by repeated drawing. Its ductility muft then be reftored by heating the wire to rednefs; this is called annealing: it renders the wire foft, and it will then draw finer and longer; but it will foon require annealing again, and fo on.

The iron which is felected for wire-drawing muft be of good quality, to bear the requifite extenfion without breaking. It muft be of an uniform fubftance, without any grains of of hard or soft parts. The softest iron is not always found the best, as it will diminish by the strain of drawing it through the holes alone: and to obviate this, the workman must draw such iron through a greater number of holes to obtain the required extension.

The iron is wrought at the tilt-mills from square bars into round rods of a proper size to commence drawing. The operation of tilting is nearly the same as *tilting of steel.* (See that article.) The tilt-hammer for a wire-work generally makes twenty strokes *per* minute, and weighs about fifty pounds. There is also a larger hammer worked by the same mill, which strikes about 130 times *per* minute, and weighs 100 pounds. This hammer is only used for the first preparation of the iron, or for welding a faggot of small bars together, in order to give the iron a better quality by a preparation similar to the German steel. To draw out the iron bars into rods of a proper size to begin drawing, the workman heats six or eight inches of the end of a large bar, which comes from the great forge where the iron is made, and when properly heated he works it regularly under the small tilt, until it is drawn out to a small and regular round rod of five or six feet in length. A good workman can thus draw out two hundred weight of iron in a day, or an ordinary workman one and a half hundred weight. The loss of metal in the operation is near 26 *per cent.* by weight.

The small rod, before it is cold, is taken by another workman, who straightens the rod with a hammer upon an anvil, then cuts it off, and places the end of the great bar again in the forge. This same workman also superintends the heating of the iron, and must be very careful not to overheat it, but to heat the whole regularly.

It is a good practice to pass the iron-rod through a pair of grooved rollers, the grooves of the two rollers being opposite, so as to form a round between them. By these means, the iron may be reduced small, and rendered very true, previously to beginning the drawing. For common wire, the whole reduction may be done by the rolling-mill without a tilt; but the hammer will give a more tenacious quality to the iron than can be obtained by rolling.

A small round bar, thus prepared, must be drawn through a hole in a draw-plate, by a strong machine with a chain, or else by the lever-machine, *fig.* 7. The end of the iron is first reduced, so that it will enter the hole in the draw-plate, and pass through sufficiently for the pincers to take hold. This is done at the forge by a hammer and anvil. By passing through the plate the wire becomes lengthened, in proportion as it is diminished in size. It must then be annealed to soften it, the end pointed anew, and again put through a smaller hole.

The workman who attends the process must study the nature of the iron, and regulate the manner of drawing accordingly. This he does by altering the figure of the hole through which the wire is drawn. The hole must be conical; the smallest part, being that which acts principally on the metal, must be at that side of the plate where the wire comes through. If the taper of the hole is not properly proportioned, the iron will be strained in drawing; for though the machine will force it through, grains of harder metal than the rest of the wire will form themselves, which will occasion the wire to break when it comes to be much reduced. This is particularly the case in soft iron. To avoid this, the hole must be chosen very little smaller than the iron, and must be made with a regular taper. It must be well supplied with grease, to diminish as much as possible the friction; and the motion of the draught must be regulated according as the metal will bear it.

Much depends upon the quality of the draw-plate; although the metal of the plate is sufficiently hard to draw the wire, it will not resist the blow of a hard steel hammer and punch. The punch is driven into the hole from behind, until it enlarges it to the required size and figure. In the operation of drawing, the hole becomes gradually enlarged, and that in a greater degree at the smallest end of the hole, so that it becomes nearer to a cylinder. To rectify this, the punch must be applied, or the wire would not pass easily; that is, if the same degree of reduction in the size of the wire was attempted, it would break or strain the wire, if the hole was cylindrical, although it would pass through a regular taper hole. The hole sometimes wears irregularly, and loses its circular figure. In this case, the plate is hammered around the small end of the hole, and the hole is thereby reduced. The punch is then driven in, to enlarge it again to the required size: sometimes the punch is introduced at the small end, and then at the large end, as it may be required to form the hole. In all cases, the punch must be driven very gently; and after every stroke of the hammer it must be loosened in the hole, and turned round before another blow is struck, and without this precaution it would fix fast in the hole.

The French draw-plates are the most esteemed; and, in time of war, a good French draw-plate has been sold for its weight in silver. M. Du Hamel, in Les Arts et Metiers, vol. xv. gives the following account of the process of making the draw-plates for the large iron-wire.

A band of iron is forged of two inches broad and one inch thick. This is prepared at the great forge. About a foot in length is cut off, and heated to redness in a fire of charcoal. It is then beaten on one side with a hammer, so as to work all the surface into furrows or grooves, in order that it may retain the substance called the potin, which is to be welded upon one side of the iron, to form the hard matter on which the holes are to be pierced. This potin is nothing but fragments of old cast-iron pots; but those pots which have been worn out by the continued action of fire are not good: the fragments of a new pot which has not been on the fire are better.

The workman breaks these pieces of pots on his anvil, and mixes the pieces with charcoal of white wood. He puts this in the forge, and heats it till it is melted into a sort of paste; and to purify it he repeats the fusion ten or twelve times, and each time he takes it with the tongs to dip it in water. M. Du Hamel says, this is to render the matter more easy to break into pieces.

By these repeated fusions with charcoal, the cast iron is changed, and its qualities approach those of steel, but far from becoming brittle; it will yield to the blows of the hammer and to the punch, which is used to enlarge the holes. The bar of iron which is to make the draw-plate is covered with a layer of pieces of the potin, or cast iron, thus prepared. It is applied on the side which is furrowed, and should occupy about half an inch in thickness. The whole is then wrapped up in a coarse cloth, which has been dipped in clay and water mixed up as thick as cream, and is put into the forge. The potin is more fusible than the forged iron, so that it will melt. The plate is withdrawn from the fire occasionally, and hammered very gently upon the potin, to weld and in some measure amalgamate it with the iron, which cannot be done at once; but it must be repeatedly heated, and worked until the potin fixes to the iron. The workman then throws dry powdered clay upon it, in order, they say, to soften the potin.

The union being complete, the plate is again heated, and forged by two workmen, who draw out the plate of one

 foot

foot to a length of two feet, and give it the form it is to have. It is well known that caft iron cannot be worked at the forge without breaking under the hammer; but in the prefent inftance, it is alloyed with the iron-bar, and is drawn out with it. It has alfo acquired new properties by the repeated fufions with charcoal.

The holes are next pierced whilft the plate is hot. This is done with a well-pointed punch of German fteel, applied on that fide of the plate which is the iron-bar. It requires four heats in the fire to pierce the holes, and every turn a finer punch is employed, fo as to make a taper hole. The makers of draw-plates do not pierce the holes quite through, but leave it to the wire-drawers to do it themfelves when the plate is cold, with fharp punches, and then they open the hole to the fize they defire; and although this potin is of a very hard fubftance, the fize of the hole may be reduced by gentle blows with a hard hammer, on the flat furface of the plate, round the hole.

A great many holes are made in the fame plate; and it is important that they fhould diminifh in fize by very imperceptible gradations; fo that the workman can always choofe a hole fuitable for the wire he is to draw, without being obliged to reduce it too much at once.

To afcertain the fize of the wire, gauges are ufed. They are commonly made of a piece of wire bent in zigzag, as fhewn in *fig.* 11; and the fpace between every bend is of a different width; but a better fort is made of a fteel-plate, with notches on the edge. (See *fig.* 12. for the ftandards.) Thefe fhould be hardened, that they may not be fubject to wear.

Fig. 13. is another kind of gauge, which is very accurate. It confifts of two ftraight rules of fteel, put together at an angle. The diameter of the wire is indicated by the depth to which it will enter into the angle; the edges of the rulers are divided into equal parts for that purpofe, and numbered, to correfpond with the different fizes of wire.

The wire manufactory of Meffrs. Mouchel, fituated at l'Aigle, in the department de l'Orne, is one of the moft confiderable in France. It furnifhes annually, in cards for wool-combing only, an hundred thoufand quintals of iron-wire, each 100lbs. A part of this is confumed in France, and the reft is exported to Portugal, Spain, Italy, and even to the fhores of the Levant.

They employ the iron manufactured in the departments of l'Orne and La Haute Saone, as being of the beft quality. The firft produces the beft wire for making fcrews, nails, and pins, as much on account of its hardnefs as its fine polifh, which refembles fteel-wire. In this refpect, it is fuperior to the iron of Haute Saone, but from its ductility the latter can now be made extremely fine, and it appears to be moft free from heterogeneous particles.

The fmelted iron, prepared and hammered, being in a ftate nearly fit for their purpofe, is tranfported, at a fmall expence, to l'Aigle, by the rivers and canals. They have a forge to reduce the fteel and iron of Normandy, which arrives in large pieces, into fmall and regular bars.

When the iron is formed into an irregular bar of about a centimetre, near four-tenths of an inch in diameter, they begin to draw it into wire. Although it be already much extended by hammering, it is in the firft place paffed four times through the drawing-plate; then its molecules become difpofed lengthways, and exhibit fibres at their utmoft extenfion. The fibres muft be removed by means of heat, which difperfes and divides them; and after that the wire may again be reduced three numbers. The fibres which are re-produced by this operation are again removed by heat. The whole procefs is five times repeated; confequently the wire is paffed through fifteen numbers; after which, a fingle expofure to the fire is fufficient to fit it for paffing fix others, whereby it is reduced to the thicknefs of a knitting-needle.

The fteel-wire, being much harder, requires to be paffed through forty-four numbers, and to be annealed every other time.

The machine which draws the fteel-wire muft go flower than that which draws the iron; for the firft being very hard, and offering more refiftance to the drawing-plate, fhould be pulled out with more care, fince the quicknefs ought to be proportioned to the refiftance, and reciprocally; and if they depart from this principle, the refults will vary. Thus, for example, the iron of the department de l'Orne, which is more compact than that produced at Haute Saone, if drawn by the fame machines, augments in hardnefs, and is weakened when it is brought to too great a degree of finenefs. But this iron, which is very hard, and capable of receiving a very high polifh, is to be preferred for certain ufes.

In order to anneal the wire, they formerly employed a large and elevated furnace, with bars of caft iron to fupport the wire in the middle of the flames. It contains feven thoufand pounds weight, fo contrived as to contain equal portions of each number. They are fo arranged that the thickeft wires receive the ftrongeft heat; therefore, the whole is equally heated in the fame fpace of time. The operation lafts three hours with a fire well kept up, and it might be imagined that this apparatus was completely adapted to the purpofe; but there are imperfections in this method, becaufe it leaves the wire expofed to the contact of the atmofpheric air, the oxygen of which feizes it with extreme avidity; whence a confiderable quantity of oxyd is occafioned, and alfo an operation to free it from the fcales, which confifts of beating the bundles of wire with a wooden hammer wetted with water.

Notwithftanding this precaution, there often remains a portion of oxyd adhering to the furface of the metal, which ftreaks the draw-plate, or fixes on the wire, and gives it a tarnifhed appearance, and caufes it to break when it is brought to a great degree of finenefs. This furnace is only ufed for the fteel-wire, or the iron from l'Orne, which is lefs liable to change, and befides being harder is not fo eafily attacked by the oxygen.

In order to diminifh the wafte that the fire occafions, they have contrived another procefs, which confifts in dipping the bundles of wire into a bafin of wet clay before they put them into the furnace; and they are left in the furnace to dry before the fire is lighted, without which precaution the clay would peel off from the iron.

For making wire for cards, M. Mouchel invented another furnace. It is round, and about one metre fix decimetres in diameter, and one metre eight decimetres in height, without including its parabolic arch and the chimney above it. The interior is divided by horizontal grates into three ftories; the loweft receives the cinders, the fecond is the fire-place, and into the third or upper place they flide a roleau of wire, weighing one hundred and fifty kilogrammes, which is inclofed in a fpace comprifed between two caft-iron cylinders, being luted to prevent the admiffion of air between them. The flames circulate about the outfide of the firft, and within the interior of the fecond, which defends the wire from atmofpheric air. The diameter of the largeft cylinder is about one metre four decimetres, that of the fecond one metre. Thus the fpace comprifed between them is two decimetres, on an elevation of five decimetres. There muft be feveral pairs of cylinders provided; becaufe whilft one

pair

pair is in the furnace another muſt be prepared to receive a freſh roleau of wire. They are changed every hour by means of a long iron lever, with which a ſingle man can eaſily puſh them in and draw them out again, as the cylinder ſlides on caſt-iron rails.

They are very careful not to open the cylinders immediately on their being drawn out of the fire; for the roleaus of wire contained in them, being ſtill red, would oxydate quite as much as if they had been heated in the midſt of the flames without the leaſt precaution.

The opening contrived for the paſſage is on the ſide, and has a door of caſt iron, with a groove which winds round the furnace. The fire-place has one ſomething ſimilar to it. That of the aſh-hole is vertical, in order that it may be raiſed to increaſe the fire at will.

When the iron-wire is reduced to the thickneſs of a knitting-needle, it is made up in bundles of 125 kilogrammes (275 pounds) each, into a large iron veſſel, in order to anneal it ſufficiently to be reduced for the laſt time. This veſſel is placed upſide-down in the middle of a round furnace, which is ſo conſtructed as to ſuſtain burning coals all round it, and of which it conſumes 35 kilogrammes (77 pounds) before the operation is completed. The cover muſt be carefully luted, as the ſlighteſt admiſſion of air is ſufficient to burn the external ſurfaces of the wire to an oxyd, which cannot afterwards be reduced.

When one of theſe veſſels is ſufficiently heated, it is filled with water, containing three kilogrammes (ſix pounds and a half) of tartar, and ſuſpended over the flames of the furnace to make it boil. This ſolution, without attacking the metal, frees it from the greaſe and the little oxyd that adheres to it. This is the laſt operation in which the wire is expoſed to the fire; and it is then in the proper ſtate for being reduced to the utmoſt degree of fineneſs it is capable of ſuſtaining, and will preſerve enough of the effect of the annealing to require it no more. But when the natural hardneſs of the iron varies, this laſt expoſure to the fire ſhould take place in proportion to its thickneſs. As ſteel loſes its capacity of extenſion much ſooner than iron, it is annealed until it is no thicker than a ſewing-needle. The ſpace which is left in the veſſel is filled up with charcoal-duſt, which prevents it from loſing the quality of ſteel, and preſerves the heat long enough to give it the proper degree of pliancy.

As Meſſrs. Mouchel always uſe iron and ſteel of the ſame manufactory, they have been able to reduce their operations to a general ſyſtem; and to attain this end, have determined a graduated ſcale, by which the wire will not be more ſtretched in the drawing-plate in one number or ſize than another. The following is the method they contrived, in order to form this ſcale for the iron-wire. They take a certain quantity of various thickneſſes, which has been drawn as fine as the iron would bear. The ſmalleſt ſize is 100,000 metres (109,333 yards) in length to the kilogramme, 2.2 pounds avoirdupois. They note the weight that each might be capable of ſupporting without breaking. This being expreſſed by figures, it is eaſy, by a few interpolations, to expreſs them in a progreſſive form. This kind of ſcale has been partly formed by comparing the weight of the different ſizes with equal lengths, from which gauges or calibres may be made for the uſe of the workmen. Theſe gauges are certain guides, which they cannot miſtake except through great careleſſneſs. If they had not theſe guides they would often paſs the wire through holes in the drawing-plate that are too large for it, whence it does not acquire the ſtrength it ſhould have in proportion to its thickneſs, and loſes its hardneſs. They might alſo paſs it through holes that were too ſmall, which would weaken it, and render it very brittle. In the latter caſe, it frequently happens that the ſteel of the drawing-plate, being unable to ſuſtain the force to which it is expoſed, will give way, as if the plate were too ſoft; and the wire will be brittle at the beginning, and ſoft and too thick at the other extremity.

The greateſt part of the fine wire of Meſſrs. Mouchel's manufactory is drawn by workmen who are diſperſed about the country; but they have alſo a machine which moves twenty-four bobbins in a horizontal direction, which only requires the workman to look after it. It is upon the bobbins that the wire is reduced to the different degrees of thinneſs deſired; therefore, this is the laſt operation in the art of making iron and ſteel wire; although it has all requiſite qualities given to it in the work-ſhop of the wire-drawer.

Wire is ſtill incapable of being made into needles and carding-hooks, until it has undergone another operation for dreſſing or ſtraightening the wire, by which it is made to loſe the bend or curve that it acquires on the bobbins.

This work conſiſts in drawing the wire between nails fixed in a piece of wood, and which act to bend the wire, firſt in one direction, and then in the oppoſite, in a waving line, of which the waves are at firſt larger, but decreaſe gradually, and the laſt bend of which tends to force the wire into a ſtraight line. The dreſſer is obliged conſtantly to adjuſt the nails, by inclining or raiſing them with ſtrokes of the hammer. Alſo for each number of wires the pins muſt be at different and calculated diſtances. This requires a workman of intelligence, diligence, and addreſs.

An ingenious inſtrument is now appropriated to this operation, and removes all difficulty. Six little puppets of very hard ſteel are ſubſtituted for the nails of the ordinary inſtrument, and are fixed on parallel bars of metal, ſo jointed together that the movement of them all will be parallel, and the puppets are widened or brought nearer together by ſcrews. The wire is drawn between theſe puppets in a zigzag or waving line, and the repeated flexures break the ſinuoſities of the wire. There is a conductor of the wire to the puppets, and another conductor which ſerves to prevent the wire from being ſhaken. There are ſlight grooves at the extremity of the puppets, to give a paſſage to the wire. A ſcale ſuſtained by a ſcrew indicates the diſtance at which the puppets ſhould be placed from each other, to ſtraighten each ſize of wire. This forms an invariable rule, and the dreſſer (who may be a child) ſaves a third of the time which is employed in regulating the nails of the inſtrument formerly uſed. There is nothing more to be done but to draw out the wire by means of a wheel, on which he reels it, and then forms it into bundles to be delivered to the conſumers.

The ſteel-wire of France is proper for many purpoſes. It is brought from Meſſrs. Mouchel, for making knitting-needles in the Engliſh faſhion, ſhoemakers' needles, and other ſimilar articles. It may alſo be uſed for needles of all ſizes, and even for cards for wool-combing; but as this ſteel is much more expenſive than the iron-wire, it is very ſeldom uſed for the latter purpoſe.

The method of preparing the draw-plates is deſcribed by Meſſrs. Mouchel, and is different from that before deſcribed.

For making wire for cards, two ſorts of drawing-plates are uſed, large and ſmall ones. The firſt, for the ſort of wire that we have been deſcribing, is drawn with the pincers, as *fig.* 7, and with the bobbin or roller, which is a cylinder adapted to the axis turned by the water-mill, and is uſed in preference, to avoid the marks made on the wire by the pincers. The ſmall drawing-plates are uſed for ſuch wire as may be drawn by hand. The ſteel which they employ for theſe drawing-plates ſhould never vary in quality, except that the ſmaller plates are made of the fineſt ſteel. Several pieces of iron are diſpoſed in the furnace in the form of a box without a lid, their weight being according to the uſe for which they are intended to be employed.

The workman fills each of theſe boxes with caſt ſteel, and having covered it over with a luting of clay, it is expoſed to a fierce fire until the ſteel be melted. His art conſiſts in ſeizing the proper moment to withdraw the plate from the fire: he raiſes the luting, and blows on it through a tube, in order to drive off all heterogeneous parts, and then amalgamates it with the iron by light blows. After it is cool, he replaces it at the fire, where the fuſion again takes place, but to a leſs degree than before; he afterwards works the ſteel with light blows of the hammer, to purify and ſolder it with the iron. This operation is repeated from ſeven to ten times, according to its quality, which renders it more or leſs difficult to manage. During this proceſs, a cruſt forms on the ſteel, which is detached from it the fifth time of its expoſure to the fire, becauſe this cruſt is compoſed of an oxydated ſteel of an inferior quality. It ſometimes happens that two and even three of theſe cruſts are formed of about two millimetres, or one-ſixteenth of an inch in thickneſs, which muſt alſo be removed.

After all theſe different fuſions, the plate is beaten by a hammer wetted with water, and the proper length, breadth, and thickneſs, are given to it. When thus prepared, the plates are heated again, in order to be pierced with holes by punches of a conical form; the operation is repeated five or ſix times, and the punches uſed each time are progreſſively ſmaller. It is of importance that the plate never be heated beyond a cherry-red, becauſe if it receives a higher degree of heat, the ſteel undergoes an unfavourable change. The plates, when finiſhed, preſent a very hard material, which nevertheleſs will yield to the ſtrokes of the punches and the hammer, which they require when the holes become too much enlarged by the frequent paſſing of the wire through them.

When the plates have been repaired ſeveral times, they acquire a degree of hardneſs, which renders it neceſſary to anneal them, eſpecially when they paſs from one ſize to another; ſometimes they do not acquire the proper quality until they have been annealed ſeveral times. Notwithſtanding all the precautions which are taken in preparing the plates, the ſteel ſtill varies a little in hardneſs, and according to this variation they ſhould be employed for drawing either ſteel or iron wire; and if the workman who proves them finds that they are too ſoft for either the ſteel or iron, they are put aſide, to be uſed by the braſs-wire drawers.

A plate that is beſt adapted for drawing ſteel-wire is often unfit for the iron; for the long pieces of this latter metal will become ſmaller at the extremity than at the beginning, becauſe the wire as it is drawn through the plate is inſenſibly heated, and the adhering parts are ſwelled, conſequently preſſed and reduced in ſize towards the latter end. The plates that are fit for braſs are often too ſoft for iron, and the effect reſulting is the reverſe of that produced by a plate that is too hard.

The ſmalleſt plates which Meſſrs. Mouchel uſe are at the leaſt two centimetres, or eight-tenths of an inch in thickneſs, ſo that the holes can be made ſufficiently deep; for when they are of a leſs thickneſs, they will ſeize the wire too ſuddenly and injure it. This inconvenience is much felt in manufactories where they continue to uſe the plates for too long a time, as they become exceedingly thin after frequent repairs. One of Meſſrs. Mouchel's large plates reduces 1400 kilogrammes (3080 pounds avoirdupois) from the largeſt ſize of wire to No. 6, which is of the thickneſs of a knitting-needle; 400 kilogrammes (880 pounds) of this number are afterwards reduced in one ſingle ſmall plate to No. 24, which is carding wire; and to finiſh them, they are paſſed through twelve times ſucceſſively.

For the tenacity of iron wire, ſee Iron.

The firſt wire-mill in England was ſet up by a Dutchman at Sheen, near Richmond, in 1663.

Wires are frequently drawn ſo fine, as to be wrought along with other threads of ſilk, wool, or hemp: and thus they become a conſiderable article in the manufactures. See Ductility.

Wire, *Gold*. See Gold-*Wire*.

Muſchenbroeck records, that an artiſt of Augſburg drew a wire of gold ſo ſlender, that 500 feet of it weighed only one grain; and Dr. Wollaſton, ſecretary of the Royal Society, has ſhewn, that a wire of gold may be drawn much finer than this, and that wires of platina may be drawn much more ſlender, with the utmoſt facility. Thoſe who draw ſilver-wire in large quantities for lace and embroidery, ſometimes begin with a rod that is about three inches in diameter, and ultimately obtain wires that are ſo ſmall as $\frac{1}{100}$ of an inch in thickneſs. If in any ſtage of this proceſs a rod of ſilver-wire be taken, and a hole be drilled through it longitudinally, having its diameter one-tenth part of that of the rod, and if a wire of pure gold be inſerted, ſo as to fill the hole, it is evident that by continuing to draw the rod, the gold within it will be reduced in diameter exactly in the ſame proportion as the ſilver; ſo that if both be thus drawn out together till the diameter of the ſilver is $\frac{1}{500}$ of an inch, then that of the gold will be only $\frac{1}{5000}$; and of ſuch wire, 550 feet would be requiſite to weigh one grain. In order to remove the coating of ſilver that ſurrounds it, the wire muſt be ſteeped for a few minutes in warm nitrous acid, which diſſolves the ſilver without any injury to the gold. Dr. W., in his endeavours to make ſlender gold-wires by the method above-deſcribed, found it difficult to drill the central hole in a metal ſo fine as ſilver, and therefore tried whether platina might not be ſubſtituted for the gold, as in that caſe its infuſibility would allow its being coated with ſilver, without the neceſſity of drilling. Having formed a cylindrical mould one-third of an inch in diameter, he fixed in the centre of it a platina wire previouſly drawn to the $\frac{1}{100}$ of an inch, and then filled the mould with ſilver. When this rod was drawn to $\frac{1}{30}$, his platina was reduced to $\frac{1}{1000}$, and by ſucceſſive reduction he obtained wires of $\frac{1}{4000}$ and $\frac{1}{5000}$, and excellent for applying to the eye-pieces of aſtronomical inſtruments, and perhaps as fine as can be uſeful for ſuch purpoſes. The extremity of a platina wire having been fuſed into a globule near $\frac{1}{4}$ of an inch in diameter, was next hammered out into a ſquare rod, and then drawn again into a wire $\frac{1}{253}$ of an inch in diameter. The fuſion was effected by the following ſimple and eaſy method ſuggeſted by Dr. Marcet:

Marcet:—A piece of wire, about fix inches long, having been bent to an angle in the middle, one half of its length was held in the flame of a fpirit-lamp impelled by a current of oxygen, and its extremity was thus fufed in about half a minute. An inch of the wire above-mentioned duly coated with filver was drawn, till its length was extended to 182 inches; confequently the proportional diminution of the diameter of the platina will be expreffed by the fquare root of 182, fo that its meafure had become $\frac{1}{253 \times 13.5} = \frac{1}{3425}$. The fpecific gravity of the coated wire was affumed to be 10.5, and fince the weight of 100 inches was 114 grains, its diameter was inferred to be $\frac{1}{42.8}$ of an inch, and juft eighty times of the platina thus contained in it. With portions of the platina wire thus obtained, and fucceffively reduced in diameter, its tenacity was afcertained; and the refults of feveral trials fhewed in general, that the procefs of wire-drawing, which is known to improve the ftrength of metals within moderate limits, continued alfo to add fomething to the tenacity of platina, even as far as $\frac{1}{18.000}$ of an inch, which fupported $1\frac{1}{3}$ grain before it broke; but the wire in which the experiments were made began then to be impaired by repetition of the operation; fo that although he afterwards obtained portions of it as fmall as $\frac{1}{30.000}$ of an inch in diameter, it was in many places interrupted, and he could not rely on any trials of its tenacity. For other particulars with regard to thefe fine wires, we refer to the Phil. Tranf. vol. ciii. pt. 1.

Wire, *Silver*, is the fame with gold wire, except that the latter is gilt, or covered with gold, and the other is not. There are alfo counterfeit gold and filver wires: the firft made of a cylinder of copper, filvered over, then covered with gold; and the fecond of a like cylinder of copper filvered over, and drawn through the iron, after the fame manner as gold and filver wire.

By 43 Geo. III. c. 68. feveral duties are impofed on wire imported, as fet forth in tables annexed to the act; and by c. 69. fched. A. duties are laid upon wire made in Great Britain; and by 49 Geo. III. c. 98. new duties are impofed. Every wire-drawer who fhall draw any gilt or filver wire, commonly called 'big wire,' fhall take out a licence, for which he fhall pay 2*l.*, to be renewed annually on pain of 20*l.* 24 Geo. III. c. 41. One licence fuffices for a partnerfhip. Notice is to be given of working on pain of 20*l.*, and the place of working is to be approved by the commiffioners under the fame penalty. Wire, and bars for making it, and utenfils, found in any private workhoufe, of which no notice hath been given, fhall be forfeited. Officers fhall be permitted to enter and furvey, and the penalty of obftructing him is 20*l.* 10 Ann. c. 26. Preventing him from taking a juft account incurs a forfeiture of 100*l.* 26 Geo. III. c. 77. Juft fcales and weights fhall be kept on pain of 10*l.* Perfons ufing falfe fcales and weights forfeit 100*l.* 10 Geo. III. c. 44. And the fame fhall be forfeited and feized. 28 Geo. III. c. 37. Ingots or bars of filver, defigned for gilt wire, fhall be weighed in the prefence of the excife officer, before they be covered with gold, and again weighed and marked after the gold is laid on, under penalty of 20*l.* 15 Geo. II. c. 20.

By 10 Ann. c. 26. an allowance of one-fifth is made for wafte in reducing the big wire to fmall wire. Removing wire before it is furveyed incurs a penalty of 40*l.*; and unfurveyed wire is to be kept feparate, on pain of 10*l.*; and the punifhment of concealing wire, &c. is a forfeiture of 20*l.* The wire made fhall be entered every month, on oath, on pain of 100*l.* The duty muft be cleared off in fix weeks after entry, on pain of double duty.

By 15 Geo. II. c. 20. and 22 Geo. II. c. 36. no foreign embroidery, or gold or filver brocade, thread, lace, fringe, or work made thereof, or of copper, brafs, or other inferior metal, or gold or filver wire, or plate, fhall be imported. And by 10 Ann. c. 26. if any perfon fhall export any gold or filver thread, or lace or fringe made of plate wire fpun upon filk, he fhall have a drawback after the rate of 5*s.* a pound avoirdupois, of fuch filver thread, lace, or fringe, and of 6*s.* 8*d.* a pound of fuch gold thread, lace, or fringe.

For regulations concerning the true making of gilt and filver wire, fee the ftatute 15 Geo. II. c. 20. and for prohibiting the felling or working up of foreign gold or filver lace or thread, fee 22 Geo. II. c. 36.

Wire, *Brafs*, is drawn after the fame manner as the former. Of this there are divers fizes, fuited to the divers kinds of works. The fineft is ufed for the ftrings of mufical inftruments, as fpinets, harpfichords, manichords, &c.

The pin-makers likewife ufe vaft quantities of wire of feveral fizes, to make their pins of. See Pin.

Wire, *Iron.* See Wire *fupra.*

Wire-*Gauze Safety-Lamp*, and *Safety-Lamp*, in the *Arts*, are lamps conftructed to prevent the explofion of inflammable air in mines, by intercepting the communication of the flame on the infide of the lamp with the furrounding atmofphere. The difcovery of fafety-lamps for this purpofe belongs exclufively to our own country, and will form a new era in mining operations. We fhall, therefore, ftate the hiftory of their invention with as much accuracy as poffible, amidft the contending claims of the different inventors for priority. The explofions of inflammable air in coal-mines arife from the ignition of carburetted hydrogen evolved from the ftrata, and mixed with the atmofpheric air that circulates through the mine. Thefe explofions very frequently occafion the moft fatal effects, deftroying the lives of all the perfons employed as well as of the horfes, and producing great mifchief to the fubterranean works. Some mines are much more liable to accidents from this caufe than others. In fome the carburetted hydrogen accumulates flowly from the want of due circulation; in other mines, it is generated very rapidly, iffuing from fiffures called blowers, which occur either in the roof, the floor, or the fides of the mine.

In the coal-fields of the Tyne and the Wear, it has been eftimated that fix hundred men and boys were deftroyed in two years by explofions in the mines; but thefe accidents, unlefs they took place on a large fcale, were as much as poffible kept from public notice, partly from the fear of alarming the workmen, and partly from the apprehenfion of blame to the viewers and managers of the works. Of thefe melancholy cataftrophes, few regifters are kept in any part of Great Britain; but in the year 1810 an explofion took place in a mine in the parifh of Felling near Newcaftle, which, from the magnitude of the evil it occafioned, excited a general fenfation of horror throughout the country. In this mine, the property of wealthy and liberal owners, no expence had been fpared in the introduction of machinery and the moft approved methods of ventilation. (See Ventilation *of Mines.*) Notwithftanding this, on the 25th of May

May 1812, the inflammable air exploded in two difcharges from one of the pits, which was fhortly followed by a third from another pit.

The depth of thefe explofions under the furface obtunded the found of the reports; but for half a mile round the vibrations of the earth announced the occurrence of the accident before the noife efcaped, and an alarm was created four or five miles round by low and hollow rumblings in the air. Immenfe volumes of denfe vapour and coal-duft, with pieces of wood and coal, were driven high into the atmofphere; and the mangled bodies of feveral men and boys were abfolutely thrown out of the fhaft. The country in the immediate vicinity was enveloped in darknefs, and every kind of machinery near the mouths of the pits was blown to pieces, or fet fire to. Out of a hundred and twenty men and boys employed in the mine only thirty-two were faved, three of whom afterwards died. The coal being fet fire to, and the fubterranean works blown down or deftroyed, the owners were compelled to clofe the mouths of the pits in order to extinguifh the fire; and it was not till the feventh or eighth of the following month that it could be re-opened to extract the bodies, which were, many of them, too much mangled, and in too putrefcent a ftate, to be identified by the relatives. A feries of fimilar difafters, in each of which from twenty to thirty-five human beings were deftroyed, occurred foon afterwards in the fame diftricts, and even in the Felling mine another explofion took place in December 1813, by which twenty-three men and boys and twelve horfes were killed. The only method that bad been adopted to prevent explofions, befides the ufual modes of ventilation for clearing the mine, was the fubftitution of fteel-mills for candles.

The fteel-mill is an inftrument for producing light by the collifion of flint and fteel: it confifts of a brafs wheel about five inches in diameter, with fifty-two teeth, which works a pinion with eleven teeth. On the axis of the pinion is fitted a thin jagged fteel wheel, from five to fix inches in diameter; againft the circumference of this wheel the fharp edge of a flint is fixed, and the toothed wheel has a handle, which is turned by a boy; the whole machine being fixed in an iron frame fufpended by a leather belt. The fteel wheel revolves with great velocity, and elicits a ftream of fcintillations, which give a confiderable light. Where the mines were fufpected to contain inflammable air, thefe machines were ufed; but befides affording only an unfteady light, and being difficult to manage, many inftances had occurred of the air igniting from the fcintillations of fteel-mills. For the purpofe of exploring the unworked and more dangerous parts of the mine, the fteel-mill was both an inconvenient and incomplete inftrument; but until the year 1809 no method of lighting had been attempted which might fuperfede its ufe.

About that time Dr. Reid Clanny, a fcientific and ingenious phyfician at Sunderland, commenced a feries of experiments, with a view to infulate the gas which might explode in a lamp, and cut off its communication with the furrounding air in the mine. With this intent, he conftructed a lamp in which the combuftion of the oil or tallow is fupported by the ordinary air of the coal-mine fupplied by a pair of bellows, and paffing through a ftratum or refervoir of water below the light; at the fame time, a portion of the air already in the lamp is driven through another refervoir in the upper part above the light, and thus the air fupplied may explode within the body of the lamp without communicating the flame to the external air, however highly it may be charged with carburetted hydrogen gas. The moment the air enters the lamp it comes in contact with the flame, and confequently only a fmall portion of it can be exploded, inftead of the whole contents of the lamp; by this means feveral obvious advantages are fecured. The air paffing in a brifk current clofe by the flame carries the fnuff with it, fo that the light is always clear and fteady. The other parts of the lamp were air-tight, and the whole made very ftrong, with a glafs nearly half an inch thick to prevent it from being broken by any common accident. It is capable of being managed by a boy at a much lefs expence than the fteel-mill. This lamp, which, for ftrength and for fecurity from explofions and accidents, exceeds any other that has fince been invented, excited little attention among the coal-workers where it was firft made known. Had not the prejudices againft improvements prevented its general introduction, more than one thoufand lives might have been preferved, which were deftroyed in the mining diftricts of the Tyne and Wear in a few years after its difcovery. In its firft form, the lamp, though fecure, was not made fufficiently light to be portable without being placed on a barrow; but Dr. Clanny afterwards improved it in this refpect, by fubftituting a fmall pair of bellows to be worked under the right arm; the lamp, being fufpended by a leather belt from the left fide of the boy who carried it, might in this way be moved into the narroweft or moft dangerous parts of the mine. A defcription of Dr. Clanny's fafety-lamp, with a plate, was firft given in the Philofophical Tranfactions of the Royal Society for 1813, part ii. p. 200. In this lamp, however ftrong may be the currents of air in the mine, the flame cannot be affected by them, and the moft dangerous *blower* may be approached in perfect fafety. When an explofion takes place in the lamp it extends no farther, and the flame is inftantly extinguifhed; and wherever there is fufficient atmofpheric air to fupport life, this lamp will afford a fafe and abundant light. The conftruction of the lamp was rendered more fimple by paffing the air through the oil, by which the neceffity of the lower refervoir of water was avoided.

In *Plate* I. *fig.* 2. *Geology*, is given an outline of the lamp on its original principle, which, though lefs portable, is, we confider, the fafeft that has yet been employed. A is the body of the lamp, conftructed of copper or block-tin; B, the upper part of the lamp, ending in a conical bent tube, by which the air is difcharged after fupporting combuftion through the water-ciftern C and D, the part D being filled with water to keep the lamp cool, if neceffary; E, the window of the lamp, made of very thick glafs; F, the candle, fupported on a tin ftand; G, a ciftern containing water, through which the air is forced by the bellows; H, a tube from the bellows, which conveys air to the lamp. A flexible leather tube may be fixed to the valve of the bellows, to fend atmofpheric air from a diftance, if neceffary. If the lamp be in order, it is fcarcely poffible to conceive any infulation of the flame more perfect than it prefents; and to Dr. Clanny muft be allowed the undoubted claim of priority in having firft directed the attention of miners to a method of avoiding danger before unknown, and of fhewing practically how it might be effected. In the improvement which Dr. Clanny made in this lamp afterwards, to render it more portable, (fee *fig.* 3. in the fame plate,) *a* is the tube fixed to the lamp, and which conveys the air; *b*, the oil-ciftern; *c*, the air aperture, under the burner of the oil; *d*, the flexible tube connected with the bellows; *e*, *f*, the glafs. In both thefe lamps, the air being fupplied by bellows, required the conftant attention of a boy; this, however, was the cafe with the fteel-mills, which were in general ufe before. A lamp that would fupply itfelf with atmofpheric air was ftill a defideratum; when Dr. Clanny difcovered, in November 1815, as he was making experiments with the original fafety-lamp in an atmofphere of fire-damp

in

in the Horrington mine, near Sunderland; that if the infulation of the lamp were made with hot water, the fire-damp burned filently at the wick, and did not explode within the lamp, as formerly. This he afcertained to be owing to the fteam; and he farther difcovered, that one part in volume of fteam to two of the moft explofive mixtures deftroyed their inflammability. A fimilar effect of fteam had been before noticed by Von Grotthus, in the 82d volume of the Annales de Chimie, but had not been applied to any ufeful purpofe. In December of the fame year, Dr. Clanny conftructed a fteam fafety-lamp, which he exhibited to the Society, for preventing accidents in coal-mines, and received their unanimous thanks; and in 1817 he received a gold medal from the Society of Arts for the difcovery.

In the fteam fafety-lamp there is a refervoir of water at the top of the lamp, which is a clofed tin box, or ciftern. The water is kept boiling by the flame of the lamp, and the fteam mixing with the carburetted hydrogen prevents all rifk from explofion. The air is fupplied through a tube to the upper part of the ciftern above the water, and defcends, mixed with the fteam, down two other tubes, into the body of the lamp. By this means, the fire-damp burns filently and fteadily at the wick of the lamp alone for any length of time. Should the carburetted hydrogen exceed the proportion of atmofpheric air for fupporting combuftion, the light is extinguifhed, but this can rarely happen. It has alfo the valuable property of keeping cool throughout every part, and under all circumftances; this is effected by the evolution and motion of the fteam. This lamp, fays Dr. Clanny, is now well known to burn moft brilliantly in an atmofphere of fire-damp, even after the original fafety-lamp has had the fire-damp exploded within it. The fteam-lamp has now been extenfively ufed in feveral of the northern collieries. Its great recommendation over other inventions is the fuperior light which it affords. Thefe lamps are made of the ftrongeft tinned iron, with a flat glafs in front, three-eighths of an inch in thicknefs. They are exceedingly ftrong and durable, and coft about twelve fhillings, but might be manufactured on a large fcale for half the price.

Fig. 4. reprefents the fhort tube by which the air enters into the tube *b*, and this tube fupports the water-ciftern *c* at the top, being fitted into the tube *a* at the bottom, fo as to be taken out and replaced when the water is to be poured in or removed from the ciftern *c*. The air which afcends the tube *b* mixes with the fteam of the water-ciftern, and paffes down the two tubes *d*, *d*, to fupport the combuftion of the flame, and afterwards afcends by the fide of the ciftern through the chimney of the lamp. Thefe tubes are clofed at the bottom, and perforated on the fides, to retard the progrefs of the air, and mix it with the fteam before it reaches the flame *e*. The bottom is air-tight; *f* the glafs, and *g* the oil-lamp. Thefe lamps are twelve inches in length, exclufively of the chimney. They fhould be cleared of water, and well dried, after they have been in ufe, that they may be more durable. When the lamp is firft lighted it is neceffary to eftablifh a current, which is beft done by turning the lamp, fo that the tube *a* may be expofed to the current of air; this will be effected in five minutes, and the lamp will afterwards continue to burn regularly and fteadily.

Dr. Clanny farther applied the fame principle to the conftruction of a larger lamp, in which were three wicks to burn the inflammable air as it was made to iffue through the oil; this is intended to confume the hydro-carburetted gas as it rufhes from a blower.

In the hiftory of ufeful inventions, perhaps no inftance of fupinenefs can be adduced, among thofe interefted in any difcovery, which equals the inattention fhewn for feveral years by the coal-workers in the north to the valuable labours of Dr. Clanny. We had an opportunity of examining his lamp in 1813, and were fatisfied with the complete fecurity which it affords. At that time, however, fo far from receiving the patronage he highly merited, he was regarded by many with a ftrange jealoufy, as an officious intruder into the myfteries of mining; myfteries which he had no right to inveftigate. To Dr. Clanny, however, the firft difcovery of a fafety-lamp is undoubtedly due; and we have no hefitation in afferting our belief that his original fafety-lamp is the moft fecure of any that have fince been invented, where dangerous parts of the mine are to be explored, on account of its more complete infulation, and its greater ftrength. His lamp had alfo the merit of firft fuggefting the poffibility of infulating the flame in the different lamps which have fince been conftructed.

The attention of the public was at length directed to the dangerous fituation of the men working in the mines by a few gentlemen, who formed a fociety, in 1813, at Sunderland, entitled A Society to prevent Accidents in Coal-Mines. Dr. Gray, rector of Bifhop-Wearmouth, an active member of this fociety, invited fir H. Davy, in 1815, who was then on a vifit in the north of England, to examine the collieries with a view to affift the efforts of the fociety to prevent the accidents to which they were fubject. From the information communicated to him by perfons employed in the mines, he was induced to commence a feries of experiments on carburetted hydrogen gas, which led to feveral unexpected refults, not lefs interefting to fcience than ufeful in their application to the arts. Before proceeding to defcribe thefe, we muft notice the labours of Mr. Stephenfon, an engineer in the Killingworth main colliery, who previoufly to this time had, as he afferts in a pamphlet on the fubject, entitled "A Defcription of the Safety-Lamp invented by George Stephenfon," made the difcovery that inflammable air will not explode through fmall apertures. In the fame pamphlet he ftates, that a lamp conftructed by him on this principle was tried in the above colliery on the 21ft of October 1815, the lamp being carried in fafety into a part of the mine where a ftrong blower of inflammable air was iffuing. The experiment, he adds, was immediately repeated in the prefence of two perfons employed in the works.

Thefe lamps, judging from Mr. Stephenfon's own defcription, yielded but a feeble light. They were afterwards improved; but thefe improvements bear fo clofe a refemblance to parts of fir H. Davy's lamp, hereafter to be defcribed, that we conceive Mr. Stephenfon muft labour under no fmall difficulty in eftablifhing his claim for their original invention. The queftion, at prefent agitated with much warmth, can only be decided by a reference to well-eftablifhed dates and authentic evidence; an inveftigation not fuited to the nature of the prefent work.

We have little doubt that the infulation obtained in Dr. Clanny's lamp by water firft fuggefted to Mr. Stephenfon the poffibility that fmall apertures might intercept the extenfion of the flame as effectually as water. On this fuggeftion his firft lamp appears conftructed, the tube which admitted the air being covered with a flide, to diminifh the aperture at pleafure; but the quantity of air which could be fafely admitted through one aperture being inadequate to the fupport of the flame, it was obvious that the only way to enfure both light and fafety was to increafe the number of apertures, diminifhing the fize of each. In this manner, it appears that Mr. Stephenfon proceeded mechanically, without a correct knowledge of the properties of the gas, or the principles on which the effects were produced. We think, however,

that

that as an approximation to a valuable difcovery, Mr. Stephenfon's lamp entitled him to the patronage and fupport which he has received. It ought alfo to be recollected that Dr. Clanny and Mr. Stephenfon both laboured under the difadvantage of living at a diftance from the refidence of ingenious practical mechanics to execute their inventions in the moft fimple, cheap, and portable manner; an advantage only to be obtained in the neighbourhood of the metropolis, or of large mechanical manufactories.

Sir H. Davy, after afcertaining that the fire-damp, or inflammable air in coal-mines, is the light carburetted hydrogen gas, as ftated by other chemifts, proceeded to examine accurately its combuftibility and explofive nature. When one part of fire-damp was mixed with one of common air, the mixture burned on the approach of a taper, but did not explode. Two of air and three of fire-damp produced fimilar refults. When four of air and one of fire-damp were expofed to a lighted candle, the mixture being in the quantity of fix or feven cubic inches in a narrow-necked bottle, the flame defcended to the bottom, but there was no noife. One part of gas inflamed with fix parts of air in a fimilar bottle, producing a flight whiftling found. One part of gas with three of air rather a louder found. One part with ten, eleven, twelve, thirteen, and fourteen parts, ftill inflamed, but the violence of the combuftion diminifhed. In one part of gas and fifteen parts of air, the candle burned without explofion, with a greatly-enlarged flame. The fame effect was obferved, but in a gradually diminifhing ratio, as far as thirty parts of the gas to one of common air. The mixture which feemed to poffefs the greateft explofive power was feven or eight parts of air to one of gas; but the report produced by fifty cubic inches of this mixture was lefs than that produced by one-tenth of a mixture confifting of two parts of common air and one of pure hydrogen.

It was alfo very important to afcertain the degree of heat required to explode the different mixtures of fire-damp. A common electrical fpark, he found, would not explode five parts of air and one of fire-damp, though it exploded fix parts of air and one of the latter gas. Very ftrong fparks from the difcharge of the Leyden jar feemed to have the fame power of exploding different mixtures of the gas, as the flame of a taper. Well-burned charcoal, ignited to the ftrongeft heat, did not explode any mixtures of the gas; and when a fire of the fame charcoal, which burned without flame, was blown to whitenefs by an explofive mixture without producing inflammation. An iron rod at a red or even at a white heat did not inflame explofive mixtures of the gas; but when in brilliant combuftion it produced that effect.

The flame of gafeous oxyd of carbon, as well as of olefiant gas, exploded the mixtures of the fire-damp.

In refpect of combuftibility, fays fir H. Davy, the fire-damp differs materially from the other common inflammable gafes. Olefiant gas, when rendered explofive by a mixture of common air, is fired both by charcoal and iron, heated to a dull rednefs. Gafeous oxyd of carbon, which explodes with two parts of air, is likewife inflammable by hot iron or charcoal. And hydrogen, which explodes when mixed with three-fevenths of air, takes fire at the loweft vifible heat of iron or charcoal; and the cafe is the fame with fulphuretted hydrogen.

The importance of thefe experiments is too obvious to require illuftration. Having afcertained the above facts, fir H. Davy proceeded to examine the degree of expanfion of mixtures of fire-damp and air during their explofion, and likewife their power of communicating flame through apertures to other explofive mixtures. It is to this latter part of fir H. Davy's experiments and its application to fafety-lamps, that the controverfy refpecting the priority of the difcovery refers.

When fix parts of air and one of fire-damp were exploded over water by a ftrong electrical fpark, the explofion was not very ftrong; and at the moment of the greateft expanfion, the volume of the gas did not appear to be increafed more than one-half. In exploding a mixture of one part gas from the diftillation of coal, and eight parts of air in a tube one-quarter of an inch in diameter, and one foot long, more than a fecond was required before the flame reached from one end of the tube to the other, and he could not make any mixture explode in a glafs tube one-feventh of an inch in diameter; and this gas was more inflammable than fire-damp, as it confifted of carburetted hydrogen mixed with fome olefiant gas.

In exploding mixtures of fire-damp and air in a jar, connected with the atmofphere by an aperture of half an inch, and connected with a bladder by a ftop-cock having an aperture of about one-fixth of an inch, the flame paffed into the atmofphere, but did not communicate through the ftop-cock fo as to inflame the mixture in the bladder; and in comparing the power of tubes of metal and thofe of glafs, it appeared that the flame paffed more readily through tubes of glafs of the fame diameter, and that explofions were ftopped by metallic tubes of one-fifth of an inch, when they were one inch and a half long; and this phenomenon probably depends upon the heat loft during the explofion, in contact with fo great a cooling furface, which brings the temperature of the firft portions exploded below that required for firing the other portions.

Metal is a better conductor of heat than glafs; and it has been already fhewn, that the fire-damp requires a very ftrong heat for its inflammation.

A mixture of the gas with air, he alfo found, would not explode in metallic canals or troughs when their diameter was lefs than one-feventh of an inch, and their depth confiderable in proportion to their diameter, nor could explofions be made to pafs through fuch canals.

Azote and carbonic acid, even in fmall proportions, diminifhed the velocity of inflammation in explofive mixtures of fire-damp. Azote, when mixed in the proportion of one to fix of an explofive mixture containing twelve of air and one of fire-damp, deprived it of its power of explofion; when one part of azote was mixed with feven of an explofive mixture only, a feeble blue flame paffed through it.

One part of carbonic acid to feven of an explofive mixture deprived it of the power of exploding; fo that its effects are more remarkable than thofe of azote, probably in confequence of its greater capacity for heat, and probably likewife of its higher conducting power connected with its greater denfity.

The confideration of thefe various facts, fir H. Davy informs us, led him to adopt a form of lamp in which the flame, being fupplied with only a limited quantity of air, fhould produce fuch a quantity of azote and carbonic acid as to prevent the explofion of the fire-damp; and which, by the nature of its apertures for giving admittance and exit to the air, fhould be rendered incapable of communicating any explofion to the external air.

If in a clofe lantern fupplied with a fmall aperture below and another above, a lighted lamp having a very fmall wick be placed, the natural flame gradually diminifhes, till it arrives at a point at which the fupply of air is fufficient for the combuftion of a certain fmall quantity of oil; if a lighted taper be introduced into the lantern through a fmall door

door in the ſide, which is inſtantly cloſed, both lights will burn for a few ſeconds, and be extinguiſhed together.

A ſimilar phenomenon occurs: if in a cloſe lantern ſupplied with a quantity of air merely ſufficient to ſupport a certain flame, a mixture of fire-damp and air is gradually admitted, the firſt effect of the fire-damp is to produce a large flame round that of the lamp, and this flame conſuming the oxygen which ought to be ſupplied to the lamp, and the ſtandard of the power of the air to ſupport flame being lowered by the admixture of fire-damp and by its rarefaction, both the flame of the fire-damp and that of the lamp is extinguiſhed together; and as the air contained a certain quantity of azote and carbonic acid before the admiſſion of the fire-damp, their effect by mixing it is ſuch as to prevent an exploſion in any part of the lantern.

In an experiment which ſir H. Davy made, to aſcertain that the flame was extinguiſhed in the lantern, though the mixture was ſtill exploſive which ſupplied the flame, the lantern was placed on a ſtand under a large glaſs receiver ſtanding in water, which was of ſufficient capacity to enable the candle to burn for ſome minutes. A quantity of fire-damp was thrown in from a bladder, ſo as to render the atmoſphere exploſive. As the fire-damp mixed with the air, the flame of the taper gradually enlarged till it half filled the lantern; it then gradually diminiſhed, and was ſuddenly extinguiſhed without the ſlighteſt exploſion. The air in the receiver was found after the experiment to be highly exploſive.

Sir H. Davy then introduced into a glaſs jar, containing an exploſive mixture of one part fire-damp and ten parts of air, a lighted lantern, to which air was ſupplied by two glaſs tubes one-tenth of an inch in diameter, and half an inch long. The taper burned at firſt with a feeble light, the flame ſoon became enlarged, and was then extinguiſhed. Theſe experiments were ſeveral times repeated with a conſtancy of reſult. It is evident, he ſays, from hence, that it is only neceſſary to uſe air-tight lanterns ſupplied with air from tubes or canals of ſmall diameter, or from apertures covered with wire-gauze, placed below the flame, through which exploſions cannot be communicated, and having a chimney at the upper part on a ſimilar ſyſtem for carrying off the foul air.

This principle ſir H. Davy adapted to a variety of glaſs lanterns, in which the air was admitted through ſmall apertures or wire-gauze, with a top protected by the ſame. Theſe lanterns, however they might have anſwered for experiments in the laboratory, were not, however, well fitted for practical uſe; for beſides the frangibility of common glaſs, which expoſed the miner to exploſions from the enlargement of the flame, the glaſs was liable to become heated and to break, however ſtrong it might be made. This inconvenience was, however, removed by the ſubſtitution of a cylinder of fine wire-gauze, forming a cloſe lamp or lantern, into which the air is admitted, and from which it paſſes through very ſmall apertures. In the firſt experiments, the wire was of braſs the $\frac{1}{200}$th part of an inch in thickneſs, and the apertures were not more than the $\frac{1}{120}$th part of an inch; this was found to ſtop exploſions as well as the long tubes or canals, and to admit a free current of air. The wire-gauze lamp, in its preſent improved form, is the moſt ſimple and portable that has yet been introduced. *Plate* V. *fig.* 5. *Geology*, repreſents the lamp as at preſent uſed; *a* repreſents the ſingle cylinder of wire-gauze; the foldings *a a a* muſt be very well doubled and faſtened by wire. If the cylinder be of twilled gauze, the wire ſhould be at leaſt of the one-fortieth of an inch of iron or copper, and thirty in the warp, and ſixteen or eighteen in the weft. If of plain wire-gauze, the wire ſhould not be leſs than one-ſixtieth of an inch in thickneſs, and from twenty-eight to thirty both warp and weft; *b* repreſents the ſecond top, which fits upon *a*; *c* repreſents a cylinder of braſs, in which the wire-gauze is faſtened by a ſcrew, to prevent its being ſeparated from the lamp by any blow; *c* is fitted into a female-ſcrew, which receives the main-ſcrew *b* of the lamp *f*, furniſhed with its ſafe-trimmer *b*, and ſafe-feeder for oil *i*.

Lamps on the ſame principle were conſtructed, in which the cylinder is made of copper of one-fortieth of an inch in thickneſs, perforated with longitudinal apertures of not more than one-ſixteenth of an inch in length, and the one-thirtieth in breadth. (See *Plate* I. *fig.* 6. *Geology*.) In proportion as the copper is thicker, the apertures may be increaſed in ſize. This form of the lamp may be proper where ſuch an inſtrument is only to be occaſionally uſed, but for the general purpoſe of the collier, ſir H. Davy ſtates that wire-gauze is much ſuperior from its flexibility, and the eaſe with which new cylinders are introduced.

To this lamp a valuable addition has been lately made by the application of a lens before the flame, to condenſe the rays of light, and direct them to any particular ſpot. It has the farther advantage of protecting that part of the wire-gauze from coal-duſt, by which it is liable to be choaked and obſcured in a few hours.

In ſubſequent experiments, ſir H. Davy diſcovered that much thicker wires and larger apertures might be uſed than were at firſt applied. This gave to the lamp greater ſtrength, and tranſmitted more light.

Gauze made of braſs wire $\frac{1}{30}$th of an inch in thickneſs, and containing only 100 apertures in the ſquare inch, did not communicate exploſion in a mixture of one part coal-gas and twelve of common air, ſo long as the wire was cool; but as ſoon as the top became hot an exploſion took place. A quick lateral motion alſo enabled it to communicate exploſion. With 196 apertures to the ſquare inch, the exploſion was not communicated till the wire became ſtrongly hot.

Iron wire-gauze, containing 240 apertures to the ſquare inch, was ſafe in exploſive mixtures of coal-gas, till it became ſtrongly red-hot at the top.

Iron wire-gauze, of 576 apertures to the ſquare inch, or the $\frac{1}{24}$th part of an inch each in diameter, appears, ſays ſir H. Davy, to be ſafe under all circumſtances, in exploſive mixtures of coal-gas. With very fine wire-gauze, mixtures of oxygen and hydrogen gaſes may be burned without exploſion until the braſs wire begins to melt.

The explanation which ſir H. Davy gives of the effect of wire-gauze, and ſmall tubes in arreſting the progreſs of flame, is as follows:—Theſe reſults are beſt explained by conſidering the nature of the flame of combuſtible bodies, which in all caſes muſt be conſidered as the combuſtion of an *exploſive mixture* of inflammable gas, or vapour and air; for it cannot be regarded as a mere combuſtion at the ſurface of contact of the inflammable matter: and the fact is proved by holding a taper, or a piece of burning phoſphorus, within a large flame made by the combuſtion of alcohol; the flame of the candle, or of the phoſphorus, will appear in the centre of the other flame, proving that there is oxygen even in its interior part.

The heat communicated by flame muſt depend upon its maſs: this is ſhewn by the fact, that the top of a ſlender cylinder of wire-gauze hardly ever becomes dull-red in the experiment on an exploſive mixture; whilſt in a larger cylinder made of the ſame material, the central part of the top ſoon becomes bright-red. A large quantity of cold air thrown upon a ſmall flame, lowers its heat beyond the exploſive

exploſive point; and in extinguiſhing a flame by blowing upon it, the effect is probably produced principally by this cauſe, aſſiſted by a dilution of the exploſive mixture.

If a piece of wire-gauze ſieve is held over a flame of a lamp, or of coal-gas, it prevents the flame from paſſing it, and the phenomenon is preciſely ſimilar to that exhibited by the wire-gauze cylinders: the air paſſing through is found very hot, for it will convert paper into charcoal; and it is an exploſive mixture, for it will inflame if a lighted taper is preſented to it; but it is cooled below the exploſive point, by paſſing through wires even red-hot, and by being mixed with a conſiderable quantity of air comparatively cold. The real temperature of viſible flame is, perhaps, as high as any we are acquainted with. Mr. Tennant was in the habit of ſhewing an experiment which demonſtrates the intenſity of its heat. He uſed to fuſe a ſmall filament of platinum in the flame of a common candle; and it is proved by many facts, that a ſtream of air may be made to render a metallic body quite hot, yet not be itſelf luminous.

A conſiderable maſs of heated metal is required to inflame even coal-gas, or the contact of the ſame mixture with an extenſive heated ſurface. An iron-wire of $\frac{1}{30}$th of an inch, and eight inches long, red-hot, when held perpendicularly in a ſtream of coal-gas, did not inflame it, nor did a ſhort wire of one-ſixth of an inch produce the effect held horizontally; but wire of the ſame ſize, when ſix inches of it were red-hot, and when it was held perpendicularly in a bottle containing an exploſive mixture, ſo that heat was ſucceſſively communicated to portions of the gas, produced its exploſion.

A certain degree of mechanical force, which rapidly throws portions of cold exploſive mixture upon flame, prevents exploſions at the point of contact. Thus, on preſſing an exploſive mixture of coal-gas from a ſyringe, or a gum elaſtic bottle, it burns only at ſome diſtance from the aperture from which it is diſengaged.

Taking all theſe circumſtances into account, there appears no difficulty in explaining the combuſtion of exploſive mixtures within, and not without the cylinders: for a current is eſtabliſhed from below upwards, and the hotteſt part of the cylinder is where the reſults of combuſtion, the water, carbonic acid, or azote, which are not inflammable, paſs out. The gas which enters is not ſufficiently heated on the outſide of the wire to be exploded; and as the gaſes are no where confined, there can be no mechanical force preſſing currents of flame towards the ſame point.

Two papers by ſir H. Davy, connected with this ſubject, were afterwards publiſhed in the Philoſophical Tranſactions for 1817, entitled "Some Reſearches on Flame." In theſe papers, a number of new and extremely intereſting experiments on the properties of flame are detailed. The practical application of the reſults to ſafety-lamps we ſhall briefly ſtate, as they explain more clearly the principle on which their ſafety depends, and the circumſtances eſſentially requiſite to their proper conſtruction. Sir H. Davy commences the paper by informing us, that the intenſity of the light of flames depends principally upon the production and ignition of ſolid matter in combuſtion; and that the heat and light in this proceſs are in a great meaſure independent phenomena: and he afterwards defines flame to be gaſeous matter, heated ſo highly as to be luminous, and that to a degree of temperature beyond the white heat of ſolid bodies, as is ſhewn by the experiment; that air not luminous will communicate this degree of heat; for if we hold a fine platina wire one-twentieth of an inch from the exterior of the middle flame of a ſpirit-lamp, and conceal the flame by an opaque body, the wire will become of a white heat in a ſpace where there is no viſible light.

When an attempt is made to paſs flame through a very fine meſh of wire-gauze at the common temperature, the gauze cools each portion of the elaſtic matter that paſſes through it, ſo as to reduce its temperature below that degree at which it is luminous; and the diminution of temperature muſt be proportional to the ſmallneſs of the meſh and the maſs of the metal. The power of a metallic or other tiſſue, to prevent exploſion, will depend upon the heat required to produce the combuſtion, as compared with that acquired by the tiſſue; and the flame of the moſt inflammable ſubſtances, and of thoſe that produce moſt heat in combuſtion, will paſs through a metallic tiſſue that will intercept the flame of leſs inflammable ſubſtances, or thoſe that produce little heat in combuſtion. Or the tiſſue being the ſame, and impermeable to all flames at common temperatures; yet when heated it will become permeable to each different kind of flame at different temperatures: thoſe which produce moſt heat will moſt readily paſs through it. A tiſſue of one hundred apertures to the ſquare inch, made of wire of one-ſixtieth part of an inch, will, at common temperatures, intercept the flame of a ſpirit-lamp, but not that of hydrogen; and when ſtrongly heated will no longer arreſt the flame of the ſpirit-lamp.

The ratio of combuſtibility of the different gaſes is to a certain extent proportionate to the maſſes of heated matter required to inflame them. Thus, an iron-wire of one-fortieth of an inch heated cherry-red will not inflame olefiant gas, but will inflame hydrogen gas: and a wire of one-eighth of an inch heated to the ſame degree will inflame olefiant gas; but a wire of one-five-hundredth part of an inch muſt be heated to whiteneſs to inflame hydrogen.

Theſe circumſtances will explain why a meſh of much finer wire is required to prevent the exploſion from hydrogen and oxygen from paſſing; and why ſo coarſe a texture of wire is ſufficient to prevent the exploſion of the fire-damp, the leaſt combuſtible of the known inflammable gaſes.

The following experiments afford a ſatisfactory and ſimple explanation of the cauſe of the ſtoppage of flame by the wire-gauze lamp. Let the ſmalleſt poſſible flame be made by a ſingle thread of cotton immerſed in oil, and burning immediately on the ſurface of the oil; it will be found to be about one-thirtieth of an inch in diameter. Let a fine iron-wire one-hundred-and-eightieth part of an inch be made into a circle of one-tenth of an inch in diameter, and brought over the flame. Though at ſuch a diſtance it will inſtantly extinguiſh the flame if it be cold; but if it be held above the flame, ſo as to be ſlightly heated, the flame may be paſſed through it without being extinguiſhed. The effect depends entirely on the power of the metal to abſtract the heat of the flame. This is ſhewn by bringing a glaſs capillary ring of the ſame diameter and ſize over the flame: this being a much worſe conductor of heat will not extinguiſh it even when cold. If its ſize, however, be made greater, and its circumference ſmaller, it will act like the metallic wire, and require to be heated to prevent its extinguiſhing the flame.

Suppoſe a flame to be divided by the wire-gauze into ſmaller flames, each flame muſt be extinguiſhed in paſſing its aperture, till that aperture has attained a temperature ſufficient to produce the permanent combuſtion of the exploſive mixture. Where rapid currents of exploſive mixtures are made to act upon wire-gauze, it is of courſe much more rapidly heated, and therefore the ſame meſh which arreſts the flames of exploſive mixtures at reſt will ſuffer them to paſs when in rapid motion; but by increaſing the cooling ſurface,

ſurface, by diminiſhing the ſize or increaſing the depth of the aperture, all flames, however rapid their motion, may be arreſted. Preciſely the ſame law applies to exploſions acting in cloſe veſſels: very minute apertures, when they are only a few in number, will permit exploſions to paſs which are arreſted by much larger apertures, when they fill a whole ſurface. A ſmall aperture was drilled at the bottom of a wire-gauze lamp, in the cylindrical ring which confines the wire-gauze; this, though leſs than one-eighteenth part of an inch in diameter, paſſed the flame, and fired the external atmoſphere, in conſequence of the whole force of the exploſion of the thin ſtratum of the mixture included within the cylinder driving the flame through the aperture; though, had the whole ring been compoſed of ſuch apertures, it would have been perfectly ſafe. Nothing, ſays ſir Humphrey Davy, can demonſtrate more decidedly than theſe ſimple facts and obſervations, that the interruption of flame by ſolid tiſſues permeable to light and air, depends on no recondite or myſterious cauſe, but to their cooling powers ſimply conſidered as ſuch.

When light, included in a cage of wire-gauze, is introduced into an exploſive atmoſphere of fire-damp at reſt, the maximum of heat is ſoon obtained, the radiating power of the wire and the cooling effects of the atmoſphere, more efficient from the mixture of inflammable air, preventing it from ever arriving at a temperature equal to that of dull redneſs. In rapid currents of exploſive mixtures of fire-damp, which heat common gauze to a high temperature, twilled gauze, in which the radiating ſurface is conſiderably greater and the circulation of air leſs, preſerves an equal temperature. Indeed the heat communicated to the wire by combuſtion of the fire-damp in wire-gauze lamps is completely in the power of the manufacturer, for by diminiſhing the apertures, and increaſing the maſs of metal, or the radiating ſurface, it may be diminiſhed to any extent. One important circumſtance, however, is not here adverted to by ſir Humphrey Davy; by increaſing the thickneſs of the wire and diminiſhing the aperture, the quantity of light tranſmitted is greatly reduced, and its power of illumination rendered nearly inefficient. Hence the power of the manufacturer to conſtruct a lamp perfectly ſafe and ſufficiently luminous muſt be limited by certain conditions. However, ſir Humphrey Davy informs us, he has lately had lamps made of thick twilled gauze formed of wires the one-fortieth of an inch, ſixteen to the warp and thirty to the weft, which being rivetted to a ſcrew cannot be diſplaced, from its flexibility it cannot be broken, and from its ſtrength cannot be cruſhed, except by a very ſtrong blow.

From ſome very ingenious experiments on the combuſtion of inflammable ſubſtances at low temperatures, ſir Humphrey Davy diſcovered that a coil of platina wire, one-ſeventieth of an inch thick, remains at a white heat when the quantity of coal-gas is increaſed ſo as to extinguiſh the flame of the lamp; hence he has ſuggeſted the advantage of introducing a coil of ſuch wire into the ſafety-lamp, but we do not learn that it has yet been found of practical uſe. An account of theſe experiments is given in the Phil. Tranſ. for 1817.

The principal objections to the uſe of wire-gauze ſafety-lamps in mines, and alſo to other ſafety-lamps, may be briefly ſtated; namely, the accidents to which the lamps may be unavoidably ſubject, and the accidents which may ariſe from negligence in the uſe of them; the injury to the health of the men, from remaining in exploſive mixtures of fire-damp longer than they would have done before the introduction of theſe lamps into mines; and laſtly, the temptation they preſent to neglect the more expenſive methods of ventilating mines, and truſting too much to the ſecurity of the lamp. The accidents which may happen to the *lamp* from one or more of the meſhes being broken, when made of ſuch ſlender wire, and expoſed to the corroſive effects of mineral waters in the mine, or the rapid oxydation from moiſture alone, muſt be very frequent, independently of accidents from the falling of pieces of coal on the lamp. The breaking of a ſingle wire being ſufficient to enlarge the aperture and occaſion an exploſion, it is obvious that extreme caution is required in the uſe of the lamps, and a careful inſpection of them ſhould be made every day before they are delivered to the men. This we underſtand is done in extenſive collieries, a perſon being appointed for the ſole purpoſe of inſpecting and trimming the lamps. The accidents which may ariſe from the negligence of a ſingle man, in extenſive mines where more than fifty or one hundred perſons are employed, are leſs eaſy to guard againſt; the lives of a great number are conſtantly depending on the carefulneſs of each perſon; and, however perfect the inſtrument may be, no one can feel perfectly ſafe when the air in the mine is in an exploſive ſtate. Some of the lamps were at firſt ſo conſtructed that they could not be opened except by the key of the inſpector; but we believe this precaution is not generally introduced, the great object being to get the lamps made as cheap as poſſible. We conceive it, however, eſſential to the ſecurity of the miners, that the lamp ſhould be cloſed by a lock, to prevent the men from uncovering the flame. The lamp itſelf, by the enlargement of the flame, gives due notice when the air of the mine is in an exploſive ſtate, and at ſuch times the proper remedy is to be ſought in ventilation; for we conceive it to be neither wiſe nor humane to ſuffer the men to remain working in an exploſive atmoſphere, unleſs under particular circumſtances. Should the invention of ſafety-lamps induce coal proprietors to allow their workmen to remain for a longer time inhaling the fire-damp, or lead them to neglect the only permanent ſecurity, that of efficacious ventilation, we ſhould conſider the diſcovery as injurious to the intereſts of humanity. It would, however, be extremely unfair to decry the merit of any invention from the poſſible miſuſe of it. Were coal-mines firſt opening in a diſtrict where they had never before been worked, we believe that in moſt caſes it would be practicable to ſecure a conſtant and ſafe ventilation through all the works: but in diſtricts like thoſe on the Tyne and the Wear, there are numerous old excavations remaining filled with impure air, of which the preſent miners have little knowledge, having been worked out in remote periods. Any communications accidentally opened with theſe old workings may ſuddenly fill a mine with a mixture of fire-damp, in which caſe the ſafety-lamp offers the only means of ſecurity with which we are acquainted. For viewing the old workings or *waſtes* of the mine, which cannot be approached with a common lamp or candle, the ſafety-lamp is a moſt invaluable inſtrument; and in all caſes where the ſteel-mill was formerly uſed it affords a far more ſecure and convenient light. Though we have thought it neceſſary to ſtate the objections which may be urged againſt the ſafety-lamp, we conceive that they apply principally to the miſuſe of it: and the following ſtatement made by ſir Humphrey Davy offers the moſt ſatisfactory proof of its utility. "It has now been (Jan. 1817) for ten months in the hands of hundreds of common miners in the moſt dangerous mines in Great Britain, during which time not a ſingle accident has occurred where it has been employed, whilſt in other mines much leſs dangerous, where it has not been adopted, ſome lives have been loſt, and many perſons burned."

The farther experience of another year, on a more ex-

tended

tended ſcale, has fully confirmed the concluſions to be drawn from the above ſtatement, and we may juſtly conſider the ſafety-lamp as one of the moſt valuable preſents which philoſophy has made to the uſeful arts.

Wire-*Grates*, in *Gardening*, are contrivances formed of fine wire-work, and uſed for keeping various kinds of large inſects out of vineries, hot-houſes, and ſuch places, as being very miſchievous to the fruit in them.

Wire-*Heels*, *&c.* a defect and conſequent diſeaſe in the feet of the horſe or other animal. Some, as Gibſon, think that narrow heels are for the moſt part a natural defect, but that they are often rendered incurable by bad ſhoeing. Some, in ſhoeing, hollow the quarters ſo deep and ſo thin, it is ſaid, that one may almoſt pinch them in with one's fingers, and think by that means to widen them out by a ſtrong broad-webbed ſhoe; but this turns them narrow above and *wires their heels*, and dries up or rots the frog. The beſt way in all ſuch caſes is, it is ſuppoſed, not to hollow the foot in ſhoeing, and to pare nothing out but what is rotten or foul. If the foot be hard or dry, or inclined to be ragged, it may be bathed often with chamber-ley; or two pounds of linſeed bruiſed may be boiled in two quarts of chamber-ley to the conſiſtence of a poultice, then adding to it ſix ounces of ſoft-ſoap, and the foot be ſoftened with it every day, rubbing a little of it upon the ſole; or, a compoſition formed of two ounces of bees'-wax, ſix ounces of hog's-lard, one ounce of tar, and linſeed oil as much as will make it into the conſiſtence of a ſmooth ointment, may be mixed together, and be uſed daily in the ſame manner as the foregoing poultice.

The diſeaſes and affections of the feet of theſe animals have of late been more accurately underſtood, and better means of relief and cure recommended.

In the caſe of narrow or contracted heels, attended with inflammation, and moſtly confined to the fore-feet, there is great pain; the animal is conſtantly moving its legs, and generally inclined to lie down. When firſt taken out, it is almoſt incapable of performing any of the paces; the weight being ſo much thrown on the hinder legs. In trotting, the legs are ſcarcely lifted above the ſurface of the ground; the ſteps are very ſhort, and a walk or canter is gone into inſtead of any other pace. In the gallop, the weight of the body is thrown on the fore-part of the foot; and in trotting, on the heels; which produce very conſiderable pain, on account of the action of the foot being confined to the quarter in a backward direction.

The diſeaſe is moſtly cauſed by improper ſhoeing, very great and hard exerciſe, ſtanding in confined ſituations on litter, and many other ſuch cauſes.

In effecting a cure in all the more freſh caſes of this ſort, where the variation from the natural round form of the hoof is not conſiderable, it may be accompliſhed without the animal being entirely made to reſt, by removing the ſhoes, and if poſſible reducing the heels on a line with the inferior part of the frog. The ſole parts may be thinned, and that portion which is between the bars of the foot and the cruſt be hollowed out. The hoofs ſhould likewiſe be thinned with a proper tool, eſpecially at the quarters. The ſhoes ſhould not be put on again for two or three weeks in ſuch caſes, and the parts from near the coronet to the fetlock be anointed with a bliſtering liniment, compoſed of half an ounce of finely-powdered cantharides and four ounces of Barbadoes tar, well mixed together.

And when neceſſary, three or four pints of blood may be taken from the plate vein, and a rowel be put in the cheſt.

Maſhes, containing nitre in the quantity of an ounce, are to be occaſionally had recourſe to. At the ſame time, the feet of the animal ſhould be put in a trough of warm water for two or three hours every day, ſo filled as juſt to cover the hoof-parts of them; gentle walking or trotting exerciſe being uſed on ſuch ground as is ſoft.

Afterwards the ſhoes which are made uſe of ſhould be thinner at the heels than thoſe which were taken off, the heels reſting well and firmly on the bars and cruſt. The patent frog may be uſed when the animal is at reſt, as by continuing its uſe in a proper manner, the foot will gradually regain its natural form and action. See Frog.

In ſuch caſes, too, the coronet may now be bathed every day with an embrocation compoſed of an ounce and a half each of marſh-mallow ointment and Barbadoes tar, with half an ounce of ſpirit of turpentine, well incorporated together; which will promote and haſten the growth of the hoof-part of the foot.

In caſe the animal has been lame ſome length of time, and the contraction of the heels is very conſiderable, it ſhould be put in moiſt paſture-grounds, to run for ſome time, carefully lowering the heels every four or five weeks, or oftener if neceſſary. As ſoon as the hoof has been elongated from the coronet to the ſole, the cure will be completely effected; which will in moſt caſes be accompliſhed in the courſe of about five months; at the end of which time the animal will have regained an entirely new circular foot of the natural ſhape. The animal ſhould then be ſhod with thin-heeled ſhoes, which admit the frog-part of the foot to reſt upon the ground.

In caſes in which the animals cannot be turned out in this manner, they ſhould be provided with a large ſhed building, well clayed on the bottom part, and preſerved ſoft and moiſt by the occaſional application of water ſlightly over it.

But though this ſort of management may moſtly recover and reſtore the natural ſhape of the foot, the proper action of it is not reſtored with ſuch facility. In a great number of caſes, the feet become ſo much altered in their ſtructure and power on account of the long-continued inflammation, that the means of expanſion are wholly deſtroyed; as is often the caſe in the cartilages that are ſituated at the higher and hinder part of the foot, which not unfrequently become bony, and, of courſe, it becomes impoſſible to regain the action of the foot. As in theſe caſes, the more the foot is expoſed, the greater will be the injury and miſchief afforded; the only means of relief that can be made uſe of, is the covering of the foot with ſuch a ſhoe as is calculated to prevent concuſſion, which may be accompliſhed by the application of a bar-ſhoe that will reſt on every part of the cruſt, and not upon the frog-part of the foot. This is ſuppoſed to be the beſt form of ſhoe that can be uſed for the purpoſe.

In theſe caſes, when the animals are at reſt, the feet ſhould be ſtopped with an ointment, compoſed of one ounce and a half each of common turpentine and tar, and two ounces and a half of mallow ointment, well mixed together.

In the caſes of cracks or ſeparations of the fibres of the hoofs in a perpendicular manner, which when they extend to the coronet are often very troubleſome; the animals moſt liable to them, are thoſe which have either ſtrong brittle hoofs or narrow heels. Blood animals of the horſe kind are more ſubject to them than others.

In the management and cure of them, the parts around the cracks ſhould be made thin by the raſp, when the firing iron ſhould be drawn over above and below them, to the extent of the fiſſures, in order to prevent their extenſion. It ſhould

ſhould likewiſe be carried over the cracks, by which means a ſlight quantity of tenacious moiſture will exude, and glue up the ſeparated parts; which may be covered over with an ointment compoſed of four ounces of marſh-mallow ointment, and two ounces of common turpentine, ſpread upon tow, and kept on the parts by bandages.

The animals ſhould have bar-ſhoes, which may reſt firmly on the frogs, and be made hollow in the parts oppoſite to the ſeats of the complaints, in order that no preſſure may be given to thoſe parts of the feet; reſt being given for ſome days, and then only moderate exerciſe allowed, until the cracks have deſcended towards the lower parts of the feet. The coronets and hoofs may be bathed twice a day, as in the above caſes of contracted heels, in order that the growth of horn may be promoted. By the uſe of theſe means, the animals moſtly ſoon get better.

Wires *of Aſteriæ*, in *Natural Hiſtory*, a name given by authors to a ſort of extraneous foſſil belonging to the *aſteriæ*, and being a ſort of branches from the body of that column.

Wire *of Lapland*. The ſavage inhabitants of Lapland have a ſort of ſhining ſlender ſubſtance in uſe among them on ſeveral occaſions, which is much of the thickneſs and appearance of our ſilver wire; and is therefore called, by thoſe who do not examine its ſtructure or ſubſtance, *Lapland wire*.

The people of this miſerable country find many uſes in every thing nature has afforded them, and, among the reſt, that ſpecies of ſtag called the rein-deer, which is the moſt frequent animal among them, is not only ſerviceable in furniſhing them with meat, clothes, houſes, and the means of carriage and travelling; but its bones make many of their moſt neceſſary utenſils; and the ſinews, which are all carefully ſeparated in the eating, are, by the women, after ſoaking in water, and beating, ſpun into a ſort of thread, which is of admirable fineneſs and ſtrength, when wrought to the ſmalleſt filaments; but when larger, is very ſtrong, and fit for the purpoſes of ſtrength and force. Their wire, as it is called, is made of the fineſt of theſe threads, covered with tin. The women do this buſineſs, and the way they take is to melt a piece of tin, and placing at the edge of it a horn with a hole through it, they draw theſe ſinewy threads, covered with the tin, through the hole, which prevents their coming out too thickly covered. This drawing is performed with their teeth, and there is a ſmall piece of bone placed at the top of the hole, where the wire is made flat, ſo that we always find it rounded on all ſides but one, where it is flat.

This wire they uſe in embroidering their clothes as we do with gold and ſilver; and they often ſell it to ſtrangers, under the notion of its having certain magical virtues. Scheffer, Hiſt. Lapland.

Wire-*Worm*, in *Agriculture*, a moſt miſchievous worm in different ſorts of grain-crops. It has been deſcribed by Bierkander, in the Swediſh Tranſactions, as having in the grub-ſtate a yellow colour, with the head brown, and the extremities of the jaws black; the body conſtituted of twelve joints, ſhining, and hard-ſkinned; when it changes its ſkin it is for ſome time white; a few hairs are ſcattered here and there, but moſtly upon the head and laſt joint; under the three firſt joints are ſix horny and pointed feet, and at the beginning of the laſt joint, which is round, there are two black ſpots, one on each ſide, which are, probably, apertures through which it breathes.

It is conſidered by ſome, notwithſtanding the almoſt general opinion of farmers to the contrary, that the diſeaſe of wheat-crops, which is attributed to this inſect or worm, depends upon ſome other cauſe, as a fault in ploughing, by which the land is left in too light, open, and porous a ſtate or condition, and which prevents the young plants from being fully and properly nouriſhed, and conſequently from forming their roots in a proper manner in the ground. And this notion is in ſome meaſure ſupported by the circumſtance of the benefit which is afforded by rolling, treading, and otherwiſe compreſſing the land.

It has been proved and ſhewn by many different trials, that this worm is one which is extremely tenacious of life, and conſequently not eaſily deſtroyed or got quit of by any means which have yet been made uſe of for the purpoſe.

Wire, in *Geography*, one of the ſmaller Orkney iſlands, ſeparated from Rouſa by a ſtrait called Wire Sound, about three-quarters of a mile in breadth. N. lat. 58° 58′. W. long. 2° 51′.

Wire. See Wyre.

WIREDY, a town of Sweden, in the province of Smaland; 16 miles N.E. of Jonkioping.

WIRESTA, a town of Sweden, in the province of Smaland; 26 miles S.W. of Wexio.

WIRI, two ſmall iſlands in the gulf of Finland. N. lat. 59° 50′. E. long. 27°.

WIRING, among *Animals*, the operation of putting a ſharp-pointed wire up the noſtrils of a ſheep, ſo as to paſs up into the brain, and produce a diſcharge in caſes of the ſturdy, turn, gid, or vertigo. It ſeems, however, a dangerous remedy, though it is ſaid to have been ſucceſsful in curing the diſeaſe in many caſes.

Wiring *Fruit-Trees*, in *Gardening*, the operation and practice of paſſing a fine wire round their branches, in order to bring on the fruiting ſtate.

WIRKOWENES, in *Geography*, a town of Poland, in the palatinate of Kiev; 44 miles W.N.W. of Bialacerkiew.

WIRKSWORTH, an ancient market-town in the wapentake of the ſame name, in the county of Derby, England, is ſituated near the ſouthern extremity of the mining diſtrict, in a valley nearly ſurrounded by hills, at the diſtance of 14 miles N.N.W. from the county-town, and 140 miles N.W. by N. from London. In the year 835, the manor belonged to the abbey of Repton; after the deſtruction of that monaſtery by the Danes, it became veſted in the crown, to which it appertained at the time of taking the Domeſday-ſurvey. King John granted it to William de Ferrars, earl of Derby. Having been forfeited by the attainder of earl Robert in 1265, it was granted, together with the wapentake, by Edward I. to his brother, Edmund, earl of Lancaſter; and has ever ſince formed part of the earldom or duchy of Lancaſter. It is now held under the duchy by Richard Arkwright, eſq. A market on Wedneſdays, and a fair of three days, were granted for this town to Thomas, earl of Lancaſter, in 1305. The market is now held on Tueſday, chiefly for butcher's-meat, butter, eggs, and pedlar's-ware: the corn-market is ſmall. Four annual fairs are now held. The town-hall, a handſome brick ſtructure, was built in 1773, by the direction of Thomas, lord Hyde, the chancellor of the duchy. In this hall are held courts-baron for the manor, courts-leet for the wapentake, and barmote-courts for regulating the mines and mineral concerns. The church, a ſpacious edifice, apparently of the fourteenth century, conſiſts of a nave and ſide-aiſles, a north and ſouth tranſept, a chancel, and a ſquare tower, ſupported by four large pillars. In the church-yard is a grammar-ſchool, founded in 1576, by Anthony

Anthony Gell, efq. who endowed it with lands which now produce 170*l.* *per annum.* He alfo founded an alms-houfe for fix poor men, to which he gave a rent-charge of 20*l.*; this has been augmented by fubfequent benefactions. In the town was formerly a meeting-houfe for Prefbyterians, but it is now occupied by a congregation of Independents. Here are alfo chapels for Baptifts and Wefleyan Methodifts. In the population return of the year 1811, the inhabitants of this town are enumerated at 3474, occupying 777 houfes. The parifh of Wirkfworth is extenfive, and includes, befides the town, fourteen townfhips or villages, fome of which are very populous.—Beauties of England and Wales, vol. iii. Derbyfhire. By J. Britton and E. W. Brayley, 1803. Lyfons' Magna Britannia, vol. v. Derbyfhire, 1817.

WIRNAU, a town of the county of Henneberg; 5 miles S.E. of Smalkalden.

WIRRAL, or WIREHALL, a ftrip of land in the county of Chefter, extending from the city of Chefter to the fea, between the rivers Dee and Merfey.

WIRREY, or ST. ANDREW, one of the Shaint iflands. N. lat. 57° 53'. W. long. 6° 19'.

WIRSRUM, a town of Sweden, in the province of Smaland; 46 miles N.N.W. of Calmar.

WIRSTBERGHOTZEN, a town of Weftphalia, in the bifhopric of Hildefheim; 8 miles S. of Hildefheim.

WIRSUNG, JOHN GEORGE, in *Biography*, was a native of Bavaria, ftudied medicine at Padua, and was a difciple of Vefling. In 1642 he publifhed the difcovery of the pancreatic duct, with which his name is connected; and in the following year he was affaffinated by a Dalmatian, under the influence of a paffion excited by having been filenced by him in a public difputation. Haller. Eloy.

WISANGI, in *Geography*, a town of Sweden, in Weft Bothnia, on the Tornea; 95 miles N.N.W. of Tornea.

WISBADEN, a town of Germany, in the principality of Naffau Saarbruck Ufingen. This town was known to the Romans, and the *Heidenifche Maur*, or *Heathen Wall*, which runs through the prefent town of Wifbaden, appears to be a work of that nation; and a part of the boundaries of this town are derived from the lined trenches thrown up by Drufus, oppofite to Mentz, for the covering of the Rhine. In the days of the kings of the Franks, in this town was a royal court. At Wifbaden are fome medicinal fprings, formerly in great repute; 5 miles N.W. of Mentz. N. lat. 50° 3'. E. long. 8° 9'.

WISBECH, a large market-town in the county of Cambridge, England, gives name to a hundred and a deanery, and is fituated in the extreme northern part of the county, about 30 miles N. from Ely, 42 from Cambridge, and 90 from London, in the fame direction. Wifbech is a great mart for corn, about 100,000 quarters being annually exported from thence by the river Oufe, and the canals communicating with Cambridge, Lynn, and other towns. Other articles of export are rape-feed and long wool, of which great quantities are fent to the Yorkfhire clothiers. Timber, from Northamptonfhire, is alfo embarked for the fervice of the navy. The principal imports are, coals, deals, and wine. The river is navigable up to Wifbech, at fpring-tides, flowing fix or eight feet, for veffels of 60 tons, which are conftantly employed in the corn trade, to London, Hull, and other ports. Prior to the Norman Conqueft, Wifbech belonged to the convent of Ely. In 1071 William of Normandy erected a caftle of ftone at the town; but this being difmantled, a new caftle of brick was built on the fcite, between 1478 and 1483, by Morton, bifhop of Ely, and which became the epifcopal refidence. Being purchafed by fecretary Thurloe during the interregnum, it was rebuilt after defigns by Inigo Jones. Reverting at the Reftoration to the fee of Ely, it was fold fome years ago, and on the ground of the detached buildings fome good houfes have been erected. The church is a fpacious, handfome fabric, although of a fingular conftruction, having two naves and two aifles. The naves are lofty, and feparated by light flender pillars, with pointed arches; the aifles, which are the moft ancient, are divided from their refpective naves by low maffy pillars and femicircular arches. The tower of the church is beautiful, and notwithftanding the antiquity attributed to it, is proved by records to have been erected pofterior to 1520. Wifbech, with the adjacent country, has frequently fuffered by inundations, particularly in 1236, when great numbers of fmall craft, cattle, and men, were deftroyed. In 1437, by a breach in the bank of Wifbech fen, upwards of 4000 acres of land were overflowed. But the greateft devaftations of this kind occurred in Nov. 1613, by the fpring-tide concurring with a violent N.E. wind; and in March 1614, by the melting of the fnow in the country. In 1611 the inhabitants obtained a renewal of their charter, which conftituted them a body corporate, by the ftyle of the burgeffes of Wifbech; but the right of the election of the ten capital burgeffes was limited to the poffeffors of freeholds of the value of 40*s.* *per annum.* The executive officer, the town-bailiff, although a perfon wholly unknown to the charter, has the entire management of the eftates and affairs of the corporation. The annual income under the management of thefe capital burgeffes, allotted to public and charitable purpofes, amounts to about 800*l.* A principal object of this charge is the maintaining of beacons and buoys, and the clearing of the channel of the river Oufe or Wis, from which the town takes its name; precautions highly neceffary, on account of the fhifting fands between the town and the fea. Among the improvements made in Wifbech of late years, muft be mentioned the ftone bridge of one elliptic arch, and the new cuftom-houfe. The ftreets are paved, lighted, and watched, at the expence of the corporation. The trade of Wifbech has much increafed of late years, through the improved ftate of the drainage and navigation of the fens. The neighbouring lands are in high cultivation, and are chiefly appropriated to grazing. The fheep and oxen grow to a great fize; and confiderable numbers are fent off twice every week to London. The inhabitants are almoft wholly employed in commerce, the town poffeffing no kind of manufacture, although the furrounding country produces vaft quantities of wool, hemp, and flax. The canal, opened not many years ago, extending from Wifbech river to the river Nene at Outwell, and thence to the Oufe, affords a communication with Norfolk, Suffolk, and the weftern counties, and which proves very beneficial to the town. In 1781 a literary fociety was eftablifhed in Wifbech, and the education of youth is provided for by a free-fchool, and by two charity-fchools, fupported by fubfcription. The diffenters from the eftablifhed church are not numerous, but have their refpective places of worfhip. The parifh, containing 6308 acres, is in the greateft part a very rich arable and pafture land. In 1676 the inhabitants of Wifbech were computed to be 1705; in 1801 they amounted to 5004; and in 1811 to 6300: the inhabited houfes were 1237.—Beauties of England; Cambridgefhire. By J. Britton and E. W. Brayley, 8vo. 1802. Magna Britannia, by the Rev. D. Lyfons and S. Lyfons, 4to. 1808.

WISBERG, a town of Germany, in the principality of Culmbach; 8 miles E. of Culmbach.

WISBY, a town of Sweden, on the weſt coaſt of the iſland of Gothland. This is a very ancient ſtaple, and in former times one of the Hanſe towns. When Wineta, a place of great trade in the iſland of Uſedom, near the coaſt of Pomerania, was deſtroyed by an inundation, ſeveral of its wealthieſt inhabitants removed to Wiſby. It was likewiſe frequented by Swedes, Goths, Danes, Normans, French, Engliſh, Saxons, Livonians, Spaniards, Ruſſians, Greeks, and other nations. The maritime laws of Wiſby were famous in all parts, and adopted along the coaſt of the Baltic. (See INSURANCE.) The wall of Wiſby, and the towers with which it is flanked, were built in the year 1289. This town continued in a flouriſhing condition till the year 1361, when the Danes almoſt totally deſtroyed it. The harbour is ſafe and commodious, but not very large. N. lat. 57° 38′. E. long. 18° 18′.

WISCASSET, a ſea-port town of America, in the province of Maine, in the county of Lincoln, on the Sheep cut, with 2083 inhabitants; 30 miles N.E. of Brunſwick.

WISCHAU, or WISKAU, a town of Moravia, in the circle of Brunn; 15 miles E. of Brunn. N. lat. 49° 17′. E. long. 16° 54′.

WISCHBACH, or FISCHBACH, a town of the duchy of Stiria; 5 miles S. of Muertzenſchlag.

WISCHGROD, a town of the duchy of Warſaw, on the Viſtula; 27 miles S.E. of Poloczk.

WISCHITEN, a town of Lithuania, in the palatinate of Troki; 70 miles W. of Troki.

WISCHKOWA, a town of Bohemia, in the circle of Saatz; 5 miles N.N.E. of Saatz.

WISCHNOWA, a town of Bohemia, in the circle of Beraun: 3 miles E. of Przibram.

WISDIM, a town of Bohemia, in the circle of Boleſlaw; 14 miles W.N.W. of Jung Buntzel.

WISDOM, SAPIENCE, uſually denotes a higher and more refined knowledge of things, immediately preſented to the mind, as it were by intuition, without the aſſiſtance of ratiocination.

In this ſenſe, wiſdom may be ſaid to be a faculty of the mind, or at leaſt a modification and habit of it.

Sometimes the word is more immediately uſed in a moral ſenſe, for what we call *prudence* or *diſcretion;* which conſiſts in the ſoundneſs of the judgment, and a conduct anſwerable to it.

The ſchool-divines ſometimes reſtrain wiſdom to the knowledge of the more ſublime and remote objects, as that of God, &c. In which ſenſe, theology is properly ſaid to be wiſdom.

The Latin word for wiſdom is *ſapientia*, which literally expreſſes the ſenſe of taſting; to which wiſdom is ſuppoſed to have ſome conformity. The ſight, and other ſenſes, only repreſent to us the ſurface of things: taſte goes deeper, and penetrates into the ſubſtances; ſo that what, *e. gr.* to the feeling ſeemed cold, to the taſte will be found hot: ſo wiſdom, ariſing from a deep attention to our ideas, goes farther, and frequently judges otherwiſe than the common apprehenſions of men would reach to.

WISE, MICHAEL, in *Biography*, an admirable compoſer for the church, foſtered in the Chapel Royal after the Reſtoration, under captain Henry Cook, at the ſame time as Humphrey and Blow, three muſicians, who not only far ſurpaſſed their maſter in genius and abilities, but all our church compoſers of the 17th century, except Purcell. However, they prepared the way for his bold and original genius to expand; as ſeveral new melodies, modulations, and happy licences, which we uſed to think entirely of his invention, upon an attentive examination of their works, appear to have been firſt ſuggeſted by theſe three fellow-ſtudents. Yet, what they had ſlightly and timidly touched, Purcell treated with the force and courage of a Michael Angelo, whoſe abilities rendered the difficult eaſy, and gave to what, in leſs powerful hands, would have been diſtortion, facility, and grace.

Dr. Boyce has printed ſix verſe and full anthems, by Wiſe, which are admirable; and in Dr. Tudway's collection, Brit. Muſ., there are ſeven more, and a whole ſervice in D minor.

He was author of the celebrated two-part ſong, "Old Chiron thus preached to his pupil Achilles," which is ſtill too well known to need an encomium here.

Michael Wiſe was killed in a ſtreet-fray at Saliſbury, by the watchman, in 1687.

The firſt movement of his verſe-anthem for two voices, "The ways of Zion do mourn," is more beautiful and expreſſive than any grave and pathetic compoſition for the church of other countries, of the ſame kind and period of time, that we have hitherto diſcovered.

The uſe which the author has made of chromatic intervals at the word *mourn*, is not only happy and maſterly, but *new*, even now, at more than a hundred and twenty years diſtance from the time when the anthem was produced! The whole compoſition ſeems to us admirable; and beſides the intelligence and merit of the deſign, the melody is truly plaintive, and capable of the moſt touching and elegant expreſſion of the greateſt ſingers of modern times; the harmony too and modulation are ſuch as correſpond with the ſenſe of the words, and enforce their expreſſion.

There is an elegance of phraſe in a paſſage of the ſecond movement of the preceding anthem, at the word *down*, which has been lately revived, and in great favour, with a very minute difference, among the firſt ſingers of Italy. The difference conſiſts only in pointing the firſt note if a crotchet or quaver, and making the ſecond and third notes ſemiquavers or demiſemiquavers.

Wiſe was a native of Saliſbury, in which cathedral he was appointed organiſt and maſter of the choriſters, in 1668; and in 1675, a gentleman of the chapel royal. In 1686, he was preferred to the place of almoner and maſter of the boys at St. Paul's. He is ſaid to have been in great favour with Charles II., and being appointed to attend him in a progreſs, claimed, as king's organiſt for the time, the privilege of playing to his majeſty on the organ, at whatever church he went.

WISE *Men of Greece, Seven*, in the *Hiſtory of Philoſophy*, an appellation given to ſeveral eminent men, on whom was beſtowed the praiſe of civil and moral wiſdom. The hiſtory of theſe perſons, originally without doubt plain and ſimple, has been rendered obſcure and uncertain by traditionary reports. The incident to which this appellation was at firſt owing was as follows:

In the third year of the 49th Olympiad, it happened that certain youths of Ionia, purchaſing from a fiſherman of Miletus a large draught of fiſh, which he had brought to ſhore, found in the net a golden tripod of great value. Upon this a diſpute aroſe between the fiſherman and the purchaſers: the former maintaining that he had only ſold them the capture of fiſh; the latter aſſerting that they had bought the chance of the draught, whatever it might be. The queſtion was referred to the citizens of Miletus, who were of opinion, that in an affair ſo extraordinary, the Delphic oracle

oracle ſhould be conſulted. The anſwer of the oracle was 'To the Wiſeſt.' In obedience to this anſwer, the Mileſians unanimouſly adjudged the tripod to Thales. Thales modeſtly declined the honour intended him by his fellow-citizens, and ſent the tripod to Bias, a wiſe man of Priene; from him it was paſſed on through ſeveral hands, till it came to Solon, the Athenian legiſlator, who judging that the character of 'the wiſeſt' could not properly belong to any human being, ſent the prize of wiſdom to Delphos to be dedicated to Apollo. The ſtory, as above related, has in it ſomething fabulous; and the circumſtances that attend it are differently related by different writers. It is more probable, ſays Brucker, that in ſome public aſſembly a tripod was propoſed as an honorary prize to the man who ſhould recite, in verſe, the moſt excellent maxims of political and moral wiſdom, and that the ſages who engaged in this generous conteſt afterwards agreed to dedicate the prize to Apollo. In confirmation of this conjecture it is alleged, from a paſſage in Plato's Protagoras, that the wiſe men of this period met together to frame conciſe precepts and maxims for the conduct of life, and agreed to ſend ſuch ſentences as were thought moſt valuable to Delphos, to be inſcribed in the temple. Hence Apollo is ſaid by the ancients to have been the author of the precept 'Know thyſelf.'—'E cœlo deſcendit, Γνῶθι σεαυτόν.' The names commonly included under the appellation of the Seven Wiſe Men of Greece are, Thales, Solon, Chilo, Pittacus, Bias, Cleobulus, and Periander. Brucker's Philoſ. by Enfield, vol. i.

WISECK, in *Geography*, a river of Heſſe, which runs into the Lahn, near Gieſſen.

WISELL, a town of the duchy of Stiria; 4 miles N.E. of Rein.

WISEMAN, Richard, in *Biography*, was firſt known as a ſurgeon in the civil wars of Charles I., and accompanied prince Charles, when a fugitive, in France, Holland, and Flanders. He ſerved for three years in the Spaniſh navy, and returned with the prince to Scotland, and was made priſoner in the battle of Worceſter. After his liberation, in 1652, he ſettled in London. When Charles II. was reſtored, he became eminent in his profeſſion, and was made one of the ſerjeant-ſurgeons to the king. In May 1676 he appears, from the preface to his works, to have been a ſufferer by ill health for twenty years; but the time of his death is not known. The reſult of his experience appears in "Several Chirurgical Treatiſes," fol. 1676, 1686, and in 2 vols. 8vo. 1719. The ſubjects of theſe treatiſes are, tumours, ulcers, diſeaſes of the anus, king's-evil, wounds, gunſhot-wounds, fractures and luxations, and lues venerea. The courſe of his practice comprehended more than 600 caſes, of which he gives apparently an honeſt account, recording his failures as well as his cures, and the detail merits attention. In his relation of the miraculous effects of the royal touch in ſcrofula, it is not eaſy to reconcile his honeſty with his ſagacity, though from his own narration, duly conſidered, the fallacy is eaſily detected. His writings have long been regarded as ſtandard authority in the examinations at Surgeon's-Hall. Gen. Biog.

Wiseman, *Mr.*, a worthy Engliſh muſician, who went early in life to Italy, in order to receive leſſons on the violin from Tartini, in Padua, who recommended him, in 1736, to one of his favourite ſcholars, Paſqualino Bini, at Rome, where, after ſome time, finding himſelf likely to thrive as a profeſſor, by the patronage of the Engliſh nobility and gentry with which that city always abounds in their travels, ſettled there for the reſt of his life; and though not a performer of the firſt claſs, being a good muſician, and a man of probity and good conduct, he was not only reſpected by his countrymen, but by the natives of that city, which, though no longer the capital of the world, is ſtill the capital of Italy and the fine arts.

Mr. Wiſeman had reſided ſo long in Italy, that he had almoſt forgotten his native tongue. In 1770 he lived in the Palazzo Rafaele, without the gates of Rome, where, during the firſt winter months, he had a weekly concert till the operas began. It was here that the great Raphael lived and died, where there were ſtill ſome of his paintings in freſco, and where the late duke of York, the prince of Brunſwick, and ſeveral other great perſonages, gave concerts to the firſt people of Rome.

WISEN, in *Geography*, a river of Baden, which runs into the Rhine, near Bâle.

WISENT, a river of Bavaria, which runs into the Rednitz, near Forcheim, in the biſhopric of Bamberg.

WISEPPE, a town of France, in the department of the Meuſe; 3 miles S. of Stenay.

WISFTARDA, a town of Sweden, in the province of Smaland; 22 miles N. of Carlſcrona.

WISHART's Island, an iſland in the Pacific ocean. This is one of the Solomon iſlands, and by the Spaniards called Artreguada. S. lat. 2° 20′. E. long. 150° 55′.

WISIR, a ſmall iſland in the Eaſt Indian ſea, near the weſt coaſt of Aroo. S. lat. 15° 21′. E. long. 134° 51′.

WISK, or Wirsk, a river of England, in the county of York, which runs into the Swale.

WISKA, a river of Sweden, which runs into the ſea, 3 miles S. of Waro, in Weſt Gothland.

WISKI, a town of Bohemia, in the circle of Beraun; 4 miles N. of Przibram.

WISLAUFF, a river of Wurtemberg, which runs into the Rems, N.E. of Schorndorff.

WISLITZA, a town of Poland, in the palatinate of Sandomirz; 48 miles W.S.W. of Sandomirz.

WISLOCH, a town of the duchy of Baden, in the palatinate of the Rhine; 14 miles E. of Spire. N. lat. 49° 18′. E. long. 8° 45′.

WISMAR, a town of the duchy of Mecklenburg, ſituated in a bay of the Baltic, with a good harbour; large, well fortified, and defended by a citadel. This is one of the beſt and largeſt places in the country; as, beſides ſix churches, it has alſo a particular conſiſtory of its own, with a grammar-ſchool, under the direction of eight maſters, and is the ſeat of a Swediſh court of juſtice, erected in the year 1653, both for the diſtrict and Swediſh Anterior Pomerania. The court conſiſts of a preſident, a vice-preſident, and four aſſeſſors. It was formerly a Hanſe town, and poſſeſſed of the privilege of coining: the firſt origin is not known with any degree of certainty. In the year 1238, it was enlarged; and in the year 1266, obtained the Lubeck rights. In the year 1261, it was annexed to the duchy of Schwerin; in the year 1627, the Imperialiſts got poſſeſſion of it; but in the year 1632 were driven out by the Swedes, to whom it was ceded, at the peace of Weſtphalia, in 1648; 33 miles E. of Lubeck. N. lat. 53° 55′. E. long. 11° 26′.

WISMATH, a town of Auſtria; 14 miles S. of Ebenfurth.

WISNA, a town of the duchy of Warſaw; 70 miles N.E. of Warſaw.

WISNUM, a town of Sweden, in the province of Warmeland; 25 miles E.N.E. of Carlſtadt.

WISOKIA, a town of Lithuania; 20 miles N.N.W. of Brzeſc.

WISP, in *Rural Economy*, a term ſignifying a ſmall bunch of of ſtraw which is uſed in rubbing horſes down. Wiſp is alſo a term ſometimes applied to a rowel or ſeton put in animals.

WISPEL, in *Commerce*, a corn meaſure in Germany. A laſt of wheat contains 3 wiſpels; and a laſt of oats only 2 wiſpels. See SCHEFFEL.

WISSANT, in *Geography*, a town of France, in the department of the ſtraits of Calais; 12 miles N. of Boulogne.

WISSING, WILLIAM, in *Biography*, was born at Amſterdam in 1656. He received inſtructions in the art of painting from Dondyns, an hiſtorical painter at the Hague, but on leaving that maſter went to Paris, and in the year 1680, came to England, and aſſiſted Lely in his numerous works. After Lely's death, he became rather a favourite, and promiſed to become a formidable rival to Kneller. He drew all the royal family, and was particularly favoured by the duke of Monmouth, whoſe portrait he painted ſeveral times. The duke of Somerſet alſo patronized him, and employed him to paint himſelf and his ducheſs, and the pictures are now at Petworth.

Wiſſing was appointed principal painter to James II., and was ſent by him into Holland, to paint portraits of William and Mary. He did not long ſurvive his return to England, and died at Burleigh, the ſeat of the earl of Exeter, in 1687, at the age of 31. His heads were painted with ſoftneſs and delicacy, in a ſtyle quite diſtinct from that of his maſter, Lely, or his rival, Kneller; too ſoft, indeed, for character; and his larger pictures lack compoſition and harmony, both in line and colour.

WISSOKY-MEYTO, in *Geography*. See HOHENMAUT.

WISSOWATIUS, ANDREW, in *Biography*, a Socinian divine, was born of a noble family in Lithuania, in 1608, educated in the New Unitarian college at Racow under Crellius, and for ſome time purſued his ſtudies at Leyden, ſtrictly adhering to the principles of his tutor. Finding, on his return to Poland, that his brethren ſuffered perſecution from the diet of Warſaw, he exerted himſelf courageouſly in their defence, and encountered many perſonal difficulties and ſufferings in the exerciſe of his miniſtry in various parts of Poland. He was not ſilenced by the decree iſſued againſt Unitarians in 1658, but leading an unſettled life, he was induſtrious in ſeizing every opportunity that occurred for making proſelytes. In 1660, he was the only perſon of his party who was preſent at the "Colloquium Charitativum," where he firmly maintained his opinions againſt the jeſuit Chichovius and others. He is ſaid to have reſiſted large bribes, as well as to have encountered ſevere trials, in maintaining his ſentiments. Removing to Hungary, he ſpent two years in learning the language ſo as to be able to inſtruct and fortify his brethren in that kingdom. Laſt of all he retreated to Holland, where he was employed in ſuperintending an edition of the "Bibliotheca Fratrum Polonorum," in 9 vols. fol., and where he died in 1678. His integrity and conſtancy are highly applauded by the hiſtorians of his ſect; his writings were numerous, and one of them, publiſhed after his death, was entitled "Religio rationalis, ſeu de Rationis judicio in controverſiis, etiam theologicis ac religioſis adhibendo, tractatus." Gen. Biog.

WISSOWITZ, in *Geography*, a town of Moravia, in the circle of Hradiſch; 20 miles E.N.E. of Hradiſch.

WIST, WISTA, a quantity or meaſure of land among our Saxon anceſtors; of different dimenſions, in different places. In the Monaſticon, it is ſaid to be half a hide, or ſixty acres: in an old chronicle of the monaſtery of Battle, it is ſaid to be forty-eight acres.

WIST, in *Geography*, a town of Sweden, in the province of Eaſt Gothland; 6 miles S.S.E. of Linkioping.

WISTE, a town of the duchy of Bremen; 10 miles S.W. of Bremen.

WISTE, a river of the duchy of Bremen, which runs into the Wumme, 1 mile E. of Otterſberg.

WISTERNITZ, a town of Moravia, in the circle of Olmutz; 4 miles E. of Olmutz.

WISTERNITZ, *Unter*, a town of Moravia, in the circle of Brunn; 22 miles S. of Brunn.

WISTON, or WIZTON, a town in the hundred of Dan-Gladdan, county of Pembroke, South Wales, at the diſtance of 5 miles N.E. by E. from Haverford Weſt. It is a contributory borough with Pembroke and Tenby in ſending one member to parliament, and is governed by a mayor. The pariſh contains about 6000 acres: and in the return of the year 1811, the population was enumerated as 607 perſons, occupying 103 houſes. An annual fair is held on the 8th of November. In ancient times here was a caſtle of great extent; but it is now in ruins.—Carliſle's Topographical Dictionary of Wales, 4to. 1811.

WISTRIZ, or WESSERIZ, a river of Bohemia, which runs into the Egra, 3 miles E. of Schlakenwerth.

WISTYCZA, a town of Lithuania; 5 miles N. of Brzeſc.

WISZOGZOD, a town of the duchy of Warſaw; 52 miles N.W. of Warſaw.

WIT, DE, in *Biography*. There were ſeveral painters of this name very reſpectable in their profeſſion. Peter Candido de Wit, born at Bruges in 1548, went to Italy, and became a friend and co-labourer with G. Vaſari. He was afterwards employed by the grand duke of Tuſcany at Florence, and painted in oil and freſco. The emperor Maximilian invited him to Munich, and there he terminated his career. Gaſper de Wit, his brother, painted ſmall landſcapes very highly finiſhed, in which he introduced Italian architectural ruins. Of later date was Emanuel de Wit, born at Alkmaer in 1607, and a painter of ſtill life. He afterwards became a painter of architecture and perſpective views of churches, &c. which were touched with great clearneſs, animation, and ſpirit. He died in 1692. Another of the name, Jacob de Wit, is the flower of the flock. He was born at Amſterdam in 1695, and having exhibited a deſire for the purſuit of art, was placed with Van Spiers, an hiſtorical painter, for three years. He afterwards went to Antwerp to contemplate the admirable productions of Rubens and Vandyke, which adorned that city; and there he became the pupil of Jacob van Halen, continuing with him two years.

To him we are indebted for the preſervation of the compoſition made by Rubens for four cielings, divided into thirty-ſix compartments, in the church of the Jeſuits, which was deſtroyed by lightning in 1718. They have been ſince engraved from de Wit's ſketches by John Prout.

He was principally employed in adorning cielings and the walls of apartments; and generally choſe allegorical and emblematical ſubjects, which he compoſed with conſiderable ingenuity, and coloured in a clear and pleaſing manner. He was employed by the magiſtrates of Amſterdam, in 1736, to adorn their great council-chamber; and his work has had the honour of being applauded by ſir J. Reynolds. His ſketches for his larger works are touched with great freedom and neatneſs, and with good colour. He was living in 1744.

WIT, a faculty of the mind, conſiſting, according to Mr. Locke, in the aſſembling and putting together of thoſe ideas with quickneſs and variety, wherein can be found any reſemblance or congruity; by which to make up pleaſant pictures, and agreeable viſions, in the fancy.

This faculty, the ſame great author obſerves, is juſt the contrary of *judgment*, which conſiſts in the ſeparating carefully from one another, of ſuch ideas wherein can be found the ing optic nerve, fupplied in great abundance by the vicinity of the brain, muft make a fund of volatile matter to be difpenfed, and, as it were, determined by the eye.

Here, then, we have both the dart, and the hand to fling it. The one furnifhed with all the force and vehemence, and the other with all the fharpnefs and activity, one would require. No wonder if their effects be great!

Do but conceive the eye as a fling, capable of the fwifteft and intenfeft motions and vibrations: and again, as communicating with a fource of fuch matter, as the nervous juice elaborated in the brain; a matter fo fubtile and penetrating, that it is fuppofed to fly inftantaneoufly through the folid capillaments of the nerves; and fo active and forcible, that it diftends and convulfes the mufcles, and diftorts the limbs, and alters the whole habitude of the body, giving motion and action to a mafs of inert, inactive matter. A projectile of fuch a nature, flung by fuch an engine as the eye, muft have an effect wherever it ftrikes: and the effect will be limited and modified by the circumftances of the diftance, the impetus of the eye, the quality, fubtilty, acrimony, &c. of the juices, and the delicacy, coarfenefs, &c. of the object it falls on.

This theory, it is fuppofed by many, may account for fome of the phenomena of witchcraft, particularly of that branch called fafcination. It is certain the eye has always been efteemed the chief feat, or rather organ, of witchcraft; though, by moft, without knowing why, or wherefore: the effect was apparently owing to the eye; but how, was not dreamed of. Thus, the phrafe, to have an *evil eye*, imports as much as to be a witch. And hence Virgil,

"Nefcio quis teneros oculus mihi fafcinat agnos."

Again, old bilious perfons are thofe moft frequently fuppofed to have the faculty; the nervous juice in them being depraved and irritated by a vicious habitude of body, and fo rendered more penetrating and malignant. And young perfons, chiefly children and girls, are moft affected by it; becaufe their pores are patent, their juices incoherent, and their fibres delicate and fufceptible. Accordingly the witchcraft mentioned by Virgil only reaches to the tender lambs.

Laftly, the faculty is only exercifed when the perfon is difpleafed, provoked, irritated, &c. it requiring fome extraordinary ftrefs and emotion of mind to dart a proper quantity of the effluvia, with a fufficient impetus, to produce the effect at a diftance. That the eye has fome very confiderable powers is paft difpute.

The ancient naturalifts affure us, that the bafilifk and opoblepa kill other animals merely by ftaring at them. If this fail of credit, a late author affures us to have feen a moufe running round a large fnake, which ftood looking earneftly at it, with its mouth open; ftill the moufe made lefs and lefs circles about it; crying all the while, as if compelled to it; and, at laft, with much feeming reluctance, ran into the gaping mouth, and was immediately fwallowed.

Who has not obferved a fetting-dog; and the effects of its eye on the partridge? The poor bird, when once its eyes meet thofe of the dog, ftands as if confounded, regardlefs of itfelf, and eafily lets the net be drawn over it. We remember to have read of fquirrels alfo ftupified and overcome by a dog's ftaring hard at them, and thus made to drop out of the trees into his mouth.

That man is not fecure from the like affections is matter of eafy obfervation. Few people but have, again and again, felt the effects of an angry, a fierce, a commanding, a difdainful, a lafcivious, an intreating eye, &c. Thefe effects of the eye, at leaft, make a kind of witchcraft. But our readers will excufe our enlarging.

Witchcraft prevailed to fuch a degree both in England and Scotland in the 16th century, that it attracted the attention of government under the reign of Henry VIII., in whofe 33d year was enacted a ftatute which adjudged all witchcraft and forcery to be felony without benefit of clergy; and at the commencement of the reign of Elizabeth, the evil feems to have been very much on the increafe; for bifhop Jewel, in a fermon preached before the queen in 1558, tells her; "It may pleafe your grace to underftand that witches and forcerers within thefe four laft years are marvelloufly increafed within your grace's realm. Your grace's fubjects pine away even unto the death, their colour fadeth, their flefh rotteth, their fpeech is benumbed, their fenfes are bereft; I pray God they never practife further than upon the fubject." Of the prevalence of this delufion in 1584, we have the teftimony of Reginald Scot, in his treatife intitled "The Difcoverie of Witchcraft," written in behalf of the poor, the aged, and the fimple, as the author informs us; and it reflects fingular difcredit on the age in which it was produced, that a detection fo complete, both with regard to argument and fact, fhould have failed in effecting its purpofe. The mifchief, inftead of being reftrained, was rapidly accelerated by the publication of the "Dæmonologie" of king James, at Edinburgh, in the year 1597; and the contagion was promoted by the fucceffion of James to the throne of Elizabeth. In the year 1603, the royal treatife was printed at London, with an alarming preface concerning the increafe of witches or enchanters, "thefe deteftable flaves of the devil;" and it was accompanied by a new ftatute againft witches, which defcribes the crime in a variety of particulars, and enacts, that offenders, duly and lawfully convicted and attainted, fhall fuffer death. Reginald Scot, in the treatife abovementioned, has pourtrayed at large the character of thofe who were branded with the appellation of witches, ftating the deeds that were imputed to them, and the nature of their fuppofed compact with the devil. The abode of a witch is admirably defcribed by Spenfer, the defcription being formed from an exifting fubject:

"There in a gloomy hollow glen fhe found
A little cottage built of ftickes and reedes
In homely wife, and wald with fods around;
In which a witch did dwell, in loathly weedes
And wilful want, all carelefs of her needes:
So choofing folitarie to abide
Far from all neighbours, that her devilifh deeds
And hellifh arts from people fhe might hide,
And hurt far off unknowne whom ever fhe envide."
Faerie Queene.

Scot has, with fingular induftry, collected from every writer on the fubject the minutiæ of witchcraft, and he has annexed comments for the purpofe of refuting and expofing them; whereas James, the royal pedant, wrote in defence of this folly, and, unfortunately for truth and humanity, the doctrine of the monarch was preferred to that of the fage.

The old laws made in England and Scotland againft conjuration and witchcraft are repealed by a late ftatute, and no perfon is to be profecuted for any fuch crime. 9 Geo. II. c. 5. See Conjuration.

WITCHES-Butter, a name given by the common people of England to a fort of tremella growing on the bark of old trees, in form of a corrugated membrane.

WITELSHOFEN, in *Geography*, a town of Germany,

many, in the margravate of Anſpach; 7 miles S.E. of Creilſheim.

WITGENAU, or WITCHENAU, a town of Luſatia, on the Elſter; 13 miles N.N.W. of Budiſſen. N. lat. 51° 20′. E. long. 14° 16′.

WITGENAU, or *Wittengau*, or *Trſebon*, a town of Bohemia, in the circle of Bechin, on the river Lauſnicz; 22 miles S.S.E. of Bechin. N. lat. 49° 4′. E. long. 14° 40′.

WITGENSTEIN, a county of Germany, ſituated between the principalities of Heſſe Darmſtadt, Naſſau Dillenburg, and the duchy of Weſtphalia; about 18 miles long, and 12 broad. Some parts are mountainous and woody, and contain mines of ſilver, copper, and iron; the paſtures are good, but the arable land inconſiderable. The principal rivers are the Lahn and the Eder. It is united to the county of Sayn, and that princely houſe is divided into two branches, Sayn Witgenſtein of Witgenſtein, and Sayn Witgenſtein of Berleburg, each of which had a diſtinct vote in the Imperial college, and in the diet of the Upper Rhine. The county takes its name from a ſeat, the reſidence of the counts, which is ſituated on a mountain; 1 mile N. of Laaſphe.

WITGEWALT, a town of Pruſſia, in Oberland; 8 miles N.E. of Oſterrode.

WITH-VINE, or WINE, in *Agriculture*, a term provincially ſignifying couch, or couch-graſs. See BIND-*Weed*.

WITHAM, in *Geography*, a market-town and pariſh in the hundred of the ſame name, in the county of Eſſex, England, ſituated on a branch of the river Blackwater, 8¾ miles N.E. from Chelmsford, and 37¾ in the ſame direction from London. By the parliamentary returns of 1811, the number of houſes in the pariſh was 466, and the inhabitants amounted to 2352. Witham has a weekly market on Tueſday, and fairs on Friday and Saturday of Whit-week, on the 14th of September, and 8th of November. The petty ſeſſions for the Witham diviſion of the county are alſo held in the town. Witham is ſuppoſed to have been conſtituted a town by Edward the Elder, though perhaps it was only reſtored by him, at leaſt the part on Cheping Hill round the church, which ſtands about half a mile N.W. from the other part of the town. On this eminence are conſiderable remains of a circular camp, incloſed by a double ditch and rampart. From this work, and the quantity of Roman bricks worked up in the body and tower of the church, Witham has been thought to occupy the poſition of the Canonium of Antoninus. The manor was anciently poſſeſſed by earl Harold, and afterwards by Euſtace, earl of Boulogne, who married the ſiſter of Edward the Confeſſor. Near the eaſt end of the town is a manſion, now poſſeſſed by Thomas Kynaſton, eſq., but formerly belonging to the late earl of Abercorn. Faulkbourne-hall, between one and two miles N.W. from Witham church, is the ſeat of colonel Bullock, formerly member of parliament for the county of Eſſex. Here is a cedar-tree, about nineteen feet in circumference near the ground. A coin of Domitian and veſtiges of walls indicate the Romans to have had a villa at this place.—Beauties of England and Wales, Eſſex. By J. Britton and E.W. Brayley, 8vo. 1808.

WITHAM, a river of England, in the county of Lincoln, which riſes in the ſouth part of Lincolnſhire, on the borders of Leiceſterſhire, paſſes by Grantham to Lincoln, where it becomes navigable; from thence it paſſes by Tatterſall, Boſton, &c. and runs into the German ſea, 5 miles below Boſton, in what are called the *Waſhes*.

WITHE, in *Agriculture*, a ſmall twiſted ſtick of any kind uſed as a band.

WITHER-BAND, in *Rural Economy*, the band or piece of iron which is laid underneath a ſaddle, about four fingers above the withers of the horſe, to keep tight the two pieces of wood that form the bow of the ſaddle.

WITHER-*Wrung*, in the *Manege*. A horſe is ſaid to be wither-wrung, when he has got a hurt in the withers; which ſort of hurts it is very hard to cure. See WITHERS.

WITHERING, WILLIAM, M.D. F.R.S., in *Biography*, was born in 1741, and finiſhed his medical education in the univerſity of Edinburgh, where he took his degree of doctor in 1766. From Stafford, where he firſt ſettled and married, he removed to Birmingham, and ſpeedily attained by his ſkill and aſſiduity to very extenſive and profitable practice; without ſeeking much ſociety or neglecting his ſcientific purſuits in order to ſecure it. The chief objects of his attention, independently of his profeſſional engagements, were botany and chemiſtry. The reſult of his ſcientific inquiries and labours appears in the following liſt of his valuable publications; *viz.* "A Botanical Arrangement of Britiſh Plants," in 2 vols. 8vo. 1776, which paſſed through two more editions, in 1787, 3 vols., and in 1796, 4 vols., with numerous improvements and additions, ſome of which were ſuggeſted by his friends, and particularly by Dr. Stokes. In chemiſtry and mineralogy, a tranſlation of Bergman's "Sciagraphia Regni Mineralis," 1783, and the following papers in the Philoſophical Tranſactions; "Experiments on different Kinds of Marle found in Staffordſhire," 1773; an "Analyſis of the Toad-ſtone of Derbyſhire," 1782; "Experiments on the Terra Ponderoſa," 1784; and "Analyſis of a Hot Mineral Spring in Portugal," 1798. In the improvement of his own profeſſion, "Account of the Scarlet Fever and Sore Throat, particularly as it appeared at Birmingham in the year 1778;" and "An Account of the Fox-glove and ſome of its Medical Uſes; with Practical Remarks on the Dropſy and other Diſeaſes," 1785. Subject to pulmonic attacks, which weakened his lungs, he thought it neceſſary, in 1793 and 1794, to paſs the winter in a warmer climate, and he fixed on Liſbon. Afterwards he became incapable of his former profeſſional exertions, and died at the Larches, near Birmingham, in November 1799, at the age of 58. In his intellectual character he joined unremitting application with ſagacity and diſcernment. In his medical practice he limited preſcription to that quantity and kind of medicine which was abſolutely neceſſary for his patients; and if any in the inferior branches of the profeſſion diſliked this mode of practice, their diſapprobation of it was a teſtimony in its favour. In his diſpoſition he was mild and humane; and his natural reſerve did not preclude him from the pleaſure of rational ſociety. His valuable library and handſome property were inherited by an only ſon. Gen. Biog.

WITHERING, in *Medicine*. See ARIDURA.

WITHERING *of a Cow*, is when, after calving, ſhe does not caſt her cleanſing, which, if not timely remedied, will kill her.

WITHERINGIA, in *Botany*, was ſo named by the great French botaniſt, M. L'HERITIER, (ſee that article,) in compliment to the late Dr. William Withering, F.R.S. F.L.S., the well-known author of a moſt uſeful and popular Engliſh work, entitled an "Arrangement of Britiſh Plants," which has gone through ſeveral editions, in ſome of the earlier of which Dr. Stokes was his coadjutor. (See STOKESIA.) —L'Herit. Sert. Angl. 33. Schreb. Gen. 791. Willd. Sp.

Profeffor Martyn fuppofed the honour had been defigned for Nicholas Witfen, a writer on fhells, who gave one of the earlieft accounts of New Holland. (See Phil. Tranf. v. 17 and 20.) Thunberg's miffion to Japan appears to have been furthered by the influence of the above-named gentleman. We can only rely on him for the propriety of the appellation in queftion.—Thunb. Nov. Gen. 33. Murray in Linn. Syft. Veg. ed. 14. 83. Schreb. Gen. 37. Willd. Sp. Pl. v. 1. 247. Vahl Enum. v. 2. 47. Mart. Mill. Dict. v. 4. Ker in Sims and Kon. Ann. of Bot. v. 1. 236. Ait. Hort. Kew. v. 1. 109. Juff. 59. Lamarck Illuftr. t. 30.—Clafs and order, *Triandria Monogynia*. Nat. Ord. *Enfatæ*, Linn. Ker. *Irides*, Juff.

Gen. Ch. *Cal.* none, unlefs the upper pair of the *bracteas* be fo confidered. *Cor.* of one petal, tubular, erect: tube cylindrical, flender at the bafe, gradually dilated at the top: limb fpreading, regular, in fix deep, equal, obovate fegments. *Stam.* Filaments three, very fhort, inferted into the mouth of the tube, at the bafe of three alternate fegments of the limb; anthers oblong, erect. *Pift.* Germen fuperior, roundifh, fmall: ftyle thread-fhaped, erect, longer than the tube of the corolla, flightly curved at the extremity; ftigma in three fhort, equal, rather fpreading fegments. *Peric.* Capfule membranous, of three cells and three valves. *Seeds* feveral, angular.

Eff. Ch. Calyx none. Corolla with a cylindrical tube; limb in fix deep, equal, obtufe fegments. Stigma flightly three-cleft. Capfule of three cells, with feveral angular feeds.

1. W. *maura*. Downy-flowered Witfenia. Thunb. Nov. Gen. 34. t. 2. f. 1. Fl. Cap. v. 1. 255. Willd. n. 1. Vahl n. 1. Ait. n. 1. Redout. Liliac. t. 245. (Antholyza maura; Linn. Mant. 175.) — Flowers terminal, in pairs. Outer fegments of the corolla exterally downy.— Native of the fhady fides of hills, at the Cape of Good Hope, flowering in April and May. Sent to Kew by Mr. Maffon, in 1790, but it does not appear to have bloffomed in that collection, nor elfewhere in Europe, M. Redoute's fine figure being made from a dried fpecimen, aided by defcription. The *root* is perennial and woody. *Stem* fhrubby, erect, more or lefs branched, two feet high, compreffed; naked in the lower part, and appearing as if jointed, from the fcars left by former foliage; leafy above. *Leaves* numerous, alternate, feffile, two-ranked, equitant, four or five inches long, compreffed, ftriated, acute, entire. *Flowers* in pairs at the extremities of the fhort terminal branches, crowded, more or lefs numeroufly, into a corymbofe tuft. *Corolla* two inches long: its tube yellow at the bafe, dark blue for a confiderable extent in the upper part; limb yellow, fcarcely fpreading, full half an inch long, clothed externally with denfe fhaggy pubefcence of a very peculiar kind, confined to the tips of the inner fegments.

2. W. *corymbofa*. Corymbofe Witfenia. Ker in Curt. Mag. t. 895. Ait. n. 2. Sm. Exot. Bot. v. 2. 17. t. 68. —Corymb many-flowered. Corolla externally fmooth.— Native of the Cape of Good Hope. Raifed from feed by G. Hibbert, efq. in 1803. A green-houfe plant, flowering in fpring and autumn. The *ftem* is fhrubby, from four to fix inches high. *Leaves* like the laft, but only half the fize, fomewhat glaucous. *Flowers* very numerous, bright blue, in a forked corymbofe, compound panicle, fupported by a long ftalk, at firft terminal, but foon becoming lateral. *Bracteas* two pair at the bafe of each flower, concave, obtufe. *Corolla* about an inch long, including its horizontal limb.

3. W. *ramofa*. Branching Witfenia. Thunb. Fl. Cap. v. 1. 256. Vahl n. 2. (W. fruticofa; Ker in Ann. of Bot. v. 1. 237. Ixia fruticofa; Thunb. Diff. n. 1. t. 1. f. 3. Lamarck Illuftrat. t. 31. f. 4. Linn. Suppl. 93.) —Stem much branched. Corolla externally fmooth; its tube capillary, twice the length of the limb.—Native of hills at the Cape of Good Hope, flowering in October, November, and December. The *ftem* is a fpan high at moft, remarkably woody, repeatedly branched in a corymbofe manner; naked below; the branches compreffed, two-edged, knotty or fcarred as if jointed, leafy at their extremities. *Leaves* equitant, two-ranked, linear, narrow, one and a half or two inches long, rather glaucous; reddifh at the bafe. *Flowers* terminal, very few together, if not quite folitary, blue, remarkable for the length and flendernefs of their tube, which fometimes meafures nearly two inches; the limb is rather lefs fpreading, and more bell-fhaped, than that of *corymbofa*. *Bracteas* membranous, elongated, brownifh.

4. W. *pumila*. Dwarf Witfenia. Vahl n. 3. (Ixia pumila; Forft. Comm. Gott. v. 9. 20. t. 2. I. magellanica; Lamarck Illuftr. v. 1. 109. Moræa magellanica; Willd. Sp. Pl. v. 1. 241, excluding Cavanilles' fynonym. Tapeinia, Juff. 59.)—Stems fimple, fingle-flowered.—Gathered by Forfter, Commerfon, and others, at the ftraits of Magellan. The *root* is perennial, long, branched, bearing denfe tufts of numerous, fimple, leafy *ftems*, an inch or inch and a half high. *Leaves* crowded, two-ranked, awl-fhaped, compreffed, ftrongly ribbed, about an inch long. *Flowers* whitifh, fmall, folitary, nearly feffile, among the uppermoft leaves, which form a kind of fheath, but each appears to have alfo a bivalve *fheath*, or pair of *bracteas*, which are permanent. *Capfule* brown, with rather rigid, emarginate valves.

Mr. Ker obferves, that this is the only genus of its natural order whofe habit is in any degree fhrubby. He mentions, in the Annals of Botany, another fpecies, by the name of *partita*, feen by himfelf in Mr. Hibbert's herbarium; but without any indication of its characters, fo that we have no means of knowing how it differs from the foregoing.

WITSIO, in *Geography*, a town of Sweden, in the province of Schonen; 28 miles N.N.W. of Chriftianftadt.

WITT, John de, in *Biography*, the fon of a burgomafter of Dordrecht, was born in 1625, and educated in various ufeful fciences, fo as to excel in a knowledge of jurifprudence, politics, and mathematics, in the latter of which he was fo great a proficient, that he wrote a treatife on the elements of curve-lines, which was publifhed under the infpection of Francis Schooten. For further improvement he fpent fome years in travel, and upon his return was elected to his father's poft of penfionary of Dordrecht. Attached by his defcent to the principles of republicanifm, and jealous of the houfe of Orange, he oppofed the elevation of this houfe, and diffuaded the province of Zealand from conferring the office of captain-general upon the young prince, William III. His conduct in this bufinefs was much approved, and he was henceforth regarded as at the head of the political adminiftration of the United Provinces. This was a period peculiarly critical and interefting. The war with the new Englifh republic diftreffed the ftates; it was injurious to their trade and finances; and prefented to the Orange party a favourable opportunity for advancing prince William to the power and dignities poffeffed by his anceftors. Peace at length became abfolutely neceffary; and one of the articles concluded upon in 1654, and dictated by Cromwell, was the perpetual exclufion of the prince of Orange from the high offices formerly held by his family. This article was agreed to by the ftates of Holland alone, and when De Witt drew up a declaration for divulging it, it, ſome of the provinces cenſured it, and charged the anti-Orange party with having ſuggeſted it to Cromwell. The province of Holland, however, carried the point, and the general tranquillity was little diſturbed. De Witt now directed his attention to the ſtate of the finances, and ſucceeded in reducing the intereſt of the public debt, and perſuading the people to acquieſce in this meaſure. The reſtoration of Charles II. was generally agreeable to the United States, and more eſpecially to the Orange party: but the reſtored ſovereign ſoon declared his diſſatisfaction with De Witt, becauſe he had been hoſtile to the elevation of the houſe of Orange. From this time, the Dutch ſtateſman favoured the politics of France more than thoſe of England. At length a war took place between the Dutch and Engliſh in 1665; during the progreſs of which De Witt was often unpopular, though he was the main ſpring which kept in action the reſources of the ſtate, and remedied every calamity. Peace with England in 1667 developed the ambitious projects of Lewis XIV. in taking poſſeſſion of the Spaniſh Netherlands; and the alarm which this meaſure produced in the United Provinces gave occaſion to the friends of the houſe of Orange to propoſe the elevation of the young prince to the dignities which his family had poſſeſſed. De Witt, with a view of counteracting this purpoſe, obtained a reſolution on the part of the ſtates of Holland for ſeparating the offices of captain-general and ſtadtholder (ſee William III.), which reſolution gave great offence to the other provinces, and rendered De Witt, with whom it was ſuppoſed to have originated, extremely unpopular. Senſible, however, of the dangers ariſing from French ambition, he concurred in the triple alliance between England, Sweden, and the United Provinces, concluded, in 1668, by himſelf and ſir William Temple. The ſtates of Holland were ſo ſatisfied with his conduct, that they nominated him for five years more to the office of their penſionary, which he had already occupied for fifteen years. Confiding in the triple alliance, and the ſubſequent peace of Aix-la-Chapelle, he again indulged his jealouſy of the Orange party and a ſtanding army, and conſidered the danger from France as a ſecondary object. But the ambition of Lewis had no bounds; the unprincipled Charles II. could not be relied upon; the triple alliance was ſet aſide; and the Engliſh cabinet joined the French in direct war with the United Provinces; ſo that in the year 1672 a French army made an irruption into the territories of the ſtates, and threatened to overwhelm the whole country. The anti-Orangiſts were then compelled to confer the chief command on William. The conduct of the French had been ſo atrocious, that every perſon who had manifeſted the ſlighteſt attachment to their politics was charged with treaſon. De Witt became the object of public indignation, and to him were aſcribed all the calamities which were felt or feared. Four aſſaſſins attempted his life, as he was returning home from an aſſembly of the ſtates of Holland, attended by a ſingle ſervant; but though he received many wounds, none of them were mortal. One of the aſſaſſins was taken and executed; but ſuch is the influence of party, the friends of the houſe of Orange regarded the wretch as a martyr. Cornelius de Witt, on his return from the fleet, where he had ſerved as deputy of the ſtates, narrowly eſcaped from a ſimilar attempt. The prince was now elevated to the ſtadtholderate; and the penſionary, as ſoon as he was recovered from his wounds, viſited him with congratulation on the event, but was coolly received. Finding that, as he was become an object of the public hatred, he could be no longer of any ſervice, he requeſted permiſſion from the ſtates of Holland to reſign his office, which was granted him upon the moſt honourable terms. His brother was at this time impriſoned among common felons at the Hague, under a charge, preferred by a perſon of infamous character, of having formed a plot againſt the life of the prince of Orange. On his trial he was put to the torture, in the moſt cruel form of applying it; but though he endured the moſt aggravated ſufferings, proteſting his innocence, and citing his judges before the tribunal of God for their treatment of him, they pronounced ſentence, which deprived him of all his dignities, and baniſhed him for life from the province. Although no criminal charge was brought againſt John de Witt, the enemies of the family reſolved that neither of the brothers ſhould eſcape with life. Decoyed by a fictitious meſſage to viſit his brother Cornelius in the priſon, a furious mob aſſembled to prevent his return. The ſtates of Holland ordered a guard to diſperſe the people, and requeſted ſome companies of horſe and foot to be ſent from the camp of the prince of Orange. But the commanding officers were inveterate in their enmity againſt the De Witts; and the inflamed populace, not reſtrained from executing their bloody purpoſe, forced open the doors of the priſon, dragged out the two brothers, and inhumanly maſſacred them. This cataſtrophe took place in Auguſt 1672, John de Witt being in the 47th year of his age. Although the ſtates of Holland pronounced the deed to be deteſtable, and requeſted the ſtadtholder to take proper meaſures for avenging the death of theſe two brothers, it was pretended that it would be dangerous to inquire into a deed in which the principal burghers of the Hague were concerned, and therefore none of the murderers were brought to juſtice. It ſhould, however, be recollected, that the prince never ſpoke of this maſſacre without the greateſt horror.

The character of De Witt has been deſcribed in honourable terms by ſir William Temple, who knew him well, both in private life and in his public ſtation. He ſpeaks of him as a perſon of indefatigable application, of invincible reſolution, of a ſound and clear judgment, and of irreproachable integrity, inſomuch, that if he was blinded in any reſpect, it was in conſequence of his paſſion for promoting what he thought the welfare of his country. He bears teſtimony to the penſionary's knowledge of the intereſts of foreign courts, though he did not make ſufficient allowance for the treachery of princes, or rather their miniſters, and was thus miſled with regard to the ambitious views of France. If he had any wrong bias in his political conduct, it was that of an hereditary jealouſy and diſlike of the houſe of Orange, which led him in ſome caſes to act rather as a party leader than an unprejudiced patriot. No man could be leſs influenced than De Witt by views of avarice or oſtentation. His manners and appearance were adapted to the ancient ſimplicity and frugality of his country, even in the height of his power. When his papers and private letters were ſubmitted to a rigorous ſcrutiny after his death, nothing was diſcovered that could impeach his integrity. When one of the commiſſioners was aſked what they had found in De Witt's papers; "What (ſaid he) could we have found—nothing but probity!" As a man of buſineſs, he was ſcrupulouſly attentive to order and method; and when he was once aſked, How he was able to tranſact ſuch a multiplicity of affairs? he replied, "By doing only one thing at a time." Mod. Un. Hiſt. Gen. Biog.

WITTBACH, in *Geography*, a river of Germany, which riſes near Hackenburg Sayn, and after a circuitous courſe runs into the Rhine, about a mile below Neuwied.

WITTELM, a ſmall iſland in Steinhuder lake, with a fort; 3 miles N. of Hagenburg.

WITTELOHE, a town of Germany, in the county of Verden; 10 miles S.E. of Verden.

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"Whoever," ſays ſir John Forteſcue Aland, who was very learned in the Saxon language and legal antiquities, in his preface to the book of chancellor Forteſcue on the difference between an abſolute and limited monarchy, "carefully and ſkilfully reads the Saxon laws, and the prefaces or preambles to them, will find, that the commons of England always in the Saxon times made part of that auguſt aſſembly." In a paſſage occurring in lib. iii. ſ. 56. of William of Malmſbury, we have an expreſs declaration, that by the Saxon conſtitution eſtabliſhed in England, the "people," as well as the nobles, had a right to be called to the "General Aſſembly" upon affairs of great moment, and to join in the "edicts" made there; ſo that, without "their conſent," the ſucceſſion to the crown could not be ſettled. The term *Senatus* uſed by this hiſtorian denotes the ordinary aſſembly of the nobles, which he diſtinguiſhes from the "people;" but he ſuppoſes that the latter ought to be joined to the former, in order to compoſe the entire legiſlature and great council of the nation, upon extraordinary occaſions. This was agreeable to the cuſtom aſcribed by Tacitus to the Germans, from whom they ſprung; "De minoribus rebus principes conſultant, de majoribus omnes; ita tamen, ut ea quoque, quorum apud plebum arbitrium eſt, apud principes pertractantur." See BOROUGH.

It has been, among conſtitutional antiquarians, an intereſting queſtion, whether they who poſſeſſed this quantity of land had thereby the right of being in the wittena-gemote; or whether the members of this great council were elected from the territorial proprietors, and ſat as their repreſentatives? One perſon is mentioned by Mr. Turner (ubi infra), whoſe

whose designation seems to have the force of expressing an elected member.. Among the persons signing to the act of the gemote at Closeshoe in 824 is, "Ego Beonna *electus* consent. et subscrib."

The members of the gemote were convened by the king's writ, of which many instances occur; and the times of their meeting seem to have been usually the great festivals of the church, as Christmas, Easter, and Whitsuntide; but of these Easter, being most frequently mentioned, seems to have been the favourite period. Their meetings, however, were not absolutely restricted to these seasons. The place of their assembly was not fixed. Perhaps this might depend on the king's residence at the time, and might have suited his convenience. Our monarchs seem to have maintained their influence in the wittena-gemote by their munificence. The king presided at this council, and sometimes, perhaps always, addressed them. In 993 we have an account of a royal speech. One of their duties was to elect the sovereign, and to assist at his coronation. Another was to co-operate with the king in making laws. The wittena-gemote appears also to have made treaties jointly with the king. Many instances occur to this purpose. The treaty, printed in Wilkins's Leges Anglæ-Saxonicæ, p. 104, is said to have been made by the king and his witan. They are also mentioned as assisting the king in directing the military preparations of the kingdom. Impeachments of great men were made before the wittena-gemote. At these councils grants of land were made and confirmed; and the wittena-gemote frequently appears in the Saxon remains, as the high court of judicature of the kingdom, and it exercised power over the public guilds of the nation. The lands of the Anglo-Saxons, the burghs, and the people, appear in all the documents of our ancestors, as subjected to certain definite payments to the king as to their lords; and by a custom, whose origin is lost in its antiquity, among the Anglo-Saxons, all their lands, unless specially exempted, were liable to three great burdens, the building and reparation of bridges and fortifications, and to military expeditions. But what we now call taxation seems to have begun in the time of Ethelred, and to have arisen from the evils of a foreign invasion. Thus the payment of 10,000*l.* to the Danes to buy off their hostility, mentioned by Henry of Huntingdon, and those which followed, are stated to have been ordered by the king and the wittena-gemote. Under sovereigns of feeble capacity, the wittena-gemote seems to have been the scene of those factions, which always attend both aristocracies and democracies, when no commanding talents exist to predominate in the discussions, and to shape the council. Turner's Hist. of the Anglo-Saxons, vol. ii. book 10. Littelton's Hist. Henry II. vol. iii.

WITTENBERG, in *Geography*, a town of Saxony, and capital of a circle or district, situated on the side of the Elbe, over which is a ferry: it is the head town of the electoral circle, the seat of an aulic judicature, of the assize, as also a consistory, together with that of the general superintendancy of the electoral circle, a spiritual inspection, the circle amt, and a famous university, founded in the year 1502, at which, in 1517, the Reformation took its rise by means of Martin Luther. This town is not large, but fortified. The old citadel was formerly the electoral residence; near it stands an arsenal. In the large round tower are kept the archives of the electoral and princely houses. The university library is kept in what was formerly an Augustine cloister. The first founder of the town of Wittenberg was Bernard, duke of Saxony. In the year 1547, it was taken by the emperor Charles V.; in the year 1756, it was possessed by the Prussians, who also broke down a bastion of the fortifications; 60 miles N. of Dresden. N. lat. 51° 53′. E. long. 12° 46′.

Wittenberg, a town of Prussia, in Natangen; 8 miles N. of Heilsberg.—Also, a town of the duchy of Lauenburg, on the Elbe; 8 miles W. of Lauenburg.

WITTENBERGEN, a town of Brandenburg, in the Mark of Pregnitz; 6 miles S.S.W. of Perleberg. N. lat. 53° 2′. E. long. 11° 50′.—Also, a town of the duchy of Holstein; 8 miles S.W. of Lutkenborg.

WITTENBURG, a town of the duchy of Mecklenburg; 17 miles W. of Schwerin.

WITTENHALL, a township of England, in Staffordshire; 2 miles N.E. of Wolverhampton.

WITTENHAUSEN, a town of the duchy of Holstein; 5 miles W. of Oldeburg.

WITTENSTEIN, a town of Prussia, in the province of Natangen; 10 miles S.S.E. of Königsberg.

WITTGENAU. See Witgenau.

WITTHOEC, a town of Africa, in the country of Cape Lopez Gonsalvo; 30 miles N. of Olibato.

WITTICHSTHAL, a town of Saxony, in the circle of Erzgebirg; 7 miles S. of Schwartzenberg.

WITTINGEN, a town of Westphalia, in the principality of Luneburg Zelle; 27 miles E. of Zelle.

WITTLESEE Mere, a lake of England, in the county of Huntingdon; 4 miles S. of Peterborough.

WITTLICH, a town of France, in the department of the Rhine and Moselle; 16 miles N.E. of Treves. N. lat. 50° 4′. E. long. 6° 52′.

WITTMUND, a town of East Frieseland, on the Harle; 7 miles S.E. of Essens.

WITTOBA, in *Hindoo Mythology*, is a name of the god Vishnu in one of his numerous *descents*, or *avataras*, as they are called. Some account of these avataras is given under our article Vishnu. This, now under consideration, was one of inferior importance; and not, it is said, of very ancient occurrence, and therefore not described in the Puranas, unless it be in the one supposed to be more modern than the rest, which is entitled Maha Bhagavat. (See Purana, and Sri Bhagavata.) A splendid temple is dedicated to the worship of Wittoba, or Vishnu, at Panderpoor, a town of great respectability on the river Beemah, about 100 miles to the south-eastward of Poona. The manifestation is said to have taken place there. He is there represented sculptured in stone, of the size of a man, standing with his feet parallel to each other; his hands upon his hips, the fingers pointing forward, his thumbs backward. Two of the wives of Vishnu in his avatara of Krishna accompanied him in this; these were Rukmeni and Satyavama, and they have smaller temples at Panderpoor, besides their lord's. (See Krishna, Rukmeni, and Satyavama.) Images of Wittoba are common in the Mahratta country, generally of clumsy manufacture. Several representations of Wittoba and his wives are given in the Hindoo Pantheon, from casts and pictures. That work contains also a history of the avatara, and many particulars respecting it.

WITTORF, in *Geography*, a town of Germany, in the county of Verden; 10 miles S.S.E. of Rotenburg.

WITTOW, a town on a peninsula at the northern extremity of the island of Usedom, near Artona, an ancient fortress destroyed by the Swedes. N. lat. 54° 44′. E. long. 13° 27′.

WITTSTOCK, a town of Brandenburg, in the Mark of Pregnitz; 47 miles N.N.W. of Berlin. N. lat. 53° 10′. E. long. 12° 39′.—Also, a town of Brandenburg, in the New Mark; 12 miles N. of Custrin. N. lat. 52° 49′. E. long. 14° 50′.

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It related to the brother of an abbot, who, though nobly born, could not be reckoned among the nobility of the kingdom, becauſe he had not an eſtate of forty hides of land; and, therefore, he was refuſed by a lady, whom he ſought in marriage, till his eſtate was increaſed to that magnitude by grants of land from his brother. This paſſage merely proves, that a certain portion, and that a very large one, of landed property *in dominio* was a neceſſary qualification, under the Anglo-Saxon government, to admit any perſon to the "rank and degree of nobility." But no argument, ſays lord Littelton, can be juſtly drawn from hence, that, in order to be qualified for a place in the Saxon great council, or wittena-gemote, it was requiſite to be lord of forty hides of land. Such a notion does not agree with any accounts that are given us of that aſſembly in the writings or records of thoſe times. By a paſſage in the preface to Ina's laws, as tranſlated by Wilkins, it appears, that the Saxon legiſlature was compoſed of the king, *cum omnibus ſuis ſenatoribus*, which ſenators Littelton ſuppoſes to have been the "nobility of the kingdom," ſuch as afterwards formed the ordinary council of lords under our kings of Norman race; et *cum ſenioribus ſapientibus populi ſui*, by whom he underſtands the deputies or repreſentatives of the people, either by election or magiſtracy; et *cum multa etiam ſocietate miniſtrorum Dei*, which words evidently denote the inferior clergy, mentioned by Eadmer as preſent in the parliaments of thoſe times. It appears alſo, by a paragraph in Spelman's Councils Sub. Ann. 855, that the Saxon conſtitution required not only the "preſence," (ſee BOROUGH,) but the "approbation of the people," to the enacting of a law; though, by way of marking the diſtinction between theſe and the higher orders of the ſtate, the nobility alone ſet their hands to the act. "Whoever," ſays ſir John Forteſcue Aland, who was very learned in the Saxon language and legal antiquities, in his preface to the book of chancellor Forteſcue on the difference between an abſolute and limited monarchy, "carefully and ſkilfully reads the Saxon laws, and the prefaces or preambles to them, will find, that the commons of England always in the Saxon times made part of that auguſt aſſembly." In a paſſage occurring in lib. iii. f. 56. of William of Malmſbury, we have an expreſs declaration, that by the Saxon conſtitution eſtabliſhed in England, the "people," as well as the nobles, had a right to be called to the "General Aſſembly" upon affairs of great moment, and to join in the "edicts" made there; ſo that, without "their conſent," the ſucceſſion to the crown could not be ſettled. The term *Senatus* uſed by this hiſtorian denotes the ordinary aſſembly of the nobles, which he diſtinguiſhes from the "people;" but he ſuppoſes that the latter ought to be joined to the former, in order to compoſe the entire legiſlature and great council of the nation, upon extraordinary occaſions. This was agreeable to the cuſtom aſcribed by Tacitus to the Germans, from whom they ſprung; "De minoribus rebus principes conſultant, de majoribus omnes; ita tamen, ut ea quoque, quorum apud plebum arbitrium eſt, apud principes pertractantur." See BOROUGH.

It has been, among conſtitutional antiquarians, an intereſting queſtion, whether they who poſſeſſed this quantity of land had thereby the right of being in the wittena-gemote; or whether the members of this great council were elected from the territorial proprietors, and ſat as their repreſentatives? One perſon is mentioned by Mr. Turner (ubi infra), whoſe

whose designation seems to have the force of expressing an elected member. Among the persons signing to the act of the gemote at Closeshoe in 824 is, "Ego Beonna *electus* consent. et subscrib."

The members of the gemote were convened by the king's writ, of which many instances occur; and the times of their meeting seem to have been usually the great festivals of the church, as Christmas, Easter, and Whitsuntide; but of these Easter, being most frequently mentioned, seems to have been the favourite period. Their meetings, however, were not absolutely restricted to these seasons. The place of their assembly was not fixed. Perhaps this might depend on the king's residence at the time, and might have suited his convenience. Our monarchs seem to have maintained their influence in the wittena-gemote by their munificence. The king presided at this council, and sometimes, perhaps always, addressed them. In 993 we have an account of a royal speech. One of their duties was to elect the sovereign, and to assist at his coronation. Another was to co-operate with the king in making laws. The wittena-gemote appears also to have made treaties jointly with the king. Many instances occur to this purpose. The treaty, printed in Wilkins's Leges Anglæ-Saxonicæ, p. 104, is said to have been made by the king and his witan. They are also mentioned as assisting the king in directing the military preparations of the kingdom. Impeachments of great men were made before the wittena-gemote. At these councils grants of land were made and confirmed; and the wittena-gemote frequently appears in the Saxon remains, as the high court of judicature of the kingdom, and it exercised power over the public guilds of the nation. The lands of the Anglo-Saxons, the burghs, and the people, appear in all the documents of our ancestors, as subjected to certain definite payments to the king as to their lords; and by a custom, whose origin is lost in its antiquity, among the Anglo-Saxons, all their lands, unless specially exempted, were liable to three great burdens, the building and reparation of bridges and fortifications, and to military expeditions. But what we now call taxation seems to have begun in the time of Ethelred, and to have arisen from the evils of a foreign invasion. Thus the payment of 10,000*l.* to the Danes to buy off their hostility, mentioned by Henry of Huntingdon, and those which followed, are stated to have been ordered by the king and the wittena-gemote. Under sovereigns of feeble capacity, the wittena-gemote seems to have been the scene of those factions, which always attend both aristocracies and democracies, when no commanding talents exist to predominate in the discussions, and to shape the council. Turner's Hist. of the Anglo-Saxons, vol. ii. book 10. Littelton's Hist. Henry II. vol. iii.

WITTENBERG, in *Geography*, a town of Saxony, and capital of a circle or district, situated on the side of the Elbe, over which is a ferry: it is the head town of the electoral circle, the seat of an aulic judicature, of the assize, as also a consistory, together with that of the general superintendancy of the electoral circle, a spiritual inspection, the circle amt, and a famous university, founded in the year 1502, at which, in 1517, the Reformation took its rise by means of Martin Luther. This town is not large, but fortified. The old citadel was formerly the electoral residence; near it stands an arsenal. In the large round tower are kept the archives of the electoral and princely houses. The university library is kept in what was formerly an Augustine cloister. The first founder of the town of Wittenberg was Bernard, duke of Saxony. In the year 1547, it was taken by the emperor Charles V.; in the year 1756, it was possessed by the Prussians, who also broke down a bastion of the fortifications; 60 miles N. of Dresden. N. lat. 51° 53′. E. long. 12° 46′.

WITTENBERG, a town of Prussia, in Natangen; 8 miles N. of Heilsberg.—Also, a town of the duchy of Lauenburg, on the Elbe; 8 miles W. of Lauenburg.

WITTENBERGEN, a town of Brandenburg, in the Mark of Pregnitz; 6 miles S.S.W. of Perleberg. N. lat. 53° 2′. E. long. 11° 50′.—Also, a town of the duchy of Holstein; 8 miles S.W. of Lutkenborg.

WITTENBURG, a town of the duchy of Mecklenburg; 17 miles W. of Schwerin.

WITTENHALL, a township of England, in Staffordshire; 2 miles N.E. of Wolverhampton.

WITTENHAUSEN, a town of the duchy of Holstein; 5 miles W. of Oldeburg.

WITTENSTEIN, a town of Prussia, in the province of Natangen; 10 miles S.S.E. of Königsberg.

WITTGENAU. See WITGENAU.

WITTHOEC, a town of Africa, in the country of Cape Lopez Gonsalvo; 30 miles N. of Olibato.

WITTICHSTHAL, a town of Saxony, in the circle of Erzgebirg; 7 miles S. of Schwartzenberg.

WITTINGEN, a town of Westphalia, in the principality of Luneburg Zelle; 27 miles E. of Zelle.

WITTLESEE MERE, a lake of England, in the county of Huntingdon; 4 miles S. of Peterborough.

WITTLICH, a town of France, in the department of the Rhine and Moselle; 16 miles N.E. of Treves. N. lat. 50° 4′. E. long. 6° 52′.

WITTMUND, a town of East Frieseland, on the Harle; 7 miles S.E. of Essens.

WITTOBA, in *Hindoo Mythology*, is a name of the god Vishnu in one of his numerous *descents*, or *avataras*, as they are called. Some account of these avataras is given under our article VISHNU. This, now under consideration, was one of inferior importance; and not, it is said, of very ancient occurrence, and therefore not described in the Puranas, unless it be in the one supposed to be more modern than the rest, which is entitled Maha Bhagavat. (See PURANA, and SRI BHAGAVATA.) A splendid temple is dedicated to the worship of Wittoba, or Vishnu, at Panderpoor, a town of great respectability on the river Beemah, about 100 miles to the south-eastward of Poona. The manifestation is said to have taken place there. He is there represented sculptured in stone, of the size of a man, standing with his feet parallel to each other; his hands upon his hips, the fingers pointing forward, his thumbs backward. Two of the wives of Vishnu in his avatara of Krishna accompanied him in this; these were Rukmeni and Satyavama, and they have smaller temples at Panderpoor, besides their lord's. (See KRISHNA, RUKMENI, and SATYAVAMA.) Images of Wittoba are common in the Mahratta country, generally of clumsy manufacture. Several representations of Wittoba and his wives are given in the Hindoo Pantheon, from casts and pictures. That work contains also a history of the avatara, and many particulars respecting it.

WITTORF, in *Geography*, a town of Germany, in the county of Verden; 10 miles S.S.E. of Rotenburg.

WITTOW, a town on a peninsula at the northern extremity of the island of Usedom, near Artona, an ancient fortress destroyed by the Swedes. N. lat. 54° 44′. E. long. 13° 27′.

WITTSTOCK, a town of Brandenburg, in the Mark of Pregnitz; 47 miles N.N.W. of Berlin. N. lat. 53° 10′. E. long. 12° 39′.—Also, a town of Brandenburg, in the New Mark; 12 miles N. of Custrin. N. lat. 52° 49′. E. long. 14° 50′.

WITWALL, in *Ornithology*, a common Englifh name for the great fpotted wood-pecker, the *picus varius major* of authors.

WITZELRODE, in *Geography*, a town of Germany, in the county of Henneberg; 3 miles E.N.E. of Salzungen.

WITZELSTORFF, a town of Auftria; 4 miles S.E. of Hoffmarckt.

WITZENBURG, a town of Weftphalia, in the bifhopric of Hildefheim; 6 miles S.E. of Alfeld.

WITZENHAUSEN, a town of Germany, in the principality of Heffe Rhinfels; 13 miles E. of Caffel. N. lat. 51° 10'. E. long. 9° 48'.

WIVELISCOMBE, a large market-town in the hundred of Weft Kingfbury, and county of Somerfet, England, is fituated in a valley, at the diftance of 11 miles W. from Taunton, 25 miles W. from Somerton, and 156 miles W. by S. from London. It appears to have been of fome note under the Romans, though not diftinguifhed in their annals as a ftation or military poft. In the earlier part of their tranfactions in this ifland, they had a large caftrum, or encampment, on a hill about a mile eaftward from the town, which ftill is called the caftle. Its fummit contains about twelve acres; and though moftly covered with coppice-wood and bufhes, the veftiges of fortifications, and the foundations of buildings, are yet difcernible on its furface. Part of the foffe, which is very deep, and extended round the hill, has been deftroyed by the working of a quarry. Near the centre of the area, a great number of Roman coins of various emperors were difcovered in the beginning of the laft century. The Danes, during their incurfions into this county, availed themfelves of this caftle, and after their departure, the Saxons, recovering their tranquillity, tranfplanted themfelves to the adjacent vale, and gave their new habitations the name of Wivelifcombe. From this time it progreffively became of importance, conftituted the head of a large lordfhip, and was always held by the Saxon kings, till Edward the Confeffor granted all the lands to the church of Wells. The bifhops of that fee had a ftately palace here for nearly three centuries: it is now in ruins; a workhoufe, erected in 1735, occupies a part of the ancient feite. The town now confifts of feven irregular ftreets: it is governed by a bailiff and portreeve, who are annually chofen in May. Here were formerly two markets, one on Tuefdays, the other on Saturdays; the latter only is now retained, with three annual fairs. A confiderable woollen manufacture has been carried on for more than two hundred years, and ftill flourifhes; the chief articles made are, blanketings, knap-coatings, kerfies and other coarfe cloths, fhrouds, ermine, and baize. Many of thefe are fent to London, Briftol, and Exeter, for home confumption, and for exportation to Spain and Guernfey. The church is a plain ftructure, and confifts of a nave and two aifles, with a tower and fpire at the weft end. The parifh befides the town includes four fmall hamlets, and according to the population return of the year 1811 contains 567 houfes, and 2550 inhabitants.—Collinfon's Hiftory, &c. of Somerfetfhire, vol. ii. 1791.

WIVENHOE, a village of England, in the county of Effex, fituated on the river Coln; it is the harbour of Colchefter, and here is a cuftom-houfe. The oyfters, called Colchefter oyfters, are barrelled in this place. In 1811, the population was 1046.

WIZE, a river of England, in the county of Cumberland, which runs into the Wever.

WIZNA, a town of the duchy of Warfaw; 88 miles N.E. of Warfaw.

WIZUNY, a town of Lithuania; 20 miles N.N.E. of Wilkomiers.

WIZZARD, in *Agriculture*, a term applied in Norfolk to any particular fort of cart for farm-work.

WIZZENED, a term provincially applied to fignify withered or fhrivelled, as hay.

WLADISLAW, in *Geography*, a town of Moravia, in the circle of Iglau; 12 miles S. of Meferitfch.

Wladislaw, or *Inowroflaw*, a town of the duchy of Warfaw, and capital of a palatinate of the fame name, on the Viftula: the fee of the bifhop of Cujavia, removed from Krufwica in 1173; 108 miles N.W. of Warfaw. N. lat. 52° 35'. E. long. 18° 35'.

WLODOWA, a town of Auftrian Poland; 18 miles N.E. of Chelm.

WLODZIMIERZ, a town of Poland, in Volhynia, on the Bog; the fee of a Greek bifhop, united to the church of Rome; 48 miles W. of Luckow.

WOAD, in *Agriculture*, a plant cultivated in the field for the ufe of the dyers. It is a plant which has a ftrong thickifh fibrous root, which penetrates deep into the foil, and which is principally raifed for the ufe of the leaves, which, after being properly manufactured, are made ufe of in the art of dyeing to produce a blue colour, as well as the bafis of black, and fome others.

Soil.—It is evident from the nature of its root that it requires a foil which has much depth or ftaple, and which is perfectly frefh, fuch as thofe of the rich, mellow, loamy, and deep vegetable kind. Where this fort of culture is carried to a confiderable degree of perfection, as in Lincolnfhire, the deep, rich, putrid, alluvial foils on the flat tracts extending upon the borders of the different large rivers are chiefly employed for the growth of this fort of crop; and it has been fhewn by repeated trials that it anfwers moft perfectly when they are broken up from a ftate of fward immediately for it. In fome places, it is the practice to take lands of this defcription at high prices, for the purpofe of breaking them up and growing it upon them for two or three years; on the more low rich foils, for four years, but on thofe of lefs fertility only for three; and in fome, which are more elevated and expofed, two are confidered fufficient. For this fort of culture, people are employed, who move from place to place, and form a fort of colony. Mr. Cartwright, in the above county, has however found, that it is capable of being confined to one fpot with equal or greater fuccefs, by having a fufficient extent of ground for changing the place of its growth as may be neceffary, and for appropriating an adequate proportion annually to the raifing of the plant, by which the houfes and expenfive machinery that are neceffary for its preparation may be kept conftantly and regularly employed in the bufinefs.

Preparation.—In order to prepare the land for this crop, it is advifed by fome to plough it up with a good deep furrow, immediately before the winter commences, laying it in high narrow ridges, to have the full effect of the frofts; and early in the fpring to give another ploughing in the contrary direction, leaving the ground in the fame kind of ridge as before. When it has remained in this ftate fome length of time, and weeds appear, it fhould be well harrowed down with a heavy harrow, repeating the operation fo as to render it perfectly fine and clean. About the beginning of June a third ploughing fhould be given to the full depth with a narrow furrow, and the land be afterwards well harrowed down as before; the fourth or final ploughing being given towards the beginning of July, in a light manner, leaving the furface as even as poffible for the feed. But fome take much lefs trouble in the bufinefs of preparation.

tion. In cafes where the foils are fufficiently dry, only breaking them up early in the month of February; and where the contrary is the cafe, deferring it to a later period, taking care to plough the land in a perfect manner to the depth of five inches, or more: and that the furrow-flices may be well turned, laid flat, and nicely jointed, a perfon is employed with a fpade for the purpofe of adjufting them. This prevents the graffy matters from rifing in the feams. When this has been done, the furface is repeatedly harrowed over, to raife a fufficient depth of good mould for the drill to work in; and before the feed is put in a roller is paffed over the land.

It is probable, however, that this method is inferior to the former, as the land is not brought nearly to fo fine a ftate of mould, or the graffy material fo effectually covered and deftroyed, from which injury may be done to the woad plants in their early growth.

But a method which is equally effectual with the firft, more expeditious, and which has a fuperiority over it, in more completely deftroying grubs, infects, and other vermin, which are apt to feed on the plants in their early growth, is that of paring and burning. This is, however, chiefly practifed where the fward is rough, and abounds with rufhes, fedge, and other plants of the coarfe kind, but might be had recourfe to on others, with vaft benefit.

Where the latter modes are made ufe of as foon as the feed has been put in, the land fhould be carefully drained by forming grips in fuitable directions, as wherever water ftagnates, the woad plants are liable to be injured or deftroyed.

Seed.—In refpect to the feed, it fhould be collected from ground that has been left covered with the beft plants from the preceding feafon, as they only run up to ftem and form feeds in the fecond year; and in order to have good feed, the leaves fhould not be cropped at all or but once, the ftems being fuffered to remain till the feeds in the hufks become perfectly ripened; which is fhewn by their attaining a brownifh-yellow colour, and the pods having a dark blackifh appearance. It fhould then be gathered as foon as poffible, by reaping the ftems in the manner of grain, and then fpreading them in rows thinly upon the ground if the weather be fine, when in the courfe of a few days they will be in a ftate to be threfhed out from the hufks or pods. When they are fuffered to remain too long, the pods are liable to open, and fhed the feed. Although the pod in which the feeds are contained is of a large fize, the feeds are lefs than thofe of the turnip. New feed, where it can be procured, fhould always be fown in preference to fuch as has been kept for fome time; but when of the latter kind, it fhould be fteeped for fome time before it is put into the ground.

In regard to the quantity of feed which is neceffary, it muft be regulated by the foil, and the manner in which it is fown. Where the drill is employed, lefs will be required than in the broad-caft method. It has been found that a rood of land, where the crop is good, will in general afford feed fufficient for eight or ten acres; and in fome cafes, in the broad-caft method, five or fix bufhels are made ufe of to the acre. In Kent they ufe ten or twelve pounds to the acre.

Sowing.—The time of fowing crops of this nature muft be regulated, in fome degree, by the mode of preparation that has been employed. Where the firft of the above methods has been followed, it will be much later than in the other cafes. But early fowing is in general to be preferred, as there will be lefs danger of the plants being injured by the attacks of the fly or grub. Where the weather is fuitable, and the land in a proper ftate of preparation, the feed may be fown in the latter end of February or March, continuing the fowings, in different portions of land, till about the middle of May, at fuitable intervals of time to vary the times of cropping the leaves of the plants. The late fowings are commonly executed about the latter end of July, or early in the following month at the fartheft.

With refpect to the manner in which the feed is fown, it differs according to the nature and ftate of preparation of the land. Where it is in a fine ftate of mould, the drill or row method is the method moftly practifed, which is by much the beft, as by it the plants may be kept more eafily clean and free from weeds, becoming more ftrong and vigorous, from the earth being more ftirred about the plants: but where the contrary is the cafe, the broad-caft mode is generally followed; but which does not by any means admit of the plants being kept fo free from weeds, or the mould fo well ftirred about the roots of them.

Where the firft method is had recourfe to, the feed is fown by a drilling-machine, fuch as is ufed for turnips, in equidiftant rows, eight or nine inches apart, covering it in, either by means of a harrow attached to the implement, or by paffing a light common harrow over the ground afterwards, once in a place, raking off any clods that may be prefent to the fides, or into the furrows: but in the latter mode, it muft be difperfed by the hand in as equal a manner as poffible, over the whole of the land, being then harrowed in by a light harrow, fo as to leave the land in as even and level a ftate as poffible. The ground is frequently rolled afterwards, that the furface may be left as even as poffible.

In favourable feafons with good feed, the plants moftly appear in the courfe of a fortnight, when much attention fhould be paid to fee that they are not deftroyed by the turnip-fly, or the frofts in thofe of the more early fowings; as, where that is the cafe, the land fhould be immediately refown; as in fome cafes it is not uncommon to fow the greateft part of the crop two or three times over. In the very late fowings, where the crops rife thin on the ground, it is fometimes a practice to give a better plant by forming holes with a hoe in the vacant fpots, and directing feeds to be dropped into them by the hand by women or children. This is the cafe with the late fpring-fowings till the beginning of June, or a later period.

Culture while growing.—From much of the goodnefs of the woad plants depending on the luxuriance of their growth, and the thicknefs of their leaves, it is neceffary to beftow great attention in the culture of the crop while growing. It is advifed that the fpring-fown crops, as well as thofe that are fown in the latter part of the fummer, fhould have the firft hoeings given them as foon as the plants are fully diftinguifhable above the ground, as by this means the weeds will not only be prevented from retarding the vegetation of the plants, but thefe by being thinned out to greater diftances be more at liberty to advance and become vigorous in their firft or early growth, which is a matter of much confequence to the fuccefs of the crop; and fecond hoeings fhould be given in the courfe of four or five weeks afterwards, when the plants fhould be thinned out to the full diftances at which they are to ftand, which may be fix or feven inches, or more, according to the goodnefs of the foil, conftantly leaving fufficient room to prevent the plants from being in any way crowded. The work is fometimes executed in much the fame manner as for turnips, by hand-hoes; but in others by fmall fhort fpuds, ufed with one hand, while the other is employed in clearing away the weeds; the labourers, moftly women and children, kneeling while they perform the work. When this work has been done, nothing further is neceffary till the firft cropping of the

the leaves has been performed, when the plants ſhould be again immediately well weeded; and after each cropping the ſame operation be had recourſe to; the extent of crop cleared in the day being, in moſt caſes, weeded before night.

With the late-ſown crops, after the ſecond weeding in October, nothing further will be requiſite till the ſpring, about the middle of April, when the work ſhould be again well executed, the mould being completely ſtirred about the roots of the plants, that they may derive the fulleſt benefit from the operation. This will be ſufficient to keep them clean till the taking of the firſt crop; after which they muſt be again weeded, and the ſame operation be had recourſe to after each cropping of the leaves, as in the above caſe.

In reſpect to the buſineſs of gathering the crops with the ſpring-ſown ones, the leaves will generally be ready to be gathered towards the latter end of June, or beginning of July, according to the nature of the ſoil, ſeaſon, and climate; but for thoſe put in at a later period in the ſummer, they are often fit to be gathered earlier. This buſineſs ſhould, however, conſtantly be executed as ſoon as the leaves are fully grown, while they retain their perfect green colour, and are highly ſucculent; as when they are let remain till they begin to turn pale, much of their goodneſs is ſaid to be expended, and they become leſs in quantity, and of an inferior quality for the purpoſes of the dyer. In favourable ſeaſons, where the ſoils are rich, the plants will often riſe to the height of eight or ten inches; but in other circumſtances they ſeldom attain more than four or five: and where the lands are well managed in the culture of the plants, they will often afford two or three gatherings, but the beſt cultivators ſeldom take more than two, which are ſometimes mixed together in the manufacturing of them. It is neceſſary that the after-croppings, when they are taken, are conſtantly kept ſeparate from the others, as they would injure the whole if blended together, and conſiderably diminiſh the value of the produce. It is ſaid that the beſt method, where a third cropping is either wholly or partially made, is to keep it ſeparate, forming it into an inferior kind of woad.

Upon an acre of land, when well managed, in favourable ſeaſons, the produce is moſtly from about a ton to a ton and a half. The price varies conſiderably; but for woad of the prime quality, it is often from twenty-five to thirty pounds the ton, and for that of an inferior quality ſix or ſeven, and ſometimes much more.

Seeding-Crops.—With ſuch parts of the crops as are reſerved for ſeed, it is a practice with ſome to crop the leaves two or three times the firſt year, and then leave the plants to run up to ſeed in the following one; but it is a better practice to only remove the ſide-leaves, as in this way the plants are leſs weakened, and the produce of the ſeed much increaſed. The plants are likewiſe ſometimes fed down by ſheep during the winter ſeaſon; but this, from its tendency to weaken them, is equally improper and prejudicial.

Preparation of for the Dyer.—The woad, after it has been gathered, undergoes ſeveral proceſſes to prepare it for the dyer; but in the improved method it is conveyed in one-horſe carts, ſo contrived as to be lifted from the axis, and, by folding doors in the bottoms, to diſcharge their contents upon the floor above the mill, on being hoiſted up to their proper ſituation: round this floor holes are formed for putting the plants down through, in order that they may drop under the grinding-wheels. The mills for this purpoſe have ſeveral wheels for grinding the plants, which have leſs diameters on one ſide than the other, and are about three feet in width, being conſtructed with iron bars for cruſhing the woad. They are wrought by horſes, or any other power, as may be the moſt convenient. The materials are preſerved under the grinding-wheels by proper contrivances, which, as ſoon as they are ſufficiently reduced, force it out of the tracks upon the ſtone floors on the ſides; thus making way for new parcels without the mill being ſtopped. The bruiſed woad is then thrown into rooms on the ſides of the mill, deſtined for its reception, by means of ſhovels. In theſe it remains till the juice is ſo much drained off as to leave it in a proper condition for being formed into balls; which is done by labourers, with apparatus for the purpoſe, and then laid upon trays to be conveyed to the drying ranges, in which they are placed upon grating-ſhelves that ſlide on ſledges in the drying-houſes. Theſe are placed on the ſides of galleries, for the convenience of being eaſily depoſited upon them and removed again. It is kept in theſe till it is ſufficiently dried to be laid up in other rooms, until the whole of the crop has undergone the ſame operations, and the workmen are ready to manufacture it.

It is ſtated in the Corrected Lincolnſhire Report on Agriculture, that to prepare it for uſe in the art of dyeing, it is neceſſary for it to take on a proper ſtate of fermentation, which is accompliſhed in the courſe of ſeven or eight weeks, and, in the technical language of the art, is termed *couching*. It is effected by regrinding the balls, in the ſame mill as before, to a fine powder, and then ſpreading it upon the floors of the rooms in which the balls were formed, to the thickneſs of about three feet; where it is then moiſtened with water, ſo as to keep it in a proper ſlow ſtate of fermentation; and ſo managed by turning that it may pervade the whole in an equal manner. In this buſineſs, the direction of an experienced workman is neceſſary. In the turning, it is of much importance that the parts of the materials be perfectly divided, which can only be effected by a nice management of the ſhovel: and it is added that much advantage has been found in the goodneſs of the woad, from the drying and ſtoring of it being performed in a careful manner. When this attention is neglected, the woad will not, on being broken between the finger and thumb, draw out into fine hair-like filaments, or, in the technical language of the manufacturer, *beaver* well; as the uſe of this ſubſtance in the blue vat of the dyer, is not merely to afford the colour of the plant, but, by bringing on a very gentle fermentation, excite the indigo in the ſame vat to yield its colouring principle more perfectly. This is even neceſſary for its own colouring-matter being fully imparted. The ſubſtance ſhould, therefore, be ſo prepared in the different operations as to produce this effect in the moſt certain and perfect manner. When the heat in the proceſs of couching has gone too far, the ſubſtance will be what is termed *foxy*; and when it has not proceeded to a ſufficient degree, it will be what is called *heavy*. If the material be good, it does not ſoil the fingers on being rubbed between them; but ſuch as is heavy does. In the concluſion of the proceſs, the cooling is effected in ſo gradual a manner, as to render it not fit for taking on the ſame proceſs; and of courſe proper for being preſerved in caſks, or in any other way. It is then ready for uſe.

The preparation of woad for dyeing, as practiſed in France, is minutely deſcribed by Aſtruc, in his Memoirs for a Natural Hiſtory of Languedoc. The plant puts forth at firſt five or ſix upright leaves, about a foot long, and ſix inches broad: when theſe hang downwards, and turn yellow, they are fit for gathering: five crops are gathered in one year. The leaves are carried directly to a mill, much reſembling the oil or tan-mills, and ground into a ſmooth paſte. If this proceſs was deferred for ſome time, they

they would putrefy, and fend forth an infupportable ftench. The pafte is laid in heaps, preffed clofe and fmooth, and the blackifh cruft, which forms on the outfide, re-united if it happens to crack : if this was neglected, little worms would be produced in the cracks, and the woad would lofe a part of its ftrength. After lying for fifteen days, the heaps are opened, the cruft rubbed and mixed with the infide, and the matter formed into oval balls, which are preffed clofe and folid in wooden moulds. Thefe are dried upon hurdles : in the fun, they turn black on the outfide ; in a clofe place, yellowifh, efpecially if the weather be rainy : the dealers in this commodity prefer the firft, though it is faid the workmen find no inconfiderable difference betwixt the two. The good balls are diftinguifhed by their being weighty, of an agreeable fmell, and when rubbed of a violet colour within. For the ufe of the dyer, thefe balls require a farther preparation : they are beat with wooden mallets, on a brick or ftone floor, into a grofs powder ; which is heaped up in the middle of the room to the height of four feet, a fpace being left for paffing round the fides. The powder, moiftened with water, ferments, grows hot, and throws out a thick fetid fume. It is fhovelled backwards and forwards, and moiftened every day for twelve days ; after which it is ftirred lefs frequently, without watering, and at length made into a heap for the dyer.

The powder thus prepared gives only brownifh tinctures, of different fhades, to water, to rectified fpirit of wine, to volatile alkaline fpirits, and to fixed alkaline lixivia : rubbed on paper, it communicates a green ftain. On diluting the powder with boiling water, and after ftanding fome hours in a clofe veffel, adding about one-twentieth part of its weight of lime newly flacked, digefting in a gentle warmth, and ftirring the whole together every three or four hours, a new fermentation begins, a blue froth arifes to the furface, and the liquor, though it appears itfelf of a reddifh colour, dyes woollen of a green, which, like the green from indigo, changes in the air to a blue. This is one of the niceft proceffes in the art of dyeing, and does not well fucceed in the way of a fmall experiment.

Aftruc propofes the manufacturing of frefh woad leaves in Europe, after the fame manner as the indigo plant is manufactured in America ; and thus preparing from it a blue fecula fimilar to indigo, which from his own experiments he has found to be practicable. Such a management would doubtlefs be accompanied with fome advantages, though poffibly woad fo prepared might lofe thofe qualities which now render it, in a large bufinefs, preferable on fome accounts to indigo, as occafioning greater difpatch when once the vat is ready, and giving out its colour lefs haftily, fo as to be better fitted for dyeing very light fhades. Neumann's Chem. by Lewis, p. 437, &c.

The ancient Gauls and Britons ufed to dye or ftain their bodies with this plant, and were probably led from this application of it to ufe it for dyeing cloth.

Some hold that it was from this plant glafs took its denomination ; though others derive both *glafs* and *glaftum* from the Britifh *glafs*, which to this day denotes a blue colour. See GLASS.

A woad blue is a very deep blue, almoft black ; and is the bafe of fo many forts of colours, that the dyers have a fcale, by which they compofe the divers cafts or degrees of woad, from the brighteft to the deepeft.

WOAD, in *Botany*. (See ISATIS.) There are four fpecies.

The broad-leaved woad is cultivated in feveral parts of England for the purpofes of dyeing, being ufed as a foundation for many of the dark colours.

Some feed down the leaves of woad in winter with fheep ; a practice which Mr. Miller condemns.

Woad grows wild in fome parts of France, and on the coafts of the Baltic fea : the wild woad, and that which is cultivated for the ufe of dyers, appear to be of the fame fpecies.

Befide the plant properly fignified by the name woad, which dyes a blue colour, we have two others known in our Englifh herbals under that name, as alfo that of *wold* or *weld*. Thefe are both called by the common people *dyer's weed*, and are the *luteola* and the *genifta tinctoria*.

The ancients confounded all thefe three plants alfo under the fame names. Paulus Ægineta feems to make them all the fame plant ; and Neophytus, fpeaking of the *ifatis*, or our woad, properly fo called, fays, that it was called by the Latins *lutum*. This *lutum* has been by fome underftood to mean the *luteola*, and by others the *genifta tinctoria* ; but the latter opinion only is right, for it is defcribed to us by the ancients as having leaves like the *linum*, or flax, and flowers like the broom.

WOAD-*Mill* and *Houfe*, that fort of mill and houfe which is neceffary and proper for preparing and fitting this kind of fubftance for the ufe of the dyer. The reprefentation of a mill and excellent apparatus for effecting the preparation of the woad plant, which is made ufe of by Mr. Cartwright, with much fuccefs and advantage, in Lincolnfhire, may be feen in the fecond volume of the "General Dictionary of Agriculture and Hufbandry."

WOAHOO, or OAHOO, in *Geography*, one of the Sandwich iflands ; as far as could be judged from the appearance of the north-eaft and north-weft parts, it is much the fineft ifland of the whole group. Nothing can exceed the verdure of the hills, the variety of wood and lawn, and rich cultivated valleys, which the whole face of the country difplayed. The road is formed by the north and weft extremities. Should the ground-tackling of a fhip be weak, and the wind blow ftrong from the north, to which quarter the road is entirely open, this circumftance might be attended with fome danger ; but with good cables there would be little rifk, as the ground from the anchoring-place, which is oppofite to the valley through which the river runs to the north point, is a fine fand. This ifland is fuppofed to contain 60,000 inhabitants. N. lat. 21° 43′. E. long. of the anchoring-place 202° 9′. See SANDWICH *Iflands*.

WOALDS, in *Agriculture*, a term not unfrequently applied by writers on hufbandry to crops of the woad kind. See WOAD.

WOAPO, in *Geography*, one of the Ingraham iflands in the Pacific ocean. Captain Ingraham called it Adams. It was afterwards vifited by captain Roberts, who named it Jefferfon. S. lat. 9° 27′.

WOBBEL, a town of Weftphalia, in the county of Lippe ; 6 miles E.N.E. of Horn.

WOBURN, or WOOBURN *Weft*, or *Bifhop's Wooburn*, a village in the hundred of Defborough, Buckinghamfhire, England, is fituated in a narrow valley, at the diftance of 3 miles W.S.W. from Beaconsfield, and 26 miles W. by N. from London. The manor of Bifhop's Wooburn had from time immemorial belonged to the fee of Lincoln, till the year 1547, when bifhop Holbeach gave it to the crown in exchange. It was granted in 1549 to John, earl of Bedford. In the 17th century it came by marriage to Philip, lord Wharton, whofe fon and grandfon, the celebrated marquis and duke of Wharton, fucceffively held it. After the death of the latter, it was fold to the Berties ; from whom it was purchafed, in 1784, by Mrs. Dupré, mother

mother of James Dupré, esq. of Wilton-park, who is the present proprietor. The old manor-house was a palace of the bishops of Lincoln, several of whom died here. The marquis and the duke of Wharton are said to have expended incredible sums of money on the house and gardens: of the latter, which in a former age were highly celebrated, scarcely a vestige now remains. The mansion was pulled down in 1750; when one of the wings was fitted up as a dwelling-house, which has since been enlarged and improved, and is now occupied by the countess of Orkney. The parish-church is a spacious and ancient structure, with a nave, two aisles, and a tower. The latter was built about the year 1480, as appears by the epitaph of John Goodwin and Pernell his wife, who are called its founders. In the chancel are several monuments of the families of Bertie and Wharton, among which is one of grey marble to the memory of Philip, lord Wharton, who died in 1695. The font is a curious piece of ancient sculpture. This parish contains 2596 acres, chiefly disposed in arable and wood land. In the population return of the year 1811, the inhabitants were estimated at 1604; the number of houses at 318. An annual fair is held, for which lord Wharton obtained a charter in 1686. A fair was also granted by king Henry VI., but is now discontinued.—Beauties of England and Wales, vol. 1. Buckinghamshire. By J. Britton and E. W. Brayley, 1802. Lysons' Magna Britannia, vol. 1. Buckinghamshire, 1806.

Woburn, or *Old Woburn*, a market-town in the hundred of Manshead, and county of Bedford, England, is situated near the western confines of the county, at the distance of 14 miles S.W. by S. from the county-town, and 42 miles N.W. by N. from London. Great part of the town was consumed by fire in 1724, which, though distressing to individuals, proved ultimately beneficial, as the houses were rebuilt in a more convenient and regular manner, with the addition of several good inns, and a market-house. The whole expence of the new buildings was defrayed by the duke of Bedford. The market-house was finished in 1737, but has been materially improved by the late duke Francis. It consists of two floors; the lower fitted up for butchers' shambles, over which is a spacious room for a corn-market. In the population return of the year 1811, the inhabitants of the parish are stated to be 1506, occupying 299 houses. A weekly market is held on Fridays, which was granted in 1242 to the abbot of Woburn, and four fairs annually. The church was erected by Robert Hobbs, the last abbot of Woburn. This structure furnishes a peculiar instance of capricious taste; the body being completely detached from the tower, which stands at about six yards distance. The tower is a small square building, with large buttresses at the corners, and four pinnacles; the church consists of three aisles and a chancel; the whole has recently undergone a thorough repair. Adjoining to the church-yard is a free-school, founded by Francis, earl of Bedford. Here are also alms-houses for twelve poor persons, founded by the Bedford family, and endowed with 50*l. per annum*, which was confirmed by act of parliament in 1761.

About a mile east of the town is Woburn abbey, the seat of the duke of Bedford. This magnificent mansion is situated in the midst of an extensive park, and occupies the four sides of a quadrangle of more than 200 feet. It was erected about the middle of the last century by Flitcroft, for John, the fourth duke of Bedford, of the Russel family, on the scite of an old abbey. The original building was founded in the year 1145, by Hugh de Bolebec, for monks of the Cistercian order. In 1234 the monastery was so reduced, that the establishment was for a time broken up, and the monks dispersed into different convents till their debts were paid. But by various benefactions their revenues were so much improved, that at the general dissolution they were estimated at 391*l.* 18*s.* 2*d.* clear yearly value. The last abbot was hanged for denying the king's supremacy. The scite of the abbey was granted in 1547 to John, lord Russel, afterwards earl of Bedford, and has ever since been the principal seat of that noble family. There are no remains of the conventual buildings. The present mansion, originally fitted up in a very costly style, has received many considerable improvements, particularly during the time it was in the possession of the late duke. Mr. Holland, the architect of Drury-lane theatre, has displayed much taste and ability in the additional buildings which have been executed under his direction. The west front is built of the Ionic order, with a rusticated basement. The principal floor, or suite of rooms on this side, consist of a saloon, state bed-rooms, drawing and dining-rooms; the south side contains the library, breakfast, Etruscan, and duke's rooms; the east, the vestibule, servants' offices, &c.; and the north, the French bed-rooms, and various other chambers. Most of the apartments are embellished with fine paintings: the gallery, in particular, exhibits a large and valuable collection of portraits by the old masters. The late duke's favourite pursuits are well known to have been experimental agriculture and breeding of cattle. For this purpose he kept several farms in his own hands. The principal of these, distinguished by the name of the Park-farm, is situated in the park, about half a mile from the house. All ingenious contrivances to shorten labour, and facilitate useful operations, are here concentrated. The farm-yard is replete with conveniences. It contains barns, stables, fatting-houses, &c.; a very complete mill, furnished with a curious machine which threshes and dresses at the same time; a maltern; two pair of stones for grinding wheat and barley; and every requisite for dressing flour, making oatmeal, &c. In another part is a small water-wheel, which gives motion to some very ingenious machinery for bruising malt, and cutting chaff. This farm originated with the late duke, through whose patronage and exertions many improvements have been made in the different branches of husbandry. The present duke follows the steps of his brother in patronising agricultural improvements, and keeps up all the establishments which he formed with a view to that purpose.—Beauties of England and Wales, vol. 1. Bedfordshire. By J. Britton and E. W. Brayley, 1801. Lysons' Magna Britannia, vol. 1. Bedfordshire, 1806.

Woburn, a town of the state of Massachusetts, in the county of Middlesex, containing 1277 inhabitants; 15 miles N.W. of Boston.

WOCANELLY, a town of Hindoostan, in Golconda; 40 miles N.W. of Adoni.

WODEN, in *Mythology*. See Odin.

WODERCUM, in *Geography*. See Worcum.

WODNANY, or Wodnian, a town of Bohemia, in the circle of Prachatitz; 12 miles N.E. of Prachatitz. N. lat. 49° 10′. E. long. 14° 2′.

WODWALLA, a town of Sweden, anciently a sea-port, but now much reduced, and its privileges removed to Gotheburg, at eight miles distance.

WOEL, a town of France, in the department of the Meuse; 12 miles N.E. of St. Mihel.

WOELFLIES, a town of Saxony, in the principality of Gotha; 21 miles S.E. of Gotha.

WOERAMATTA, a small island in the East Indian sea. S. lat. 7° 2′. E. long. 131° 36′.

WOERDEN, or Worden, a town of Holland, built by by Godfrey de Rhenen, the twenty-eighth bishop of Utrecht, on the river Rhine, about the year 1160, to keep the citizens of Utrecht in subjection, and maintain his authority. It had a castle, which was formerly supposed to be impregnable; but when the French took the city in 1672, they entirely demolished it, before that time falling to decay. This city had its own particular lords till the year 1296, when Herman de Woerden fortified it, having been convicted of being a party in the murder of Florent V. comte of Holland, who was assassinated by a gentleman named Gerard de Velsen, whose wife he had ravished. It was afterwards sold by Philip II. king of Spain, to Eric, duke of Brunswick; from whom it came, in 1581, under the dominion of the States-General. In 1672, the French having made themselves masters of this place, the Dutch came to besiege it, under the prince of Orange and the comte de Zuylestein. The comte de Marck, who commanded in the city, began to be much pressed, when the duke of Luxemburg arrived with 9000 men. He passed the morass by a way which was supposed to be inaccessible, forced the intrenchments, and put the enemy to flight. The Dutch lost 2000 men, killed and wounded, among the former of whom was the comte of Zuylestein; and the French about 1000; 8 miles W. of Utrecht.

WOGGORA, a small high province of Abyssinia, on the E. of Gondar, which is sown with wheat. This province and Dembea are the granaries of the country.

WOGGT, a river of Austria, which runs into the Ager, near Voglabruck.

WOGLYDURGAM, a town of Hindoostan, in Mysore; 15 miles S. of Oussoor.

WOGOW, a town of Prussia; 18 miles S. of Königsberg.

WOGSHAID, a town of Austria; 7 miles S.W. of Aigen.

WOHLAU, a town of Silesia, and capital of a principality, on all sides surrounded with marshes, which are a kind of natural defence. It has two suburbs, a Roman Catholic and a Lutheran church. In the year 1640, it was taken by the Swedes; in 1642, surprised by the Imperialists, but soon after retaken by the Swedes; and in 1644, recovered by the Imperialists; 20 miles N.W. of Breslau. N. lat. 51° 20′. E. long. 16° 35′.

Wohlau, or *Wolau*, a principality of Silesia, bounded on the north by the principality of Glogau, on the east by Poland and the principality of Oels, on the south by the principalities of Breslaw and Lignitz, and on the west by the principalities of Lignitz and Glogau; situated on both sides of the Oder. The soil is in some parts dry, in others marshy, or overrun with woods and bushes, though several tracts also yield good corn.

WOHRA, a river of Germany, which runs into the Werra, 2 miles N.W. of Echwegen, in the principality of Hesse.

WOHRD, a town of Bavaria, in the territory of Nuremberg, near Nuremberg.

WOINITSCH, a town of Austrian Poland; 36 miles E. of Cracow.

WOITSBACH, a town of Bohemia, in the circle of Boleslaw; 8 miles E. of Krottau.

WOITSBERG. See Voitsberg.

WOKING, a town of England, in the county of Surrey; 8 miles N. of Guildford.

WOKINGHAM, or Oakingham, a market-town and parish in the hundred of Sonning, and county of Berks, England, is situated in Windsor forest $7\frac{1}{2}$ miles E.S.E. from Reading, and $32\frac{1}{4}$ W.S.W. from London. The population in 1811 was 2085 persons, inhabiting 435 houses. The market is held on Tuesday, and the fairs on the 23d of April, 11th of June, 10th of October, and 2d of November. The town, incorporated by James I., is governed by an alderman, high steward, recorder, burgesses, and a town-clerk; and at this place are held all the courts for Windsor forest. Although within the bounds of Berkshire, the church stands in an insulated part of Wiltshire: it is a large and handsome edifice. The inhabitants are chiefly employed in agriculture, throwing silk, sorting wool, and making shoes: the gauze manufacture was some years ago introduced. At Luckelygreen, near this town, is an hospital, founded in 1665 by Henry Lucas, esq. for sixteen poor men and a master: the trustees of the charity are the Drapers' company of London. About four miles S.E. from Wokingham, is a large and irregular fortification, with a double ditch, commonly called Cæsar's camp, situated on the summit of a hill. Half a mile to the southward of this camp is the Devil's ditch, a raised road nearly ninety feet wide, running east and west, with a trench on each side. In 1661 George Staverton gave the rent of a house in this place for the purpose of buying a bull, to be baited and killed at Christmas, for the benefit of the poor of Wokingham; but this being thought insufficient, the inhabitants are in the habit of purchasing another beast for the same purpose. Archbishop Laud gave a portion of certain fee-farm rents, which produces about 40*l. per annum*, to the parish. Every third year it is divided, pursuant to the donor's intention, between three poor maidens of the age of eighteen, natives of the town, and members of the church of England, who have served the same master or mistress for three years together: the other years it is appropriated to the apprenticing of poor boys. Dr. Thomas Godwin, bishop of Bath and Wells, was a native of this town, where he was born in 1517.

About four miles S. from Wokingham is Billingbear, one of the seats of lord Braybrooke. The house is a large irregular building, seated in a fine park. A particular history and description of this place is given, with a view, in Havell's Views of Seats, folio, 1816.—Beauties of England and Wales, Berkshire; by J. Britton and E. W. Brayley, London, 8vo. 1802. Magna Britannia, by S. and the Rev. D. Lysons, vol. 1. 4to. 1806.

WOKSCHITZ, a town of Bohemia, in the circle of Konigingratz; 2 miles W. of Gitschin.

WOLBECK, or Waldbeck, a town of Germany, in the bishopric of Munster; 7 miles S.S.E. of Munster. N. lat. 51° 53′. E. long. 7° 52′.

WOLBORZ, a town of the duchy of Warsaw; 41 miles S. of Siradia.

WOLCHRADITZ, a town of Moravia, in the circle of Brunn; 18 miles S.S.E. of Brunn.

WOLCKENSTEIN, a town of the duchy of Stiria; 6 miles W.N.W. of Rottenmann.

WOLCKERSDORF, a town of Germany, in the margravate of Anspach; 2 miles N. of Schwabach.—Also, a town of Austria, on the Rusbach; 8 miles E.N.E. of Korn Neuburg.

WOLCKERSHAUSEN, a town of the duchy of Wurzburg; 6 miles N. of Schweinfurt.—Also, a town of the county of Henneberg; 3 miles N. of Menungen.

WOLCOTT. See Woolcott.

Wolcott, a town of Connecticut, in the county of New Haven, near Fairfield, with 952 inhabitants.

WOLD, signifies a plain, down, or open champaign ground, hilly, and void of wood.

Hence the names Stow in the Wold, and Cotswold, in Gloucester-

Gloucestershire; whence also that part of Leicestershire, which lies northward beyond the Wrekin, is called the Wold of Leicestershire.

Wold, or *Weld*, among *Dyers*. See Weld.

WOLDEGGE, or Woldeck, in *Geography*, a town of the duchy of Mecklenburg; 13 miles S.E. of New Brandenburg.

WOLDENBERG, a town of the New Mark of Brandenburg; 9 miles N.E. of Friedburg. N. lat. 53°. E. long. 15° 45'.

WOLEIN. See Mirzin.

WOLESCHITZ, a town of Bohemia, in the circle of Kaurzim; 4 miles W.S.W. of Kaurzim.

WOLF, Christian, in *Biography*, an eminent mathematician and philosopher, was born at Breslau in 1679, and well educated under able masters in different branches of literature and science. At the age of 21, he was entered at the university of Jena, which was then in high reputation; and quitting Jena in 1702, he prosecuted his studies at Leipsic, where, in the following year, he took his degree of master of arts, publishing on the occasion a dissertation, intitled "Philosophia practica Universalis Mathematico modo conscripta." In 1704 he published another dissertation, on the differential and infinitesimal calculus. Having studied theology as well as philosophy at Leipsic, he officiated as a preacher; and being invited to undertake the office of pastor in a country village, he was advised by Leibnitz to decline it, and to pursue the study of philosophy. As he commenced his literary career with great reputation, he was proposed to be an associate in the periodical work, intitled "Acta Eruditorum;" and in this connection he continued for many years, employing his leisure hours in teaching mathematics, logic, and natural philosophy. When the Swedes made an incursion into Saxony in the year 1706, he quitted Leipsic, and removed to Berlin; where a recommendatory letter of Leibnitz procured for him from Frederic I. the office of professor of mathematics at Halle. In 1709 he published, in Latin, his treatise on "Aerometry;" and in the following year his "Elements of Mathematics," in 4 vols. which have passed through several editions. Having composed a very ingenious essay on the intense cold of the ensuing winter, he was elected a member of the Royal Society of London, and soon after a member of the Academy of Sciences at Berlin. In 1711 he published his tables of sines and tangents, and in the next year his treatise on logic, in German, highly commended by Formey, and translated into Latin, French, and other languages. The first two volumes of his large work on the mathematics appeared in 1713, and these were afterwards followed by three more. By the advice of his friend Leibnitz, he refused an invitation from Peter the Great to remove from Halle to Petersburgh. On the death of Leibnitz in 1726, Wolf drew up his life, which supplied Fontenelle with materials for his eloge. In 1718 he published "Meditations on God, the World, and the Human Soul," which were reprinted in the following year. About this time the reputation of Wolf and the jealousy of his rivals occasioned a literary contest, which lasted for a considerable time, and which was not very honourable to either party. Wolf having delivered a dissertation on his quitting the pro-rectorate of Halle university in 1721, on which he took occasion to compare his own principles with those of Confucius and the Chinese, and having announced the opinion which he entertained on the doctrine of necessity, an outcry was raised against him, and he was represented by his enemies as a man whose principles tended to atheism, and to corrupt the morals of the people. Notwithstanding this malignant attack, he employed himself in publishing three volumes of experimental philosophy, and a volume of dogmatical philosophy, which he dedicated to the emperor of Russia, and which the emperor caused to be translated into the Russian language, repeating to him the offers which had before been made, in order to induce him to remove to Petersburgh. The contest that had been excited against him still continued; and though he attempted to justify himself in a treatise on the subject of fatality, the king was at length persuaded that his principles were dangerous, and ordered him, in November 1723, to quit his territories in two days, under pain of death. Wolf immediately proceeded to Cassel, where he met with the king of Sweden, who appointed him professor of mathematics at Marpurg, an office which he had refused sixteen years before. The clergy of Halle pursued him with their enmity and opposition to Marpurg; but Wolf was suffered to remain in the quiet enjoyment of his office during his residence at that place. Several students who attended him at Halle followed him hither, and his lectures, which he commenced in 1724, were attended by pupils from all parts of Europe. His mind being now undisturbed, he resumed his literary labours, and published his "Remarks on Metaphysics," in which he answered the principal objections against his doctrine, and gained a decided victory over his enemies. The grounds of the censure that had been passed on Wolf had been every where canvassed; and almost every German university was inflamed with disputes on the subject of liberty and necessity, so that the names of Wolfian and anti-Wolfian were every where heard. Wolf, having thus vindicated his philosophy from reproach, received new invitations from Petersburgh and Leipsic; but gratitude to his protector induced him to remain in his situation at Marpurg, which he found to be very agreeable, and to afford him leisure for pursuing his speculations. After an interval of nine years, the current of public opinion turned in favour of Wolf, and he now received numerous tokens of respect from men of rank and learning; and in 1733 he was invited to fill, in the Academy of Sciences, one of the eight places allotted to foreigners distinguished in the highest branches of science. On this occasion, Reaumur and he commenced an intimate friendship, which lasted till the time of his death. The king of Prussia was convinced of Wolf's innocence, reversed his sentence of exile, and wished to repair the injury which he had sustained. He made tempting offers, both of title and money, to induce him to return to Halle; but he declined the acceptance of them; as he also refused an invitation from George I. of England to accept a place in the new academy which he had founded at Gottingen. The clergy of Halle made some other attempts to reproach and ruin him, but they recoiled on his adversaries. In the year 1740, he prefixed to the first volume of his "Droit Naturel, or Treatise on the Law of Nature," a dedication to the hereditary prince of Prussia, afterwards Frederick the Great, which was acknowledged by a very flattering letter.

Frederick the Great, as soon as he ascended the throne, recalled Wolf to Halle; and with the permission of the king of Sweden, he consented to accept the office of professor of the law of nature and nations, and also of mathematics, with a salary of 2000 crowns, and liberty to teach whatever he thought proper. He obtained also the rank of privy-counsellor, and was made first vice-chancellor, and afterwards chancellor of the university. In 1745 he was created a baron by the elector of Bavaria. Wolf was now at the height of his prosperity. At more than 60 years of age he resumed his labours, and completed his work on the law of nature and nations, which was written in Latin, and extended to eight volumes 4to. He alfo wrote prefaces to the works of others, and particularly one to Suffmilch's work on population. Notwithftanding his great celebrity, perhaps on this account, he had many and powerful enemies. Leibnitz, Maupertuis, and Voltaire, were of this number: and with refpect to the latter, we may obferve, that both in his writings and in his converfation with the king, he contributed in no fmall degree to leffen the veneration which Frederick II. entertained for him. In 1752 he was made a member of the Inftitute at Bologna; but he did not long furvive this honour, as he died in the month of April 1754, in the 76th year of his age. He left one fon, who inherited a confiderable eftate which he had purchafed.

The adverfaries of Wolf attacked not only the principles of his philofophy, but his method and his ftyle. His Latin, it muft be acknowledged, was not elegant; but his German has been commended and imitated; and he is faid to have improved his native tongue both in precifion and energy. With regard to his general difpofition and demeanour, he is faid to have united a great degree of complaifance and affability, with irreproachable morals and exceffive vanity, which he was not able to conceal. He did not hefitate to extol himfelf and his own merits publicly and without referve, and even to exhibit them in emblematical devices on the titles of his books. Brucker fums up the character of Wolf as a writer in the following concife manner: — "He poffeffed a clear and methodical underftanding, which by long exercife in mathematical inveftigations was particularly fitted for the employment of digefting the feveral branches of knowledge into regular fyftems; and his fertile powers of invention enabled him to enrich almoft every field of fcience in which he laboured, with fome new addition. The lucid order which appears in all his writings enables his reader to follow his conceptions with eafe and certainty through the longeft train of reafoning. But the clofe connection of the feveral parts of his works, together with the vaft variety and extent of the fubjects on which he treats, renders it impracticable to give a fummary of his doctrines." Brucker's Philofophy by Enfield, vol. ii. Preface to M. de Vattel's Law of Nations. See Leibnitzian *Philofophy*.

Wolf, Jerome, a German philofopher, was born in the county of Oettingen, in the year 1516, and inftructed in the elementary parts of education at a college eftablifhed by the fenate of Nuremberg. But his ftudies were interrupted by an appointment in the fervice of Julius, the chancellor of count Von Oettingen. This interruption, however, contributed to allay the feverity of his countenance and manner, and to meliorate the morofenefs of his temper; whilft thefe unamiable qualities were amply counterbalanced by probity, diligence, and modefty, which engaged the confidence and efteem of his employer. His habitual difpofition again returned, and he refumed the ftudy of poetry, and of the ancient Greek writers, againft the remonftrances of the chancellor, who recommended attention to jurifprudence and public bufinefs, as the moft effectual means of acquiring both honour and competence. Remonftrances were ineffectual, and he perfifted in purfuing a courfe which cherifhed his morbid melancholy and difquieting irritability. Still devoted to his literary purfuits, he was fortunate in gaining the patronage of John James Fugger; and in being afterwards advanced to the poft of the director of the college of Augfburg, and that of librarian to this inftitution. In this fituation he remained till his death, which happened in the month of October 1580. Wolf was particularly diftinguifhed as a laborious tranflator, in which literary department he gained the commendation of Huet; though Henry Stephen cenfures his performances. When the edition of the Annals of Zonaras, publifhed by Wolf at Bafle in 1557, became rare, a new one, with notes by Du Cange, was printed at the Louvre in Paris in 1687. Wolf's tranflation of Demofthenes was firft printed at Bafle by Oporinus; and being much approved, it paffed through two other editions. After being revifed by the tranflator, Epifcopius printed it at Bafle in 1572, with the orations of Æfchines, the commentaries of Ulpius, and the notes of Wolfius. His other works, which were numerous, almoft wholly related to Greek and Latin authors. Eloges par Formey et Teiffier.

Wolf, John Christopher, a German Lutheran divine and eminent fcholar, was born in 1613, at Wernigeroda, and removing in 1695 to Hamburgh, was educated under the protection of the celebrated Fabricius, by whom he was employed, under the age of 20 years, in making a catalogue of all the writers quoted in Euftathius's Commentary on Homer, afterwards inferted by Fabricius in his "Bibliotheca Græca." Having profecuted his ftudies at Wittenberg, and graduated mafter of arts, he became, in 1706, adjunct of the philofophical faculty. Upon his return to Hamburgh, he undertook a tour in 1708 through Holland to England, and for fome time refided at Oxford for the ufe of the Bodleian library. His next migration to Denmark led, in 1710, to the appointment of extraordinary profeffor of philofophy at Wittenberg, where his lectures collected a great number of pupils. Although he was here advanced to the chair of theology, he removed in 1712 to Hamburgh, and was appointed profeffor of the oriental languages in the Gymnafium, and in 1715 promoted to be rector of that inftitution. He was likewife a preacher-extraordinary at the cathedral, and became paftor of the church of St. Catharine; and foon after a member of the Academy of Sciences at Berlin. He commenced his literary contributions to the "Acta Eruditorum" in 1708; and he collected from various repofitories an aftonifhing number of rabbinical and oriental books and MSS.; which library he bequeathed to the library at Hamburgh, where he died in June 1739. Of his numerous works, we fhall here enumerate his "Bibliotheca Hebræa," in 4 vols. fol.; "Hiftoria Lexicorum Hebraicorum;" "Primitiæ Flemburgenfes, five Oratio de Præcocibus eruditis, et Orationes binæ de Neceffitate et Utilitate declamandi;" "Hiftoria Bomogilorum;" "Differtatio de Atheifmi falfo fufpectis;" "Curæ philologicæ et criticæ in Novum Teftamentum," 4 vols. 4to. He was alfo the editor of feveral learned works. Gen. Biog.

Wolf. There are biographical articles for five German muficians of that name in Gerber's Continuation of Walther's Mufical Lexicon.

Firft, *Michael Chriftian Wolf*, organift and mufic director in St. Mary's church at Stettin, born 1709, and who died in 1789, after publifhing the following works: "Six Duets for two German Flutes at Berlin;" "Six Harpfichord Sonatas," Stettin, 1776; "Songs with a Harpfichord or Harp Accompaniment," Ebend, 1777; "Exercifes for the Organ in Choral Mufic;" and having in MS. a Pfalm for Four Voices, with an Accompaniment for the Organ, and many other pieces for the church and chamber.

II. *Ernft Friederic Wolf*, brother to the preceding mafter, ftate organift at Cologne, who died in 1772. He had been two years under the chapel-mafter Stölzd, for compofition; and under the concert-mafter Hühn, at Gotha, for the violin. But at nine years old he had previoufly ftudied the fcores of great mafters, and the Gradus ad Parnaffum

 of

of Fouche, fo that early in life he became a great extempore player on the organ.

Of thefe two brothers we have never heard or feen the productions; but of

Ernft William Wolf, born at a village near Gotha, in 1735, chapel-mafter at Weimer, we have feen and admired many of the works.

Wolf, in *Aftronomy*. See Lupus.

Wolf, *Lupus*, in *Zoology*, the *canis lupus* of Linnæus, a beaft of prey of the dog kind, with the tail bending inwards, rather long and bufhy, and the largeft and fierceft of that race of animals. It is extremely like the domeftic dog in fhape, and if the head, which is long, with a pointed nofe, did not differ a little in figure, the upper part of the face being broader, one would be apt to declare it the very fame animal. It is diftinguifhed alfo by fuperior fize, ftronger limbs, and more mufcular body. It has a very fierce look about the face; its eyes are more obliquely placed than thofe of the dog, and are more glaring and favage; its jaws are much ftronger; and its teeth, which are large and fharp, and the opening of its mouth, which is fhorter in proportion than that of the dog, fierce and frightful. The ancients had an opinion, that the neck of the wolf was all of one folid bone; but, on the contrary, this creature is able to turn and twift it about better than the dog kind.

The wolf, as well as all the other beafts of prey, can endure hunger a long time, though very voracious when it meets with food. The wolf differs from the dog in his note, for inftead of the barking of the dog this creature only howls; his ears, which ftand erect, and his tail, make him alfo greatly refemble the fox.

The hair of the wolf is long; the legs are long; the head and neck cinereous: and the body generally pale grey, tinged with yellow; fometimes found white; in Canada fometimes black; and taller than a large grey-hound.

The wolf inhabits the continents of Europe, Afia, Africa, and America.

How numerous thefe animals were formerly in Britain we may infer from the laws of king Edgar, who attempted to extirpate them by commuting the punifhments for certain crimes into the acceptance of a number of wolves' tongues from each criminal; in Wales by converting the tax of gold and filver into an annual tribute of three hundred wolves' heads. In fucceeding times their deftruction was promoted by certain rewards; and fome lands were held on condition of deftroying the wolves which infefted thofe parts of the kingdom.

In 1281, thefe animals infefted feveral of the Englifh counties; but after that period, our records make no mention of them. The laft wolf known in Scotland was killed in 1680, and in Ireland one was killed in 1710.

The wolves of North America are the fmalleft; and it is faid, that from thofe proceeded the dogs which were found there by the Europeans on their firft arrival: when reclaimed, they are the dogs of the natives. In the lefs inhabited parts of the country, they gather in large droves, and hunt the deer and other animals like hounds with hideous howlings, and it is affirmed that they will attack even the buffalo. In the inhabited parts, they are become rare. In fome parts of Europe their number has fomewhat increafed; *e. g.* in Sweden they were rare till about the year 1720. The Swedes deftroy them by ftuffing the carcafe of a fheep or other animal with a fpecies of lichen or tree-mofs, (lichen vulpinus,) which is confidered as a certain poifon to the wolf, and alfo, as the name imports, to the fox. This is faid to be mixed with pounded glafs, which is probably more deftructive than the lichen. The wolves of Senegal are the largeft and fierceft; and they prey in company with the lion. Thofe of the Cape are grey ftriped black; others are black.

Wolves are cruel, but cowardly animals; they fly from man, except when impelled by hunger; in which cafe, they prowl by night in great droves through villages, and deftroy any perfons they meet; and having once got the tafte of human blood, give it the preference. In hard weather wolves affemble in large troops, and join in dreadful howlings. They have a fine fcent, and hunt by the nofe: between them and the dogs a mutual enmity fubfifts. This animal has a very ftrong carnivorous appetite; and yet crafty, ftrong, and nimble as he is, and in every refpect capable of feizing his prey, he often dies of hunger. Being driven into the foreft, he finds only a few fpecies of wild animals, who fave themfelves by flight, fo that he perifhes with want. Although he is naturally timid and daftardly, he braves danger, when preffed with famine, and attacks thofe animals that are under the protection of man, and carries away lambs, fmall dogs, and kids, returning often to the charge, until being wounded by his purfuers, he retires to his den in the day, but iffues forth in the night to his ferocious and deftructive ravages. When his hunger is extreme, he attacks women and children, and fometimes darts with favage violence upon men, till at length he falls a facrifice to his own rage. We have occafional accounts of the terror which this animal has excited, and of the deftruction which he has committed among women and children in France. To fuch a degree did his ravages excite terror in 1764, that prayers are faid to have been offered for his deftruction.

Wolves, in the northern parts of the world, fometimes get on the ice of the fea, in order to prey on young feals, which they feize when afleep; but fometimes the ice detached from the fhore carries them to a great diftance from the land, and large diftricts have thus been cleared of thofe pernicious animals, which have been heard howling in a dreadful manner far in the fea.

The wolf is fometimes affected with madnefs, accompanied with fymptoms fimilar to that of dogs; and this difeafe happens to them in the depth of winter, and therefore, as Mr. Pennant obferves, cannot be attributed to the rage of the dog-days. The time of geftation in the wolf is, according to Buffon, about three months and a half; and the young whelps are found from the end of April to the beginning of July; and this difference in the time of geftation, being in the wolf about one hundred days, and in the dog only fixty, he confiders as a proof of the real difference between the two fpecies.

Although the wolf feems to be naturally favage, he is capable, when taken young, of being tamed, and of being wholly divefted of the ferocious character of his fpecies. Ray. Pennant. Shaw.

Wolf, *Golden*. See Jackall and Aureus.

Wolf, *Marine*. See Hyæna.

Wolf, *Mexican*, *Canis Mexicanus*, with deflected tail and afh-coloured body, variegated with dufky bands and fulvous fpots, a fpecies that inhabits the hot parts of Mexico, agreeing in its manners with the European wolf. Its head, jaws, and teeth, are large; in the upper lips are ftrong briftles bent backwards, of a grey and white colour; the ears are large, erect, and cinereous, and the fpace between them marked with broad tawny fpots; the head afh-coloured, croffed with dufky ftripes; the neck fat and thick, and marked with a tawny ftroke; on the breaft is another of the fame kind; the body is afh-coloured fpotted with black, and the fides ftriped with the fame colour; the belly

belly cinereous, the tail long, of the ſame colour, tinged in the middle with tawny; the legs and feet ſtriped with black and aſh-colour. This wolf is ſometimes found white. Pennant.

Wolf, *Black*, *Canis Lycaon*, with ſtraight tail, is conſidered by Buffon and others as a variety of the common wolf, and confounded by Schreber and Gmelin with the black fox; but regarded as a diſtinct ſpecies. It is found both in Europe and America, and in ſome parts of Aſia. In America it is chiefly found in Canada, and in Europe in the more northern regions. Shaw.

Wolf, in the *Hiſtory of Inſects*, the name of a ſmall white worm or maggot, which infeſts granaries, and does very great damage there.

It is in this ſtate of the worm that it does the miſchief; but this is not its perfect form, for it is afterwards tranſformed into a ſmall moth, with white wings ſpotted with black.

This little maggot has ſix legs, and as it creeps along, there iſſues from its mouth an extremely fine thread or web, by which it faſtens itſelf to every thing it touches, ſo that it cannot fall. Its mouth is furniſhed with a pair of reddiſh forceps, or biting inſtruments, by means of which it gnaws its way not only into wheat and other grain, but perforates even beams of wood, boxes, books, and every thing it meets with.

Towards the end of ſummer theſe pernicious inſects may be ſeen crawling up the walls of corn-chambers, infeſted with them in great numbers; they are then ſearching a proper place where they may abide in ſafety during their aurelia ſtate; for when the time of their undergoing this change approaches, they forſake their food, and the little cells they had formed of hollowed grains of corn clotted together, by means of the web coming from their mouths. They now wander about till they find ſome wood, or other ſubſtance into which they gnaw holes with their fangs, capable of concealing them; and there enveloping themſelves in a covering of their own ſpinning, they ſoon become a dark-coloured ſort of aurelia. They remain in this ſtate all the winter; but in April or May they come forth in their moth-ſhape, and are then ſeen in vaſt numbers, taking ſhort flights, and creeping up the walls. In this ſtate they eat nothing; but they ſoon copulate and lay eggs, which are in the ſhape of a hen's egg, but no larger than a grain of ſand. Each female lays ſixty or ſeventy eggs, which ſhe depoſits in the little wrinkles of the grains of corn, where in about ſixteen days they hatch, and the minute maggots immediately perforate the grain, and eat out all its ſubſtance, and with the threads which come from their mouths cement other grains to it, which they, in the ſame manner, ſcoop out and deſtroy.

The watchful obſerver has two opportunities of deſtroying theſe devourers from among his corn. One is, when they forſake their food, and aſcend the walls, which they will ſometimes almoſt cover. The other, when they appear in the moth-ſtate. At both theſe times they may be cruſhed to death againſt the walls in great numbers, by clapping ſacks upon them; but they may be exterminated more effectually by cloſing up all the windows and doors, and burning brimſtone on a pan of charcoal, letting the room be full of the fumes of it for twenty-four hours. This certainly deſtroys the animals, and does no ſort of injury to the grain, not communicating the ſlighteſt ſcent to it. Baker's Microſ. p. 222.

Wolf's *Bane*, in *Botany*. See Aconitum.

Wolf's *Bane*, *Winter's*, a ſpecies of *hellebore*; which ſee.

Wolf-*Fiſh*. See Lupus *Marinus*.

Wolf's *Grapes*. See Lycostaphylæ.

Wolf-*Net*, a term uſed by the ſportſmen for a kind of net uſed in fiſhing, which takes great numbers, and has its name from the deſtruction it cauſes.

It is uſed both in rivers and ponds, and is of the nature of the rattle, excepting only the wanting of the four wings. The trunk or coffer conſiſts of ſeven feet, beſides the two gullets. It is ſupported by hoops, and is to be placed in ſome part where there is an abundance of ſedges, ruſhes, and water-graſs. There is to be a place made for the net here, by the uſe of a paring-knife, cutting away all the weeds and other matter, for the ſpace that will contain it; and when the net is placed, there are to be two alleys cut or cleared in the ſame manner, one on each ſide of the net, that the fiſh may be invited into them, and by them into the net. There muſt be ſome ſtones or leaden weights uſed to ſink the net, and a long pole faſtened to the upper part of the mouth of it, by means of which, when it is well filled with fiſh, it may be lifted up and taken to the ſhore.

Wolf's *Peach*. See Lycopersicon.

Wolf, *War*, an ancient military machine, differently deſcribed by different writers. Procopius makes it a kind of portcullis, or rather a harrow for defending a gate. Matthew of Weſtminſter, and Camden, deſcribe it as a machine for throwing ſtones. "At the gates," ſays Procopius, (Hiſt. of the Gothic Wars, book i.) "they ſet up wolves in the following manner:—They erected two beams from the ground reaching to the battlements, and laid chequerwiſe pieces of wrought timber, ſome upright and ſome croſs; they jointed them ſo that the mortiſing holes met one another; and before each joint ſtuck out a pointed piece of wood, like a thick ſpar, and faſtening the croſs timbers to another beam, which from the top reached half-way down: they laid the beams flat along upon the gates, and when an enemy approached, men above laid hold of the higher ends of the beams, and thruſt them down, which falling ſuddenly among the aſſailants, with the wooden points ſticking out, killed all upon whom they deſcended." Probably there was a chain or cord to draw back the machine after it had produced its effect.

The war-wolf, for throwing ſtones, is deſcribed by Matthew of Weſtminſter, ann. 1304; by Camden, in his Remains, to which we refer; and alſo to Groſe's Mil. Antiq. vol. i. p. 383.

Wolf *Iſland*, in *Geography*, an iſland in the North Atlantic ocean, near the eaſt coaſt of Labrador. N. lat. 53° 55′. W. long. 55° 40′.—Alſo, an iſland at the north-eaſt end of lake Ontario. N. lat. 44°. W. long. 76° 50′.—Alſo, an iſland in the gulf of St. Lawrence, near the ſouth coaſt of Labrador. N. lat. 50° 2′. W. long. 60° 55′.—Alſo, a ſmall iſland in the Atlantic, near the coaſt of Georgia. N. lat. 31° 19′. W. long. 81° 30′.

Wolf *River*, or *Chickſaw Bluff*, a river of Georgia, which runs into the Miſſiſſippi, N. lat. 34° 45′. W. long. 90° 42′.

Wolf *Rock*, a very low, flat, rocky iſlet, in the North Pacific ocean, ſurrounded by rocks and breakers, which extend ſome diſtance from it; 10 miles from the ſouthern coaſt of the Prince of Wales's Archipelago. N. lat. 55° 1′. E. long. 226° 42′.—Alſo, a rock near the eaſt coaſt of Labrador, and not far from the iſland called Wolf iſland.—Alſo, a rock at the entrance of the Engliſh channel; 10 miles S. of Land's-End. N. lat. 49° 58′. W. long. 5° 45′.

WOLFBOROUGH, a townſhip of New Hampſhire,

ſhire, in the county of Strafford, on the Winnipiſcogee lake, containing 1376 inhabitants; 35 miles N.N.W. of Durham.

WOLFDORF, a town of Bohemia, in the circle of Leitmeritz; 7 miles N. of Kamnitz.

WOLFENBUTTEL, a principality which lately conſtituted a part of the duchy of Brunſwick, divided into two parts by the principality of Halberſtadt, and the dioceſe of Hildeſheim. The north part is ſurrounded on the north by the principality of Luneburg and the marquiſate of Brandenburg, on the eaſt by the duchy of Magdeburg, on the ſouth by the principality of Halberſtadt, and on the weſt by the dioceſe of Hildeſheim. The ſouth part is bounded on the north by the biſhopric of Hildeſheim and the principality of Calenberg, on the eaſt by the dioceſe of Hildeſheim and the Harz foreſt, on the ſouth by the principality of Grubenhagen and Calenberg, and on the weſt by the territories of the abbey of Corvey and Calenberg. The eaſtern half contains under it a part of the Harz foreſt, the mines and ſalt-works which the prince held in common with the elector of Brunſwick Luneburg. In the weſtern half of this ſouthern part is a part of the foreſt of Sollinger, conſiſting of oak and beech, with a chain of mountains covered with woods. Thus the ſouthern part of the principality conſiſts chiefly of hills and woods, with little arable land; but, on the other hand, has a great plenty of timber, iron, and glaſs-houſes, the manufactures of which are greatly admired, particularly thoſe of looking-glaſſes, with a fine porcelain manufacture, and the very rich mines and ſalt-works in the Harz foreſt. The north part of the principality is more level, and produces abundance of grain, flax, and hemp, together with various kinds of pulſe and fruit. Their graziery here turns to very good account, beſides which it has a ſalt-work. The culture of ſilk is now followed, and premiums are aſſigned by the prince for the encouragement of it. The Weſer, the Leine, the Inner See, and the Ocker, are the principal rivers. In this principality are 18 towns, 386 villages, and 17 fees and convents. The eſtabliſhed religion here is Lutheraniſm. The country of Brunſwick was anciently under lords of its own, who poſſeſſed it as their abſolute and hereditary property, and derived their lineage from Ludolphus, duke of Saxony; and, conſequently, by his grandmother Haſala, or Giſela, from duke Witikind, whoſe daughter ſhe was. From king Henry I., grandſon to Ludolphus, was deſcended his ſon Henry, duke of Bavaria, among whoſe iſſue was count Bruno, on whom the emperor Otho conferred a tract of land in Saxony, near Brunſwick, namely, Melverode and Hohenwart. Count Bruno, his ſon, enlarged Brunſwick; and his ſon, count Ludolphus, on the demiſe of the emperor Henry II., was the firſt that obtained the full ſovereignty over Brunſwick and Tanwarderode, and died in 1038. His ſon Egbert I. became margrave of Thuringia and Miſnia; and his ſon Egbert II. likewiſe attained to thoſe dignities. This laſt prince being killed in battle, in 1091, his ſiſter Gertrude ſucceeded to the country of Brunſwick, which country ſhe brought to her ſecond huſband, Henry the Fat, count of Nordheim; and by their daughter Ricienza it came to her huſband Lothario, count of Supplinburg, afterwards emperor. By his daughter Gertrude it deſcended to her huſband, Henry the Magnanimous, duke of Bavaria and Saxony, and thus to the houſe of Welpho. The principality of Wolfenbuttel was poſſeſſed of a vote among the princes, both in the college of the princes of the empire, and likewiſe in the diet of Lower Saxony; in each of which, by virtue of an agreement concluded in 1706, when the ſeniority lies in the houſe of Brunſwick Wolfenbuttel, it precedes thoſe of the elector of Brunſwick and Luneburg, for Zelle, Grubenhagen, and Calenberg, but otherwiſe comes after them; farther, the houſe of Wolfenbuttel, when ſenior, obtained the joint direction of the circle of Lower Saxony. In 1807, this principality was annexed to Weſtphalia.

WOLFENBUTTEL, a city of Weſtphalia, and capital of a principality of the ſame name, ſituated in a low marſhy ſoil, on the Ocker: it is well built and fortified. In it is a château, a long time the reſidence of the dukes, in which is a noble library containing 120,000 volumes of printed books and manuſcripts. The principal church contains the ſepulchral monument of the dukes. Wolfenbuttel very probably owes its name to the firſt builder of the palace, called Wolf, or Wolfer, or Wolfhard; 24 miles E. of Hildeſheim. N. lat. 52° 10′. E. long. 10° 40′.

WOLFERSDORF, a town of Saxony, in the circle of Neuſtadt; 4 miles S.W. of Weyda.—Alſo, a town of Saxony, in the circle of Neuſtadt; 6 miles E.N.E. of Weyda.

WOLFERSDYCK, a ſmall iſland of Zealand, between North and South Beveland.

WOLFERSHEIM, a town of Germany, in the principality of Solms Braunfels; 12 miles S.S.E. of Wetzlar.

WOLFERSTORFF, a town of Auſtria; 2 miles S.E. of Laab.

WOLFERZHAUSEN, a town of Bavaria; 12 miles N.E. of Weilhaim.

WOLFESHEAD, or WULVERSHEAD, Saxon, *wulferheafod*, compounded of *wulf*, *wolf*, and *heafod*, *head*, *caput lupinum*, denoted the condition of thoſe outlawed for criminal matters in the Saxon time, and not yielding themſelves to juſtice. For if they could have been taken alive, they muſt have been brought to the king; and if they, for fear of being apprehended, did defend themſelves, they might be ſlain, and their heads brought to the king; for their head was no more to be accounted of than a wolf's head. LL. Edw. in Lamb. fol. 127. and Bract. lib. iii. tract. 2. c. 11. See CAPUT *Lupinum*, and OUTLAWRY.

WOLFESTAAL, in *Geography*, a town of Auſtria; 2 miles E. of Hainburg.

WOLFFACH, a town of Germany, in the lordſhip of Furſtenberg; 4 miles S.S.E. of Hazlach. N. lat. 48° 13′. E. long. 8° 16′.

WOLFFEG, a town of Auſtria; 5 miles N.W. of Schwanaſtadt.

WOLFFEGG, or WOLFECK, a château and village of Germany, which gives the title of count to a noble family, divided into ſeveral branches, *viz.* Wolffegg Zeil, Wolffegg Zeil Wurzach, Wolffegg Wolffegg, and Wolffegg Waldſee; 10 miles W. of Leutkirch.

WOLFFEN, a town of Saxony; 3 miles N.W. of Bitterfeld.

WOLFFPASSING, a town of Auſtria; 9 miles S. of Ips.

WOLFFSHAGEN, a town of Brandenburg, in the Mark of Pregnitz; 6 miles W. of Pritzwalk.

WOLFGANG, a town of Germany, in the county of Henneberg, on an iſland in a lake; 7 miles S.W. of Meinungen.

WOLFGANG, *St.* a town of Auſtria; 3 miles S.S.W. of Aigen.—Alſo, a town of Auſtria; 1 mile N. of Kirſchſchlag.—Alſo, a town of Auſtria, on a lake, called the Abernſea, and St. Wolfgang's lake; 54 miles S.S.W. of Lintz.

Lintz. — Alfo, a town of Switzerland, in the canton of Zug; 4 miles W. of Zug.

WOLFGAST, or WOLGAST, a town of Anterior Pomerania, on the Pena, about three miles from the Baltic, with about 3500 inhabitants. It was anciently a confiderable fortrefs, and refidence of the dukes; 30 miles S.E. of Stralfund. N. lat. 54° 2'. E. long. 13° 45'.

WOLFIA, in *Botany*, a genus of Schreber's, feems by its orthography intended to commemorate Dr. de Wolf, of Dantzic, of whofe whimfical attempt in the NOMENCLATURE of plants, we have given a fufficient account at the conclufion of that article. This writer, to whom the praife of labour and originality cannot be denied, and whofe index, entitled *Concordantia Botanica*, is truly valuable, died in 1784, aged 60. There have been feveral German naturalifts and phyficians of the name of Wolf, but none eminent in botanical ftudies.—Schreb. Gen. 801.—Clafs and order, *Octandria Monogynia*. Nat. Ord. *Trihilatæ*, Linn. *Sapindi*, Juff.

Gen. Ch. *Cal.* Perianth inferior, of one leaf, coloured: tube very fhort, fomewhat dilated at the bafe, permanent: limb in five deep, linear, obtufe, moderately fpreading fegments. *Cor.* none. Nectary of eight linear, obtufe, villous, upright fcales, one-third the length of the calyx, and inferted into it at the bafe of the limb. *Stam.* Filaments eight, awl-fhaped, erect, the length of the calyx, into which they are inferted alternately with the fcales of the nectary, in the fame row; anthers ovate, attached by the back, erect, directed inwards. *Pift.* Germen fuperior, oblong, ending in a cylindrical upright ftyle, the height of the ftamens; ftigma oblong, downy, unilateral. *Peric.* Berry? ovate, of one cell, fomewhat fix-fided, with three keels furrounding its fummit. *Seeds* three, nearly ovate, oblique, externally gibbous, contracted below the middle, abrupt at the bafe, enclofed in a tunic.

Obf. There appear to be feveral feeds, fome of which prove abortive.

We have tried in vain to guefs any thing more refpecting this genus than its natural order, of which there can be fcarcely a doubt. No author has adopted *Wolfia*. There are, in its characters, fome indications of *Jambolifera*, Willd. Sp. Pl. v. 2. 326. *Cyminofma*, Gærtn. t. 58, (which ought to have found a place in our 18th volume; fee CALYPTRANTHES alfo); and a botanift who compares Schreber's defcription, literally tranflated above, with *Jambolifera pedunculata*, will find feveral coincidences, which, allowing for one or two eafy mifconceptions, might almoft perfuade us he had defcribed that plant; but ftill there are infuperable difficulties. Schreber's index directs us, at the word *Pitumba*, to the fame number as his *Wolfia*, 1749. But no fuch fynonym occurs there, nor, as far as we can find, elfewhere in his book. *Pee tumba*, Rheede Hort. Mal. v. 9. t. 46, is a *Jufticia*, and can have no connection with the prefent plant. See other obfcure genera, thus circumftanced, at the articles MEYERA, WHELERA, SPARTINA, and XYSTRIS.

WOLF-MONETH, a name given by our Saxon anceftors to the month of January, on account of the ravages committed by the wolves in that month through the feverity of the cold.

WOLFRAM, in *Mineralogy*, an ore of tungften. (See TUNGSTEN.) The colour of Wolfram is generally a brownifh or greyifh-black; it gives a reddifh-brown ftreak when cut with the point of a knife, to which it yields readily, a property characteriftic of this mineral. It occurs both maffive and cryftallized, and in concentric lamellar concretions. The form of the cryftal is a flat rectangular prifm; the lateral planes are generally ftreaked longitudinally. The ftructure is lamellar, with a very diftinct cleavage in one direction, and an indiftinct cleavage at right angles to the former. The luftre of the principal cleavage is fplendent or fhining, and is metallic; that of the indiftinct cleavage is gliftening. The crofs fracture is coarfe-grained and uneven. It is brittle and frangible. The fpecific gravity of Wolfram is from 7.1 to 7.3. Before the blow-pipe it decrepitates, and melts with difficulty into a black flag.

The conftituent parts of Wolfram, as given by Vauquelin, are,

Tungften acid	67
Oxyd of iron	18
Oxyd of manganefe	6
Silex	1.50

Wolfram moft frequently occurs in veins with tin-ftone, but may be diftinguifhed from it by its greater degree of foftnefs, and the reddifh ftreak which it yields to the knife. It is common in many of the mines of Cornwall, and in thofe of Saxony, and of Zinnweld and Schlackenwald, in Bohemia. This mineral has not hitherto been applied to any ufeful purpofe in the arts. It was originally miftaken for antimony, which by the alchymifts was called the wolf, becaufe it appeared to deftroy the bafer metals in the procefs of refining gold.

WOLFRAMITZ, in *Geography*, a town of Moravia, in the circle of Znaym; 20 miles N.E. of Znaym.

WOLFRAMITZKIRCHEN, a town of Moravia, in the circle of Znaym; 7 miles N.W. of Znaym.

WOLFSBACH, a river of Silefia, which runs into the Bober, near Loewenberg.

WOLFSBERG, a town of the duchy of Carinthia, on the river Levant, with a citadel; 10 miles N.N.W. of Lavamunt.

WOLFSDORF, a town of Pruffia, in the province of Ermeland; 18 miles W.S.W. of Heilfberg.—Alfo, a town of Saxony, in the circle of Neuftadt; 5 miles S.W. of Weyda.

WOLFSHAGEN, a town of the principality of Heffe Caffel, on the Erpe; 15 miles W. of Caffel. N. lat. 51° 18'. E. long. 9° 10'.

WOLFSON, a fmall ifland in the gulf of Finland. N. lat. 59° 22'. E. long. 24° 44'.

WOLFSPACH, a town of Auftria; 8 miles E. of Steyr.

WOLFSTEIN, a town of France, in the department of Mont Tonnerre; 43 miles W.N.W. of Manheim.

WOLHAUSEN IM MARKT, a town of Switzerland, in the canton of Lucerne; 7 miles W.S.W. of Lucerne.

WOLIN, or WOLYNIE, a town of Bohemia, in the circle of Prachatitz; 8 miles N.N.W. of Prachatitz. N. lat. 49° 10'. E. long. 13° 45'.

WOLIN, a town of Brandenburg, in the Middle Mark; 10 miles S.S.W. of Brandenburg.

WOLKART, a mountain of Carinthia; 8 miles N.E. of Milftatt.

WOLKENMARCK. See VOLKENMARK.

WOLKENSTEIN, a town of Saxony, in the circle of Erzgebirg, with a citadel, fituated on a rock, near the Zfchopa. About half a league from the town are fome warm medicinal baths; 13 miles S.S.E. of Chemnitz. N. lat. 50° 36'. E. long. 12° 59'.—Alfo, a town of the county of Tyrol; 3 miles W. of Lientz.

WOLKOMYSK, a town of Lithuania, in the palatinate of Novogrodek; 40 miles W.S.W. of Novogrodek.

WOLLACOMB BAY, a bay of England, on the weſt coaſt of Devonſhire, ſituated to the north of Barnſtaple bay.

WOLLAPALLAM, a town of Hindooſtan; 10 miles E. of Coimbetore.

WOLLASTON, WILLIAM, in *Biography*, an ethical writer, was born in 1659 at Cotton Clanford, in Staffordſhire, and finiſhed his education as a penſioner of Sidney college, Cambridge. In 1681 he commenced M.A. and entered into deacon's orders. His firſt ſettlement was as an aſſiſtant in the free ſchool at Birmingham, to which a ſmall lectureſhip was annexed; and about four years afterwards he was advanced from this laborious ſituation to the office of ſecond maſter in the ſame ſchool. In 1688 a relation died, whoſe deceaſe put him in poſſeſſion of a conſiderable landed eſtate, upon which he removed to London, and marrying a lady of conſiderable fortune, he reſided in Charterhouſe-ſquare. Diſmiſſing all thoughts of church preferment, he devoted himſelf to the retirement of private life and to a courſe of ſtudy, comprehending the learned languages, together with Hebrew and Arabic. The firſt publication which iſſued from the preſs was a poem on Eccleſiaſtes, which he would afterwards have ſuppreſſed, from a conviction that his talents were not adapted to poetry. In the progreſs of his life and literary purſuits, he was ſo much amuſed by compoſition, that he wrote many treatiſes on various ſubjects, both in Latin and Engliſh, which he committed to the flames. Of the well-known work which has perpetuated his name, and which is intitled "The Religion of Nature delineated," he printed a few copies to be diſtributed among his friends in 1722, but his declining health prevented his completing his original deſign. However, in 1723 he was prevailed upon to reviſe what he had printed for publication, and it accordingly appeared in 1724, in which year he died, at the age of 65, leaving a large family, and having loſt his wife, to whom he was affectionately attached, about four years before. In his private character he is ſaid to have exemplified the virtues which his work inculcated. The ſyſtem which he developed, and which founded morality upon "truth," excited much attention, and his book, though not written in a popular manner, paſſed through ſeven editions to the year 1750. The laſt of theſe editions includes an appendix, conſiſting of a tranſlation of the Latin notes by Dr. J. Clarke, dean of Saliſbury, undertaken at the particular requeſt of queen Caroline, who was a great admirer of the work. Dr. Warburton, in his ſtrictures on Wollaſton's theory in his Divine Legation, honours the author by ranking him as "one of our moſt celebrated writers," and compliments him with having "demonſtrated with greater clearneſs than any before him the natural eſſential difference of things;" and though modern ſyſtems have in a conſiderable degree antiquated that of Mr. Wollaſton, the author muſt always be regarded as a man of extenſive learning and ſtrong reaſoning powers. Biog. Brit.

WOLLERSDORF, in *Geography*, a town of Germany, in the margravate of Anſpach; 10 miles E. of Anſpach.

WOLLERSTORFF, a town of Auſtria; 5 miles W.N.W. of Neuſtatt.

WOLLIEN, a town of Brandenburg, in the Ucker Mark; 10 miles E.S.E. of Prenzlow.

WOLLIN, a town of Anterior Pomerania, on the eaſt coaſt of the iſland ſo called, ſeparated from the continent of Pomerania by the river Dirnow, over which is a bridge, at which all travellers pay a toll. In this town are a ſeat and prefecturate. It ſtands on the ſcite of the ancient city of Julin, which was formerly ſo famous for its commerce, though its origin is very obſcure. The firſt mention of this city in hiſtory occurs immediately after the time of Charlemagne; and in the 11th century its proſperity was ſuch, that Adam Von Bremen ſpeaks of it as the largeſt city at that time in Europe. So early as the records of the 12th century, it is called Wolin. In the year 1127, it was ſet on fire by lightning, and being built of wood, was entirely conſumed. The Pomeranian biſhopric, which had been erected there but two years before, was tranſlated upon that to Uſedom, but on the rebuilding of the city, was reſtored to it. In the year 1170, being taken by Woldemar I. king of Denmark, and Jaromar I. prince of Rugen, it was ſacked and burned; and after retrieving this calamity was, in the year 1175, again ſet on fire, and utterly deſtroyed, inſomuch that in the very ſame year the duke of Pomerania removed the biſhopric to Cammin. It was indeed rebuilt again, but never recovered its former greatneſs; 25 miles N. of Old Stettin. N. lat. 53° 48′. E. long. 14° 35′.

WOLLIN, an iſland formed at the mouth of the Oder, between the Baltic and the Friſche Haff; the form of an irregular triangle, about thirty miles in circumference. This iſland is frequently in danger of being overflowed, and the ſea-winds hurt it conſiderably, by throwing up drifts of ſand. It produces excellent cattle, with plenty of game and fiſh; and one part of it, called the Pritter, is remarkable for the great quantity of eels taken there. Beſides the town of Wollin, it contains ſeveral villages.

WOLLO, a town of Africa, on the Ivory Coaſt.

WOLLY. See WOOLLI.

WOLMIRSTADT, a town of Weſtphalia, in the duchy of Magdeburg. In the year 1642, this town was ſet on fire by the Imperial troops; 10 miles N. of Magdeburg. N. lat. 52° 18′. E. long. 11° 45′.

WOLMSDORF, or WONSDORF, a town of Pruſſia, in the province of Smaland; 24 miles S.E. of Königſberg.

WOLNITZ, a town of Saxony, in the principality of Eiſenach; 2 miles S. of Jena.

WOLNZACH, a town of Bavaria; 6 miles N.E. of Pfaffenhofen.

WOLPA, a town of Lithuania, in the palatinate of Novogrodek; 54 miles W. of Novogrodek.

WOLPAFFING, a town of Auſtria; 4 miles S.S.E. of Weikerſdorf.

WOLSDORFF, a town of the duchy of Bremen; 5 miles S. of Carlſtadt.

WOLSEY, or WULCEY, THOMAS, cardinal, in *Biography*, was the ſon of a butcher at Ipſwich, Suffolk, and born there in 1471. He finiſhed his education at Magdalen college, Oxford, and was graduated B.A. at the age of 15. He was afterwards fellow of his college, and having taken the degree of M.A. became maſter of the ſchool dependent upon that college, where he had under his tuition three ſons of the marquis of Dorſet, by whom he was preſented to the rectory of Lymington in Somerſetſhire, into which he was inducted in 1500. His advancement was rapid, firſt as domeſtic chaplain to the archbiſhop of Canterbury, and afterwards as chaplain to the houſehold of Henry VII. His manners were inſinuating, and he became the confidante of the king, who communicated to him his projected marriage with the daughter of the emperor Maximilian. Wolſey met the emperor at Bruges, and executed his commiſſion ſo much to the king's ſatisfaction, that he nominated him to the deanery of Lincoln. After the death of Henry VII. he was recommended by Fox, biſhop of Wincheſter, to Henry VIII., whoſe favour

favour and confidence he conciliated by his blending amusement with business, insomuch that he supplanted the ministers of the late king, and became himself uncontrouled minister. His preferments, civil and ecclesiastical, very speedily succeeded one another, and even profusely accumulated. He was introduced into the privy-council in 1510, made reporter of the star-chamber, registrar, and afterwards chancellor of the garter; and advanced to the sees of Tournay and Lincoln in 1513, to that of York in 1514, and to the dignity of cardinal in 1515. Thus promoted, his pride and love of pomp kept pace with his elevation of rank. In his train of servants, 800 in number, were many knights and gentlemen; and the sons of noblemen acted occasionally as his domestic menials. His equipage and furniture were of the most costly kind; but it is needless to multiply particulars. The most pardonable, not to say laudable, display of his magnificence was exhibited in his patronage of literary men and promotion of literature, both by the exercise of private bounty and the establishment of public institutions. The pope nominated him legate *à latere*, by which office he acquired legal pre-eminence over the archbishop of Canterbury; and in December 1515, he was elevated to the office of high-chancellor. By the equity of his decisions in the exercise of this office he gained great credit, but his conduct as legate *à latere* was so arbitrary and oppressive, as to produce complaints against him to the king. Charles V. and Frederic I. purchased his interest with Henry VIII. by pensions, and he was also retained in the same way by the pope. Charles flattered him with hopes of the papal crown, and settled upon him the revenues of two bishoprics in Spain. Still insatiable in the pursuit of ecclesiastical preferments, he obtained the administration of the see of Bath and Wells, and the temporalities of the abbey of St. Alban's, to which were afterwards added successively the rich bishoprics of Durham and Winchester. His revenues, thus amounting nearly to that of the crown, were expended partly in the ostentation of pomp, and partly in laudable munificence. He founded several lectures at Oxford for liberal and useful studies, and at length erected in that university the celebrated college of Christchurch. He also established a collegiate school in his native town of Ipswich. The palace which he built at Hampton Court he presented, in 1528, to the king, and he further ingratiated himself with Henry by an arbitrary loan for the supply of his wants; but by these measures he became more and more odious to the nation. But his fall was approaching; and the first step to it was the divorce of queen Catharine. This was followed by the marriage of Henry with Ann Boleyn, whose influence was employed in effecting his downfall. At length the king, not without hesitation and reluctance, employed the dukes of Norfolk and Suffolk, in 1529, to require him to surrender the great seal, and to quit York-place, a palace which he had built in London, and which afterwards became a royal residence under the name of Whitehall. His furniture and plate were seized for the king's use, and he was ordered to retire to Esher, a palace which belonged to him as bishop of Winchester. These measures overwhelmed the favourite, destitute of any inward resources of magnanimity; and when he received a slight token of the king's favour in this state of mental depression, he was transported with joy, dismounted on meeting the messenger, and fell upon his knees in the dirt to receive the expression of his master's kindness. Henry, however, was capricious and inconstant; a cloud overspread this gleam, and Wolsey was ordered to be indicted in the star-chamber, and abandoned by his sovereign to the rigour of parliament. An accusation, consisting of 44 articles, was exhibited against him by the house of lords; and in the commons, he was so ably defended by Thomas Cromwell, who had been raised by the cardinal from a low condition to a high station, that his enemies were defeated. They thus changed their plan, and indicted him upon the statute of provisors, which prohibited his procuring bulls from Rome, and which he had violated by obtaining the legantine power; and this was made the ground of a sentence, putting him out of the king's protection, forfeiting all his lands and goods, and declaring him liable to imprisonment. When these measures had induced him to resign to the king York-place with all its furniture, he obtained a full pardon for all his past offences, and the restoration of the revenues of his archbishopric, with part of his goods. But fresh tokens of royal displeasure awaited him. The earl of Northumberland was ordered to arrest him for high treason, and to conduct him to London for trial. In his way from York to London, he was seized with a disorder which obliged him to stop at Leicester, where he was hospitably received in the abbey. His disorder in a few days terminated his life, in the 60th year of his age. Shortly before he expired he closed a conversation with the constable of the Tower, which related to the king, with this exclamation, "Had but I served God as diligently as I have served the king, he would not have given me over in my grey hairs!" Thus he sunk to the grave as a victim to tyranny, but to a tyranny which he had himself formed; exhibiting an instructive example to all future ministers of the insecure possession of power and wealth acquired by extortion and oppression, and of the folly of placing confidence in princes embracing arbitrary and despotic measures, and governed by caprice and personal ambition. Biog. Brit.

The magnificence of the cardinal's chapel-establishment, as described by Cavendish, his contemporary and domestic, seems far to have surpassed that of the Roman pontiff himself.

"First, he had there a deane, a great divine, and a man of excellent learning; a sub-dean, a repeatour of the quire, a gospeller and epistollor; of singing priests, ten, a master of the children. The seculars of the chapell, being singing-men, twelve; singing-children, ten, with one servant to waite upon them. In the vestry, a yeoman and two grooms; over and besides other retainers that came thither at principal feasts. And for the furniture of his chapell, it passeth my weak capacity to declare the number of the costly ornaments and rich jewels that were occupied in the same. For I have seen in procession about the hall forty-four rich copes, besides the rich candlesticks, and other necessary ornaments to the furniture of the same."

The earl of Northumberland, whose passion for Ann Boleyn is supposed to have occasioned his disgrace at court, seems to have been treated with great insolence and indignity by the cardinal, who, by an extraordinary extension of power, demanded his choral books for the use of his own chapel. Letters concerning this requisition are still preserved in the family, in which the earl says, "I do perceayff my lorde cardinall's pleasour ys to have such boks as was in the chapell of my lat lorde and ffayther (wos soll Jhu pardon.) To the accomplychment of which, at your desyer, I am confformable, notwithstandinge I trust to be able ons to set up a chapell off myne owne.—I shall with all sped send up the boks unto my lord's grace, as to say iiij *Antiffonars* (Antiphoners), such as I think wher not seen a gret wyll—v *Gralls* (Graduals)—an *Ordeorly* (Ordinal)—a *Manuall*—viij *Proffessioners* (Processionals)." Northumberland Household Book.

WOLSINGHAM, in *Geography*, an irregular town in the

WOLKOMYSK, a town of Lithuania, in the palatinate of Novogrodek; 40 miles W.S.W. of Novogrodek.

WOLLACOMB BAY, a bay of England, on the weft coaft of Devonfhire, fituated to the north of Barnftaple bay.

WOLLAPALLAM, a town of Hindooftan; 10 miles E. of Coimbetore.

WOLLASTON, WILLIAM, in *Biography*, an ethical writer, was born in 1659 at Cotton Clanford, in Staffordfhire, and finifhed his education as a penfioner of Sidney college, Cambridge. In 1681 he commenced M.A. and entered into deacon's orders. His firft fettlement was as an affiftant in the free fchool at Birmingham, to which a fmall lecturefhip was annexed; and about four years afterwards he was advanced from this laborious fituation to the office of fecond mafter in the fame fchool. In 1688 a relation died, whofe deceafe put him in poffeffion of a confiderable landed eftate, upon which he removed to London, and marrying a lady of confiderable fortune, he refided in Charterhoufe-fquare. Difmiffing all thoughts of church preferment, he devoted himfelf to the retirement of private life and to a courfe of ftudy, comprehending the learned languages, together with Hebrew and Arabic. The firft publication which iffued from the prefs was a poem on Ecclefiaftes, which he would afterwards have fuppreffed, from a conviction that his talents were not adapted to poetry. In the progrefs of his life and literary purfuits, he was fo much amufed by compofition, that he wrote many treatifes on various fubjects, both in Latin and Englifh, which he committed to the flames. Of the well-known work which has perpetuated his name, and which is intitled "The Religion of Nature delineated," he printed a few copies to be diftributed among his friends in 1722, but his declining health prevented his completing his original defign. However, in 1723 he was prevailed upon to revife what he had printed for publication, and it accordingly appeared in 1724, in which year he died, at the age of 65, leaving a large family, and having loft his wife, to whom he was affectionately attached, about four years before. In his private character he is faid to have exemplified the virtues which his work inculcated. The fyftem which he developed, and which founded morality upon "truth," excited much attention, and his book, though not written in a popular manner, paffed through feven editions to the year 1750. The laft of thefe editions includes an appendix, confifting of a tranflation of the Latin notes by Dr. J. Clarke, dean of Salifbury, undertaken at the particular requeft of queen Caroline, who was a great admirer of the work. Dr. Warburton, in his strictures on Wollafton's theory in his Divine Legation, honours the author by ranking him as "one of our moft celebrated writers," and compliments him with having "demonftrated with greater clearnefs than any before him the natural effential difference of things;" and though modern fyftems have in a confiderable degree antiquated that of Mr. Wollafton, the author muft always be regarded as a man of extenfive learning and ftrong reafoning powers. Biog. Brit.

WOLLERSDORF, in *Geography*, a town of Germany, in the margravate of Anfpach; 10 miles E. of Anfpach.

WOLLERSTORFF, a town of Auftria; 5 miles W.N.W. of Neuftatt.

WOLLIEN, a town of Brandenburg, in the Ucker Mark; 10 miles E.S.E. of Prenzlow.

WOLLIN, a town of Anterior Pomerania, on the eaft coaft of the ifland fo called, feparated from the continent of Pomerania by the river Direnow, over which is a bridge, at which all travellers pay a toll. In this town are a feat and prefecturate. It ftands on the feite of the ancient city of Julin, which was formerly fo famous for its commerce, though its origin is very obfcure. The firft mention of this city in hiftory occurs immediately after the time of Charlemagne; and in the 11th century its profperity was fuch, that Adam Von Bremen fpeaks of it as the largeft city at that time in Europe. So early as the records of the 12th century, it is called Wolin. In the year 1127, it was fet on fire by lightning, and being built of wood, was entirely confumed. The Pomeranian bifhopric, which had been erected there but two years before, was tranflated upon that to Ufedom, but on the rebuilding of the city, was reftored to it. In the year 1170, being taken by Woldemar I. king of Denmark, and Jaromar I. prince of Rugen, it was facked and burned; and after retrieving this calamity was, in the year 1175, again fet on fire, and utterly deftroyed, infomuch that in the very fame year the duke of Pomerania removed the bifhopric to Cammin. It was indeed rebuilt again, but never recovered its former greatnefs; 25 miles N. of Old Stettin. N. lat. 53° 48′. E. long. 14° 35′.

WOLLIN, an ifland formed at the mouth of the Oder, between the Baltic and the Frifche Haff; the form of an irregular triangle, about thirty miles in circumference. This ifland is frequently in danger of being overflowed, and the fea-winds hurt it confiderably, by throwing up drifts of fand. It produces excellent cattle, with plenty of game and fifh; and one part of it, called the Pritter, is remarkable for the great quantity of eels taken there. Befides the town of Wollin, it contains feveral villages.

WOLLO, a town of Africa, on the Ivory Coaft.

WOLLY. See WOOLLI.

WOLMIRSTADT, a town of Weftphalia, in the duchy of Magdeburg. In the year 1642, this town was fet on fire by the Imperial troops; 10 miles N. of Magdeburg. N. lat. 52° 18′. E. long. 11° 45′.

WOLMSDORF, or WONSDORF, a town of Pruffia, in the province of Smaland; 24 miles S.E. of Königfberg.

WOLNITZ, a town of Saxony, in the principality of Eifenach; 2 miles S. of Jena.

WOLNZACH, a town of Bavaria; 6 miles N.E. of Pfaffenhofen.

WOLPA, a town of Lithuania, in the palatinate of Novogrodek; 54 miles W. of Novogrodek.

WOLPAFFING, a town of Auftria; 4 miles S.S.E. of Weikerfdorf.

WOLSDORFF, a town of the duchy of Bremen; 5 miles S. of Carlftadt.

WOLSEY, or WULCEY, THOMAS, cardinal, in *Biography*, was the fon of a butcher at Ipfwich, Suffolk, and born there in 1471. He finifhed his education at Magdalen college, Oxford, and was graduated B.A. at the age of 15. He was afterwards fellow of his college, and having taken the degree of M.A. became mafter of the fchool dependent upon that college, where he had under his tuition three fons of the marquis of Dorfet, by whom he was prefented to the rectory of Lymington in Somerfetfhire, into which he was inducted in 1500. His advancement was rapid, firft as domeftic chaplain to the archbifhop of Canterbury, and afterwards as chaplain to the houfehold of Henry VII. His manners were infinuating, and he became the confidante of the king, who communicated to him his projected marriage with the daughter of the emperor Maximilian. Wolfey met the emperor at Bruges, and executed his commiffion fo much to the king's fatisfaction, that he nominated him to the deanery of Lincoln. After the death of Henry VII. he was recommended by Fox, bifhop of Winchefter, to Henry VIII., whofe favour and confidence he conciliated by his blending amusement with business, insomuch that he supplanted the ministers of the late king, and became himself uncontrouled minister. His preferments, civil and ecclesiastical, very speedily succeeded one another, and even profusely accumulated. He was introduced into the privy-council in 1510, made reporter of the star-chamber, registrar, and afterwards chancellor of the garter; and advanced to the sees of Tournay and Lincoln in 1513, to that of York in 1514, and to the dignity of cardinal in 1515. Thus promoted, his pride and love of pomp kept pace with his elevation of rank. In his train of servants, 800 in number, were many knights and gentlemen; and the sons of noblemen acted occasionally as his domestic menials. His equipage and furniture were of the most costly kind; but it is needless to multiply particulars. The most pardonable, not to say laudable, display of his magnificence was exhibited in his patronage of literary men and promotion of literature, both by the exercise of private bounty and the establishment of public institutions. The pope nominated him legate *à latere*, by which office he acquired legal pre-eminence over the archbishop of Canterbury; and in December 1515, he was elevated to the office of high-chancellor. By the equity of his decisions in the exercise of this office he gained great credit, but his conduct as legate *à latere* was so arbitrary and oppressive, as to produce complaints against him to the king. Charles V. and Frederic I. purchased his interest with Henry VIII. by pensions, and he was also retained in the same way by the pope. Charles flattered him with hopes of the papal crown, and settled upon him the revenues of two bishoprics in Spain. Still insatiable in the pursuit of ecclesiastical preferments, he obtained the administration of the see of Bath and Wells, and the temporalities of the abbey of St. Alban's, to which were afterwards added successively the rich bishoprics of Durham and Winchester. His revenues, thus amounting nearly to that of the crown, were expended partly in the ostentation of pomp, and partly in laudable munificence. He founded several lectures at Oxford for liberal and useful studies, and at length erected in that university the celebrated college of Christchurch. He also established a collegiate school in his native town of Ipswich. The palace which he built at Hampton Court he presented, in 1528, to the king, and he further ingratiated himself with Henry by an arbitrary loan for the supply of his wants; but by these measures he became more and more odious to the nation. But his fall was approaching; and the first step to it was the divorce of queen Catharine. This was followed by the marriage of Henry with Ann Boleyn, whose influence was employed in effecting his downfall. At length the king, not without hesitation and reluctance, employed the dukes of Norfolk and Suffolk, in 1529, to require him to surrender the great seal, and to quit York-place, a palace which he had built in London, and which afterwards became a royal residence under the name of Whitehall. His furniture and plate were seized for the king's use, and he was ordered to retire to Esher, a palace which belonged to him as bishop of Winchester. These measures overwhelmed the favourite, destitute of any inward resources of magnanimity; and when he received a slight token of the king's favour in this state of mental depression, he was transported with joy, dismounted on meeting the messenger, and fell upon his knees in the dirt to receive the expression of his master's kindness. Henry, however, was capricious and inconstant; a cloud overspread this gleam, and Wolsey was ordered to be indicted in the star-chamber, and abandoned by his sovereign to the rigour of parliament. An accusation, consisting of 44 articles, was exhibited against him by the house of lords; and in the commons, he was so ably defended by Thomas Cromwell, who had been raised by the cardinal from a low condition to a high station, that his enemies were defeated. They thus changed their plan, and indicted him upon the statute of provisors, which prohibited his procuring bulls from Rome, and which he had violated by obtaining the legantine power; and this was made the ground of a sentence, putting him out of the king's protection, forfeiting all his lands and goods, and declaring him liable to imprisonment. When these measures had induced him to resign to the king York-place with all its furniture, he obtained a full pardon for all his past offences, and the restoration of the revenues of his archbishopric, with part of his goods. But fresh tokens of royal displeasure awaited him. The earl of Northumberland was ordered to arrest him for high treason, and to conduct him to London for trial. In his way from York to London, he was seized with a disorder which obliged him to stop at Leicester, where he was hospitably received in the abbey. His disorder in a few days terminated his life, in the 60th year of his age. Shortly before he expired he closed a conversation with the constable of the Tower, which related to the king, with this exclamation, "Had but I served God as diligently as I have served the king, he would not have given me over in my grey hairs!" Thus he sunk to the grave as a victim to tyranny, but to a tyranny which he had himself formed; exhibiting an instructive example to all future ministers of the insecure possession of power and wealth acquired by extortion and oppression, and of the folly of placing confidence in princes embracing arbitrary and despotic measures, and governed by caprice and personal ambition. Biog. Brit.

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WOLSINGHAM, in *Geography*, an irregular town in the

the county of Durham, England, is pleafantly fituated in the vale of the Wear, on a point of land formed by the confluence of that river and the Wefcrow. The church is fituated at the north fide of the town on rifing ground, but poffeffes nothing worthy of remark. Near it are fome remains of a confiderable building, inclofed with a deep moat, fuppofed by fome writers to have been part of a monaftery, which was founded by Henry de Pudfey; but Hutchinfon, in his Hiftory of Durham, refers them to the ancient manor-houfe of the bifhop's, which is mentioned in Hatfield's Survey. The inhabitants of this parifh, according to the returns of 1811, are 1983, the houfes 399. The views down the Wear from the hill above Wolfingham include a very extenfive and beautifully diverfified country. Between this town and Stanhope, the commencement of the lead diftrict is every where intimated by large parcels of lead lying near the fides of the road, and from the blue unwholefome vapours arifing from the fmelting mills in Bollihope. On Bollihope common, in 1749, was found a Roman altar with an infcription. This town is 6 miles S.E. by S. from Stanhope, and 259 N.N.W. from London. Here is a market held on Tuefday, and a fair on the 18th of May. The petty feffions are holden here. The parifh, which is large, confifts of Bradley, Hilton-park, Thornley, Wolfingham town quarter, Eaft fide quarter, Park quarter, and South fide quarter.—Beauties of England, Durham, vol. iv.; by J. Britton and E. W. Brayley.

WOLTA, a town of Bohemia, in the circle of Konigingratz; 2 miles N. of Trautenau.

WOLTERN, a town of Germany, in the county of Verden; 30 miles E. of Rotenburg.

WOLTERSDORF, a town of Saxony; 2 miles S.W. of Zahna.

WOLTIN, a town of Hinder Pomerania; 12 miles S.W. of Stargard.

WOLTZTORFF, a town of Auftria; 2 miles N.N.W. of Weikerftorf.

WOLVERENE. See GLUTTON.

WOLVERHAMPTON, formerly HAMPTON, in *Geography*, an important market-town in the hundred of N. Seifdon, and county of Stafford, England, is particularly noted for its extenfive manufactures of locks, keys, and other articles of ironmongery. It is fituated on a rifing ground 16 miles S. from Stafford, 14 S.W. from Lichfield, 13 N.W. from Birmingham, and 130 in the fame direction from London. Wolverhampton is of ancient date, for as early as 996 a monaftery was founded there by Wulfruna, from whom the town received the firft member of its name. The inftitution, confifting of a dean and fecular canons, was about the year 1200 transferred by the dean, Peter of Blois, to the archbifhop of Canterbury, to convert it into an abbey for Ciftercian monks; but this defign feems not to have been executed, for the feculars appear to have been not long after in poffeffion of the eftablifhment. The church, which was confidered as one of the king's free chapels, was by Edward IV. annexed to the deanery of Windfor; but in the feventh year of Edward VI. a grant of the college of Wolverhampton and feven prebends was made to John, duke of Northumberland. Coming again to the crown by his attainder, queen Mary reinftated the dean and prebendaries, and endowed them with all the lands, &c. which formerly belonged to the inftitution, then valued at the yearly rent of 113*l.* 13*s.* On a queftion arifing concerning thofe poffeffions, the grants of Mary were confirmed by James I., who appointed the celebrated Marc-Antonio de Dominis, who had been archbifhop of Spalatro in Dalmatia, to be dean of Windfor, and dean and firft prebendary of Wolverhampton: thofe deaneries continue to be united, but the colleges are feparate.

Wolverhampton is well built, and confidered as falubrious, notwithftanding it is in the vicinity of many coal-mines. The parifh is of great extent, being nearly 30 miles in circuit, and comprehends, befides the town, feventeen confiderable townfhips, or villages, among which are, Bilfton, Featherftone, Hatherton, Hilton, and Kinvafton. According to the returns to parliament in 1811, the houfes in the whole parifh were 2936, and the inhabitants 14,836. A market is held on Wednefday, and a fair on the 10th of July. The fkill and ingenuity of the lock-fmiths of the town and the environs, (for many of the farmers themfelves are concerned in the bufinefs,) and the trade carried on in thefe and fimilar articles of iron manufacture, are unparalleled in England: the trade is particularly promoted by the Staffordfhire and Worcefterfhire grand trunk, and the Birmingham canals, which unite about a mile to the N. of the town. The town is governed by two conftables, and in it are held the petty feffions for the N. and S. divifions of Seifdon hundred.

The collegiate church of St. Peter ftands on an elevation on the E. fide of the town, and confifts of a lofty nave, with fide-aifles and a chancel. From the centre of the building, which is of ftone, rifes a tower. The nave is feparated from the aifles by five pointed arches, fupported by octagonal pillars. Againft one of the S. pillars is erected a very curious ftone pulpit. The font, which is octagonal, and covered with fculptured figures, &c. appears to be very ancient. In the great chancel is a full-length ftatue, in brafs, of the celebrated admiral fir Richard Levefon, who had a command againft the Spanifh armada, under fir Francis Drake. In the church-yard ftands a round column twenty feet high, profufely but rudely carved in divifions, and the whole furmounted by a plain capital. It is evidently ancient, and may have fupported a crofs, or the figure of the patron-faint. The fituation of Wulfruna's monaftery is unknown; but in the S.W. corner of the burying-ground is a large room fupported by groins, the walls of which are three yards in thicknefs. Befides St. Peter's, Wolverhampton poffeffes another church, dedicated to St. John, which was erected by fubfcription, and confecrated in 1761. Diffenters of various denominations abound in the parifh of Wolverhampton, and comprehend more than one half of the inhabitants: chapels for their accommodation are confequently numerous. A free-fchool was founded here by fir Stephen Jennings of Wolverhampton, who was lord-mayor of London in 1668; befides which, charity-fchools are maintained for children of both fexes. Bilfton, a large and populous village two miles S.E. from the town, is within the parifh of Wolverhampton; but as to all parochial concerns it is a feparate townfhip. In 1811 Bilfton contained 1862 houfes, and the inhabitants amounted to 9646. Here is a parochial chapel, which is a neat modern ftructure: the living is a perpetual curacy within the exempt jurifdiction of the dean of Wolverhampton; but the nomination and prefentation of the incumbent are vefted in the inhabitants at large. Bilfton contains likewife two diffenting meetings, and an excellent charity-fchool. The bufinefs of Bilfton confifts chiefly of japanned and enamelled goods. The vicinity abounds in coal, iron-ftone, with numerous fmelting-furnaces and forges, &c. in which the operations are performed by fteam-engines. Bilfton furnifhes alfo a peculiar kind of fand of great ufe in cafting metals. At Bradley, near Bilfton, the fubterraneous coal has been burning for feveral years paft, and every attempt to extinguifh it has hitherto proved fruitlefs, by which feveral

ral acres of land have been rendered unproductive. The fire proceeds from a burning stratum of coal about four feet thick, and eight or ten yards deep, to which the air has free access; as the main bed of coal has been dug out from under it. In collecting the calcined substances for repairing the roads, sulphur and alum are frequently found. Tatenhill, a small village on a steep eminence two miles N. from Wolverhampton, was the scene of a severe battle between Edward the Elder and the Danes, in the beginning of the 10th century. In this place was founded, before the Norman Conquest, a college with a dean and five prebends, which subsisted till the general dissolution by Henry VIII. The present church, or chapel, is apparently a part of that establishment. At Wrottesley, a village in the parish of Wolverhampton, extensive ancient remains have been discovered, supposed, by Dr. Plott, in his History of Staffordshire, to be vestiges of the old Theotenhall of the Danes: but later antiquaries imagine these remains to belong to the Uriconium of Roman Britain. The parish of Wolverhampton, although varied with eminences, is in general level, and ornamented with a number of agreeable hamlets and country-seats.—History and Antiquities of Staffordshire, by the Rev. Stebbing Shaw, fol. Lond. 1798. Beauties of England and Wales, Staffordshire, 8vo. Lond. 1814.

WOLVES-TEETH, of a horse, are overgrown grinders, the points of which, being higher than the rest, prick the creature's tongue and gums in feeding, so as to hinder chewing of the meat.

They are seldom met with but in young horses; but if they be not daily worn by chewing, they will grow up even to pierce the roof of the mouth.

There are usually two of these wolves-teeth, which are small, and grow in the upper-jaw, next to the great grinding-teeth: these are so tender and painful, that the horse cannot chew his meat, but is forced to let a great part of it fall out of his mouth, or swallow it half chewed.

The remedy, in this case, is to tie up the horse's head to some part of the rafter, and open his mouth with a cord; then with an instrument like a carpenter's gauge, and a mallet, the teeth that are thus troublesome are to be knocked out, and the holes filled up with salt.

If the upper-jaw teeth hang over those of the under-jaw, and by that means cut the mouth, the same instrument is to be used, and the teeth are to be pared shorter by little and little. When they are sufficiently pared down, they must be filed smooth, and the mouth washed with vinegar and salt, and the whole complaint will be thus removed.

WOLVES, *Rout of*. See ROUT.

WOLVES *Islands*, in *Geography*, a cluster of small islands near the E. coast of Maine. N. lat. 45° 4′. W. long. 66° 50′.

WOLVEY, a village of England, in the county of Warwick. It was at this place that Edward IV. was surprised and taken prisoner by Richard Nevil, earl of Warwick; 10 miles N.E. of Coventry.

WOLZ. See WELS.

WOMAN, FŒMINA, *Mulier*, the female of man.

A woman, in England, as soon as she is married, with all her moveables, is wholly *in potestate viri*, or at the will and disposal of her husband.

There are divers considerable things relating to women in the laws of England, which see under WIFE.

St. Augustine calls women the *devout sex;* at least, this is the common opinion; though others rather think, that in the prayer usually attributed to that father, and still rehearsed in the Romish church to the Holy Virgin, the words "intercede pro devoto fœmineo sexu," are to be understood of women devoted or consecrated to God in religious houses; which had been sufficiently expressed by the words, "ora pro populo, interveni pro clero."

It is a popular tradition among the Mahometans, which obtains to this day, that women shall not enter paradise.

An anonymous author, about the close of the sixteenth century, published a little Latin dissertation, to prove that women are not men; that is, are not reasonable creatures: "Dissertatio perjucunda, qua anonymus probare nititur mulieres homines non esse." He also endeavours to prove, what naturally follows from this principle, *viz.* that women shall not be saved, that there is no future life or happiness for them. His proofs are all taken from Scripture, or founded on Scripture. Though, after all, his aim is not so much to degrade women to the condition of brutes, as to ridicule the principle or method of many Protestants, who, in points of controversy, admit of no proofs or considerations but what are taken from Scripture alone. This appears from the conclusion of the work. "Probavi, opinor, invictissimis SS. literarum testimoniis, mulierem non esse hominem, nec eam salvari: quod si non effeci, ostendi tamen universo mundo, quomodo hujus temporis hæretici, et præsertim Anabaptistæ, sacram soleant explicare Scripturam, et quo utantur methodo ad stabilienda sua execranda dogmata."

Yet Simon Gediccus, a Lutheran divine, wrote a serious confutation of this piece in 1595, wherein the women are restored to the expectation of heaven, on their good behaviour.

The ancient Marcionites allowed their women to baptize; as we are assured by St. Epiphanius, Hær. 42. cap. 4. the Montanists admitted women to the priesthood, and even the episcopate, Epiph. Hær. 49. cap. 2. The modern Quakers also permit their women to preach and prophesy, on an equal footing with the men.

It is a point much controverted, how far learning and study become the sex? Erasmus handles the question at large in one of his letters to Budæus. Lud. Vives, in his Institutio Fœminæ Christianæ, has a chapter expressly on the same subject. Madam Schurman, a German lady, has gone beyond them both, in a treatise on this problem, "Num fœminæ Christianæ conveniat studium literarum?"

Several of the women remarkable for learning have been also distinguished for their want of conduct. The reason, no doubt, lay in this; that their first studies lying in books of gallantry and intrigue, the imagination was early turned that way, and the memory filled with a sort of ideas, which a favourable disposition, and age, adopted too easily, and improved too fast. It is not that study in itself has any natural tendency to produce such effects; rather the contrary: the close abstracted researches of metaphysics, logics, mathematics, physics, criticism, &c. no doubt would be the surest means to secure and establish the virtue of continency in a woman.

For an account of women hired to weep at funerals by the Romans, see PRÆFICÆ.

Women were allowed to sing, in 1772, in the collegiate church of St. Gudula, at Brussels. It was in the performance of high mass on a Sunday, when a considerable number of voices and instruments were assembled in the choir; and we were glad to find among the former two or three women, who though they were not fine singers, yet their being employed, proved that female voices might have admission in the church, without giving offence or scandal to piety, or even bigotry. If the practice were to become general, of admitting women to sing the soprano part in the cathedrals,

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it would, in Italy, be a ſervice to mankind, and in the reſt of Europe render church muſic infinitely more pleaſing and perfect; in general, the want of treble voices, at leaſt of ſuch as have had ſufficient time to be poliſhed, and rendered ſteady, deſtroys the effects of the beſt compoſitions, in which, if the principal melody be feeble, nothing but the ſubordinate parts, meant only as attendants, and to enrich the harmony of the whole, can be heard.

Women, *Appeals of*. See Appeal.

Women, *Jury of*. See *Jury of* Matrons.

Women, *Stealing*, or *Seduction of*, is puniſhable by the ſtatute 4 & 5 Ph. & Mar. cap. 8. which enacts, that if any perſon above the age of fourteen unlawfully ſhall convey or take away any woman child unmarried, (which is held to extend to baſtards as well as to legitimate children,) within the age of ſixteen years, from the poſſeſſion and againſt the will of the father, mother, guardians, or governors, he ſhall be impriſoned two years, or fined at the diſcretion of the juſtices: and if he deflowers ſuch maid or woman child, or, without the conſent of parents, contracts matrimony with her, he ſhall be impriſoned five years, or fined at the diſcretion of the juſtices, and ſhe ſhall forfeit her lands to her next of kin, during the life of her ſaid huſband. But this latter part of the act is now rendered almoſt uſeleſs, by proviſions of a very different kind, which make the marriage totally void, in the ſtatute 26 Geo. II. cap. 33. See Marriage. See alſo Forcible *Abduction*, Rape, and Raviſhment.

WOMB, Matrix, or *Uterus*, in *Anatomy*, that part of the female of any kind, wherein the fœtus is conceived and nouriſhed till the time of its delivery.

The ancient Greeks called the *matrix*, μητρη, from μητηρ, *mother:* whence diſorders of the womb are ſtill frequently called *fits of the mother*. They alſo call it υστερα, as being the laſt of the entrails, by its ſituation. Sometimes they alſo call it φυσις, or *natura;* and *vulva*, from *volvo, to fold*, or *envelope*, or from *valvæ, doors*. See Uterus.

Womb, *Dropſy of the*. See Dropsy.

Womb, *Falling down of the*. See Procidentia *Uteri*.

Womb, *Inflammation of the*. See Inflammation.

Womb, *Suffocation of the*. See Suffocation.

Womb, *Ulcers of the*. See Ulcers.

Womb, in *Geography*, a town of Sweden, in the province of Skonen; 12 miles E. of Lund.

WOMBACH, a town of Germany, in the county of Rieneck; 3 miles S. of Lohr.

WOMBAT, in *Zoology*, an animal of which Mr. E. Home has given an anatomical deſcription in the 2d part of the 98th volume of the Philoſophical Tranſactions. It was brought from the iſlands in Baſſa's ſtraits, and lived with him in a domeſticated ſtate for two years. Whenever it had an opportunity, it burrowed in the ground, and covered itſelf in the earth with ſurpriſing quickneſs. It was quiet in the day, but in conſtant motion during the night; very ſenſible of cold; ate all kinds of vegetables; was particularly fond of new hay, which it ate ſtalk by ſtalk. It appeared attached to thoſe to whom it was accuſtomed, and who were kind to it. It allowed children to pull and carry it about, and when it bit them it was not in anger or with violence. It appeared to have arrived at its full growth, weighed about twenty pounds, and was about two feet two inches long. Another animal called the 'Koala,' is a ſpecies of the wombat, partaking of its peculiarities. It inhabits the foreſts of New Holland, about fifty or ſixty miles S.W. of Port Jackſon, whither it was brought in Auguſt 1803, and is called by the natives the 'koala wombat.' It is commonly about two feet long and one high; in the girth about a foot and a half: it is covered with fine ſoft fur, lead-coloured on the back and white on the belly: the ears are ſhort, erect, and pointed; the eyes generally ruminating, ſometimes fiery and menacing: it bears no ſmall reſemblance to the bear in the fore-part of its body: it has no tail; and its cuſtomary poſture is ſitting. The New Hollanders eat the fleſh of this animal; and are very dextrous in the purſuit of it, climbing with wonderful rapidity the loftieſt gum-trees in ſearch of it. The koala feeds upon the tender ſhoots of theſe trees; and during the day reſts on the tops of them, either feeding at eaſe, or ſleeping. In the night it deſcends, prowls about in ſearch of ſome particular roots, creeping rather than walking; and when incenſed or hungry, it utters a long ſhrill yell, and aſſumes a fierce and menacing look. Theſe animals are found in pairs, and the young is carried by the mother on its ſhoulders. It ſoon forms an attachment to the perſon who feeds it.

The external form of the wombat has been deſcribed by M. Geoffroy, in the 2d volume of the "Annales du Muſeum National de France;" and ſeveral parts of its internal ſtructure have been taken notice of by M. Cuvier, in his "Leçons d'Anatomie Comparé." The mechaniſm of the bones and muſcles of the hind legs differs in many reſpects from that of all other animals, except the koala. This has been minutely examined and deſcribed by Mr. Brodie, at the deſire of Mr. Home; and it appears that there is nothing ſimilar to it in the hind legs of the mole, or other burrowing animals. The internal ſtructure of the wombat reſembles that of the beaver; but it is ſo different from that of the kangaroo, and all the other animals of the opoſſum tribe, that it forms a very extraordinary peculiarity. The male and female organs of generation have been deſcribed; the former by M. Cuvier, and the latter by Mr. Bell in New South Wales. The male and female organs of the wombat and koala are ſimilar to thoſe of the opoſſum; and hence it is concluded, that theſe animals form the intermediate link between the opoſſum and kangaroo. See Didelphis.

WOMBINELLORE, in *Geography*, a town of Hindooſtan, in Baramaul. It was taken by the Britiſh, under general Meadows; 100 miles S.E. of Seringapatam. N. lat. 11° 43′. E. long. 78° 15′.

WOMBORN, a townſhip of England, in Staffordſhire; 3 miles S.W. of Wolverhampton.

WOMELSDORF, a town of Pennſylvania; 15 miles W. of Reading.

WONDA, a town of Africa, in Manding; 30 miles N.E. of Kamalia. See Manding.

Wonda, a river of Manding, which, at Fonilla, a ſmall walled village on its banks, is called Ba Woolima (red river); and towards its ſource it has the name of Ba Qui (white river); the middle part of its courſe being called Wonda.

WONDER. See Miracle.

The ſeven wonders of the world, as they are popularly called, were, the Egyptian pyramids; the mauſoleum erected by Artemiſia; the temple of Diana at Epheſus; the walls and hanging gardens of the city of Babylon; the coloſſus, or brazen image of the ſun, at Rhodes; the ſtatue of Jupiter Olympius; and the pharos, or watch-tower, of Ptolemy Philadelphus: inſtead of the latter, ſome reckon the royal palace of Cyrus, built by Menon, the ſtones of which were cemented with gold. See Pyramid.

WONDERFUL Water. See Water.

WONDRA, or Wondreb, in *Geography*, a river which riſes in Bavaria, and runs into the Egra, near Königſberg, in Bohemia.

WONDRZEGOW, a town of Bohemia, in the circle of Kaurzim; 10 miles W.S.W. of Kaurzim.

WONSDORF, a town of Pruſſia, in Natangen; 25 miles S.E. of Königſberg.

WONSIEDEL. See WUNSIEDEL.

WONTAMITTA, a town of Hindooſtan, in Myſore; 45 miles E. of Chinna Balabarum.

WOO-CHIN, a town of China, in the province of Kiang-ſi, near the lake Poyang, which is a place of conſiderable importance, as the great mart for exchanging commodities between the north and ſouth of China. The warehouſes are ſpacious and well filled, dwelling-houſes large and ſubſtantial, temples richly decorated, and the ſhops filled with articles of all kinds, including no inconſiderable proportion of European goods. Here are ſeveral ſmall bronze veſſels of ancient and modern workmanſhip, not unlike the Grecian and Etruſcan. Near it is a temple dedicated to Wang-ſhin-choo, the god of longevity, ſurpaſſing moſt others in riches of carved-work and gilding.

WOOD, WILLIAM, F.L.S., in *Biography*, a Proteſtant diſſenting miniſter of diſtinguiſhed reputation for general literature and ſcience, character, and uſefulneſs, was born at Collingtree, a village near Northampton, on May 29, O.S. 1745. His father, though occupying a humble ſtation, was a perſon of approved integrity and piety, in connection with the Chriſtian ſociety at Northampton, under the perſonal care of the juſtly-celebrated Dr. Doddridge, and paid particular attention to the religious inſtruction and moral conduct of his children. Mr. Wood, at an early age, manifeſted promiſing talents, and having finiſhed his ſchool-education under the late Dr. Addington of Market-Harborough, was introduced, at the age of 16, with a view to the miniſtry, among Proteſtant diſſenters, which was the object of his choice, to a diſſenting academy in London, conducted at the time of his admiſſion by Dr. David Jennings and Mr. (afterwards Dr.) Morton Savage, and before the cloſe of his ſtudies by Mr. Savage, Mr. A. Kippis, and Mr. A. Rees. The writer of this ſketch can bear perſonal teſtimony to his exemplary conduct during the period of his continuance at the academy, and to the diligence and ſucceſs with which he proſecuted the various branches of literature and ſcience to which his attention was directed. Few perſons ever left a public ſeminary with ſuperior qualifications for the exerciſe of the profeſſion to which he was devoted, and performed the duties of it, in the progreſs of a long and honourable life, more acceptably and more uſefully. It was then the cuſtom, admitting of few exceptions, to ordain miniſters when they were elected by particular congregations, and introduced into the full diſcharge of the paſtoral office; and ſome, we underſtand, of the wiſeſt and beſt of the Non-conformiſt miniſters have lamented the too general diſcontinuance of this decorous practice, againſt which it is thought by many that no ſufficient objection has been alleged. Ordination among Proteſtant diſſenters is a public ſervice, uſually conducted at the place where the miniſter, who is ordained or ſet apart, is about to be ſettled; and conſiſts of a ſermon addreſſed to the people, a charge delivered to the perſon ordained, and prayers for a divine bleſſing on his future labours, and for the edification and proſperity of the Chriſtian ſociety with which he is connected. It has been ſometimes accompanied with a confeſſion of faith on the part of the perſon who is thus ſet apart; but this part of the ſervice, having been miſunderſtood, is frequently omitted, though in caſes which allow of unreſtricted liberty, and in which the confeſſion neither deſcends into a variety of minute particulars, nor contains any pledges that embarraſs or reſtrain future free inquiry, it is thought to be unexceptionable. Ordination, however, among the perſons to whom we now refer, is not conceived to impart any new qualifications or powers which the perſon ordained did not poſſeſs previouſly to this ſervice, or to conſtitute him either a miniſter in general, or the paſtor of any particular church. But to return from this digreſſion: Mr. Wood was publicly ordained, and the occaſion afforded an opportunity for many miniſters of acknowledged reputation among diſſenters to bear their united teſtimony to his talents and character. He commenced his public ſervices at Debenham in Suffolk, on the 6th of July 1766, with a ſermon peculiarly appropriate to the occaſion, from Luke, ix. 26., and he ſpent the remaining part of this year, and a great part of the year 1767, in the vicinity of London, where he occaſionally officiated to the ſatisfaction of thoſe who attended, and gained the friendſhip of ſome of the moſt eminent of the diſſenting miniſters of that period. In September 1767, he ſettled at Stamford, in Lincolnſhire; and removed from thence to Ipſwich in November 1770, where he remained till the cloſe of the year 1772. In 1773, having nearly completed his 27th year, he was unanimouſly choſen to ſucceed Dr. Prieſtley at Mill-hill chapel, Leeds, and in that connection he continued till his death. About two years after his ſettlement with this congregation, he publiſhed a ſmall volume conſiſting of twelve ſermons on ſocial life, which entitled the author, in the judgment of a contemporary critic, to the character of a uſeful and elegant preacher. In 1780 he formed a matrimonial connection with a daughter of Mr. George Oates, of Low-hall, near Leeds, which laſted twenty-ſix years, and contributed in a high degree to his domeſtic felicity. By this lady he had four children, of whom three ſurvived their parents.

Ardently devoted to the ſtudies that were more immediately or more remotely connected with his profeſſion, and attached by affectionate gratitude as well as intereſt to the congregation in the ſervice of which he was engaged, and which claimed his moſt aſſiduous and reſpectful attention, he commenced for the benefit of the young a courſe of lectures, in the year 1785. Theſe were comprehenſive and improving; and though they were delivered once a fortnight, they laſted ſeveral years. Our limits will not allow us to avail ourſelves of the detail, furniſhed by his excellent biographer, of the ſubjects which were diſcuſſed in this extenſive courſe of uſeful inſtruction. It will be ſufficient to obſerve, that they contributed no leſs to the information of thoſe who attended them than to the reputation of the lecturer, as well as to the mutual reſpect and eſteem which were thus cemented between Mr. Wood and his congregation. The public would probably have derived inſtruction from the peruſal of them, if ſome circumſtances had not occurred which rendered it neceſſary for Mr. Wood to devote a conſiderable part of his time and attention to ſubjects of a very different nature. Without abandoning the ſtudies connected with his profeſſion, he was led by the ſtate of his health, and by ſome other conſiderations, to the purſuit of natural hiſtory, and particularly of Engliſh botany; but whilſt he was thus occupied, he rendered his inveſtigations ſubſervient to the great object of his life and miniſtry, the promotion of religion and virtue, as well as the perſonal ſatisfaction and future happineſs of thoſe with whom he was connected. His new purſuits were the means of introducing him to acquaintance and friendſhip with many eminent perſons; and more eſpecially with Dr. (now ſir James) Smith, the juſtly celebrated preſident of the Linnæan Society. To Mr. Wood the good opinion and friendly regard of *one*, who commands the reſpect and eſteem of all who know him, by mental accompliſhments and moral qualities of the moſt excellent and engaging kind, muſt have afforded a ſatisfaction which, as we can teſtify from perſonal know-

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ledge, he very highly appreciated. The good opinion of ſuch a judge of merit, in the department of natural hiſtory, which now engaged his attention, muſt have encouraged his aſſiduity and perſeverance. He was thus qualified for contributing ſeveral valuable articles to this Cyclopædia, in the reputation and ſucceſs of which the editor is happy to ſay he felt and expreſſed a peculiar intereſt. His contributions comprehended the botanical articles that occur, with ſome few exceptions, from the beginning of the letter B to the end of C; and the editor, who moſt ſincerely lamented his death as a pupil and a friend, as well as a coadjutor in this work, would have found it difficult to ſupply the loſs, if the kindneſs and condeſcenſion of the Linnæus of our time, for ſo, it is hoped, we may be allowed to denominate him without offending his delicacy, had not relieved his anxiety, and amply compenſated the injury which the botanical department of the Cyclopædia muſt have ſuſtained.

Mr. Wood had attained, by his talents and cultivation of them, to ſo high a rank among his brethren in that part of the country where his lot was caſt, that few public ſervices occurred in which he was not expected to be active and conſpicuous. Attached to liberty, civil and religious, from his youth, he had in his maturer years thoroughly acquainted himſelf with the genuine principles of the Britiſh conſtitution; and accordingly he took occaſion on the centenary of the Revolution, in 1788, to expreſs his conviction and feelings in two ſermons, which were afterwards publiſhed. In the three following years he took an active part in the application of the diſſenters to parliament for the repeal of the teſt and corporation acts. In 1794 he preached a funeral ſermon, on occaſion of the death of the Rev. W. Turner, of Wakefield; and in the following year be performed the ſame ſervice in conſequence of the deceaſe of the Rev. Mr. Ralph, of Halifax: the ſermons which he delivered in both caſes were publiſhed. The ſhort account of Leeds which was this year communicated to Dr. Aikin for his Hiſtory of Mancheſter deſerves to be noticed, as he took great pains in exactly aſcertaining the number of its inhabitants. About this time he commenced a courſe of education, addreſſed to young females, with a view partly to his own emolument, but principally for the benefit of thoſe who were diſpoſed to avail themſelves of his inſtruction; and indeed few perſons could be found capable of conducting ſuch a courſe with greater ſatisfaction and advantage to thoſe who attended it. His lectures occupied three years, and comprehended hiſtory, geography, natural philoſophy, grammar, the belles lettres, natural hiſtory, mental and moral philoſophy, and the evidences of natural and revealed religion. His next publication was his ſermon occaſioned by the death of the Rev. Newcome Cappe, which contained a very appropriate and juſtly-merited eulogy of his late revered friend. It was dedicated to Mrs. Cappe, who claimed from her talents and character, as well as relation to the deceaſed, a tribute of reſpect; and annexed to it ſome brief memoirs of Mr. Cappe's life. In the year 1801, Mr. Wood publiſhed a liturgy, conſiſting of five forms, for the uſe of his congregation at Mill-hill chapel, and compoſed, for the moſt part, from the ſervice of the eſtabliſhed church, the Liverpool, Shrewſbury, and other liturgies before publiſhed by the diſſenters, as well as from a ſimilar ſervice compoſed by the Rev. T. Simpſon. Of this performance it will be ſufficient to ſtate, that it was executed with judgment and taſte. On the reſtoration of peace in the year 1802, he publiſhed an animated diſcourſe, which he delivered, in the courſe of his public ſervices, on that occaſion. About this time he exerted himſelf in eſtabliſhing at York the academical inſtitution, which had for ſome years ſubſiſted at Mancheſter, and which was likely to be diſcontinued in conſequence of the reſignation of the late Rev. G. Walker, the theological tutor.

Intending, as he advanced in life, and when he had finiſhed the education of his daughter, to relinquiſh the anxiety and labour of tuition, he propoſed to engage in ſome literary undertakings. Accordingly he was a contributor, in the department of natural hiſtory, to the Annual Review; but the work which occupied his chief attention, and which afforded him the greateſt pleaſure, was the Cyclopædia already mentioned.

As a preacher, the laſt of his publications was a ſermon delivered at Birmingham, June 9, 1805, for the benefit of the Proteſtant diſſenting charity-ſchool, ſupported by the joint contributions of the two ſocieties of the old and new meeting-houſes. After his return from an excurſion in the months of July and Auguſt 1806, he was attacked by a ſevere paroxyſm of the gout, to which he had been long ſubject; and in a few days his diſorder was ſo alarming, that his recovery was not expected. As an aggravation of his diſtreſs, the affectionate partner of his life was ſeized with a diſorder, which terminated in her death. For ſome time his ſtate was ſuch, that it was prudent to conceal from him both the progreſs and termination of her diſorder. The mournful event which he had apprehended was gradually diſcloſed to him; and he received the afflictive intelligence with a degree of compoſure and reſignation, which evinced the efficacy of his religious principles, and the conſolation derived in ſuch circumſtances from Chriſtian hope. During a long illneſs, which interrupted bis public labours, and which was attended with a conſiderable expence, the ſociety with which he was connected had an opportunity of teſtifying, by ſubſtantial acts of kindneſs, the high ſenſe they entertained of his meritorious ſervices. Providence at length reſtored his health to ſuch a degree, that he was able to reſume his public labours; but they were of no long continuance. On Sunday the 27th of March 1808, he performed the uſual ſervices with an uncommon degree of animation. On the following day, however, having previouſly experienced ſymptoms of a flying gout, he was ſuddenly ſeized at dinner with a violent ſickneſs, which continued for many hours. This was ſucceeded by an inflammation of the bowels, which ſoon terminated in a mortification. The conſequence was a delirium; and on Friday, the 1ſt of April, he expired ſo quietly, that the friends who attended his bed were not apprized of the moment of his departure. Thoſe who wiſh for further information concerning the natural talents and acquired endowments, the private character and public ſervices of Mr. Wood, will be amply gratified by the peruſal of the "Memoirs of his Life and Writings," and of the "Addreſs and Sermon" delivered on occaſion of his death, by his friend and neighbour the Rev. Charles Wellbeloved of York.

Wood, Anthony, the *Oxford Antiquary*, was born at Oxford in 1632, and entered of Merton college in 1647. Having commenced M.A. and acquired a taſte for ſtudies pertaining to antiquity, he purſued with indefatigable diligence both at Oxford and in London reſearches, which furniſhed him with materials for his "Hiſtory and Antiquities of the Univerſity of Oxford," a copy of which he ſold to the univerſity in 1669 for 100*l*. It was written in Engliſh, but afterwards tranſlated into Latin, under the inſpection of Dr. Fell; and the verſion was publiſhed from the Oxford preſs in 1674, under the title of "Hiſtoria et Antiquitates Univerſitatis Oxonienſis, duobus Voluminibus comprehenſa," fol. The firſt part of this work includes the annals of the univerſity, from its earlieſt period to the year 1648; and the ſecond contains an account of all its particular foundations, endowments, officers, &c. The tranſlation is badly executed, and Wood, the original author, was deftitute of thofe qualifications that would have rendered him a fit hiftorian of a learned univerfity. Another of Wood's works was his "Athenæ Oxonienfes; or, an Account, in Englifh, of almoft all the Writers educated at Oxford, and many of thofe at the Sifter Univerfity, from the year 1500." It was firft publifhed in 1691, 2 vols. fol., and foon after fubjected him to a profecution in the vice-chancellor's court for his account of lord Clarendon, and to various other attacks, occafioned by his partialities, and more efpecially by his ftrong bias in favour of popery. His ftyle is vulgar, and his fentiments illiberal and unphilofophical; but his veracity entitles him to confidence. He died in 1695, and bequeathed his books and papers to the univerfity of Oxford. A fecond edition of this work, corrected and enlarged from the author's MS., was publifhed in 1721. Biog. Brit.

This curious and diligent antiquary, whofe whole life was fpent in the fervice of the dead, and whofe labours, fince his deceafe, have fo much facilitated the inquiries, and gratified the curiofity of the living, tells us, in the Memoirs of his Life, written by himfelf, with monaftic fimplicity, that in 1651, "he began to exercife his natural and infatiable genie to mufick. He exercifed his hand on the violin, and having a good eare to take any tune at firft hearing, he could quickly draw it out from the violin, but not with the fame tuning of ftrings that others ufed. He wanted underftanding, friends, and money, to pick him out a good mafter, otherwife he might have equalled in that inftrument, and in finging, any perfon then in the univerfity. He had fome companions that were mufical, but they wanted inftruction as well as he."

The next year, being obliged to go into the country to try to get rid of an obftinate ague, by exercife and change of air, he tells, that "while he continued there he followed the plow on well-dayes, and fometimes plowed. He learned there to ring on the fix bells, then newly put up: and having had from his moft tender yeares an extraordinary ravifhing delight in mufick, he practifed there, without the help of an inftructor, to play on the violin. It was then that he tuned his ftrings in 4ths, and not in 5ths, according to the manner; and having a good eare, and being ready to fing any tune upon hearing it once or twice, he could play it alfo in a fhort time with the faid way of tuning, which was never knowne before."

"After he had fpent the fummer in a lonifh and retired condition, he returned to Oxon. And being advifed by fome perfons, he entertained a mafter of mufick to teach him the ufual way of playing on the violin; that is, by having every ftring tuned five notes lower than the other going before. The mafter was Charles Griffith, one of the mufitians belonging to the city of Oxon., whom he then thought to be a moft excellent artift. But when Anthony Wood improved himfelf in that inftrument, he found he was not fo. He gave him 2*s.* 6*d.* entrance, and fo quarterly. This perfon, after he had extreamly wondered how he could play fo many tunes as he did by 4ths, without a director or guide, tuned his violin by 5ths, and gave him inftructions how to proceed, leaving then a leffon with him to practice againft his next coming."

In 1653, he found that "heraldry, mufick, and painting, did fo much crowd upon him, that he could not avoid them; and could never give a reafon why he fhould delight in thofe ftudies, more than in others, fo prevalent was nature, mixed with a generofity of mind, and a hatred of all that was fervile, fneaking, or advantageous for lucre fake."

"Having by 1654 obtained a proficiency in mufick, he and his companions were not without filly frolicks, not now to be maintained."—What fhould thefe frolics be, but to difguife themfelves in poor habits, and like country-fiddlers fcrape for their livings. After ftrolling about to Farringdon fair, and other places, and gaining money, victuals, and drink for their trouble, in returning home they were overtaken by certain foldiers, who forced them to play in the open field, and then left them without giving them a penny. "Moft of his companions would afterwards glory in this, but he was afhamed, and could never endure to hear of it."

By 1656, his record informs us, that "he had a genuine fkill in mufick, and frequented the weekly meetings of mufitians in the houfe of William Ellis, organift of St. John's college, fituated on that place whereon the theatre was built." Here he gives a lift of the ufual company that met and performed their parts on lutes and viols; among thefe eight were gentlemen. "The mufick-mafters were, William Ellis, bachelor of mufick, and owner of the houfe, who always played his part either on the organ or virginal. Dr. John Wilfon, the public profeffor, the beft at the lute in all England: he fometimes played on the lute, but moftly prefided (directed) the confort. —— Curteys, a lutenift, lately ejected from fome choire or cathedral church. Thomas Jackfon, a bafe-violift. Edward Low, then organift of Chrift church: he played only on the organ, fo when he played on that inftrument, Mr. Ellis would take up the counter-tenor viol, if any perfon were wanting to performe that part. Gervace Littleton *alias* Weftcot, or Weftcot *alias* Littleton, a violift. He was afterwards a finging-man of St. John's college. William Glexney, who had belonged to a choire before the war: he played well upon the bafe-viol, and fometimes fung his part. —— Proctor, a young man, and a new comer. John Packer, one of the univerfitie mufitians; but Mr. Low, a proud man, could not endure any common mufitian to come to the meeting, much lefs to play among them. Of this kind I muft rank John Hafelwood, an apothecary, a ftarched formal clifterpipe, who ufually played on the bafe-viol, and fometimes on the counter-tenor. He was very conceited of his fkill (though he had but little of it), and therefore would be ever and anon ready to take up a viol before his betters; which being obferved by all, they ufually called him Handlewood. The reft were but beginners. Proctor died foon after this time. He had been bred up by Mr. John Jenkins, the mirrour and wonder of his age for mufick, was excellent for the lyra-viol and divifion-viol, good at the treble-viol and violin, and all comprehended in a man of three or four-and-twenty yeares of age. He was much admired at the meetings, and exceedingly pitied by all the faculty for his lofs."

At this time Anthony Wood tells us, that "what by mufick, and rare books that he found in the public library, his life was a perfect *Elyfium*."

"Anthony Wood was now advifed to entertain one William James, a dancing-mafter, to inftruct him on the violin, who by fome was accounted excellent on that inftrument, and the rather becaufe, it was faid, that he had obtained his knowledge in dancing and mufick in France. He fpent in all half a yeare with him, and gained fome improvement; yet at length he found him not a compleat mafter of his facultie, as Griffith and Parker were not: and, to fay the truth, there was no compleat mafter in Oxon. for that inftrument, becaufe it had not been hitherto ufed in confort among gentlemen, only by common mufitians, who played but two parts. The gentlemen in private meetings, which Anthony Wood frequented, played three, four, and five parts with viols, as treble-viol, tenor, counter-tenor, and

bafe,

bafs, with an organ, virginal, or harpficon, joyned with them; and they efteemed a violin to be an inftrument only belonging to a common fidler, and could not endure that it fhould come among them, for feare of making their meetings to be vaine and fidling. But before the reftoration of king Charles II., and efpecially after, viols began to be out of fafhion, and only violins ufed, as treble violin, tenor, and bafe violin; and the king, according to the French mode, would have twenty-four violins playing before him, while he was at meales, as being more airie and brifk than viols."

"In the latter end of the yeare 1657, Davis Mell, the moft eminent violinift of London, and clock-maker, being in Oxon., Peter Pitt, William Bull, Kenelm Digby, and others of All Soules, as alfo Anthony Wood, did give a very handfome entertainment in the taverne called the 'Salutation.' The company did look on Mr. Mell to have a prodigious hand on the violin, and they thought that no perfon, as all in London did, could goe beyond him."

By connecting the fcattered fragments of this zealous Diletante's life, which concern mufic, we fhall be able to form an idea of the ftate of the art, not only at Oxford, but in every other part of the kingdom where it was more fecretly practifed during the latter part of the Ufurpation.

Under the year 1658, Anthony Wood tells us, that "he entertained two eminent mufitians of London, named John Gamble and Thomas Pratt, after they had entertained him with moft excellent mufick at the meeting-houfe of William Ellis. Gamble had obtained a great name among the people of Oxon. for his book of 'Ayres and Dialoges to be fung to the Theorbo, or Bafe-viol.' The other for feveral compofitions, which they played in their conforts."

He then gives an account of the arrival of Baltzar, a wonderful performer on the violin, from Lubec, arriving at Oxford, and deftroying, by his great fuperiority of hand, all the little vanities, not only of the beft fiddle-players of the univerfity, but of others from London, who had long enjoyed the reputation of great performers. See BALTZAR.

Anthony Wood purfues his mufical records, and tells us, that "all the time he could fpare from his beloved ftudies of Englifh hiftory, antiquities, heraldry, and genealogies, he fpent in the moft delightful facultie of mufick, inftrumental or vocal; and if he had miffed the weekly meetings in the houfe of William Ellis, he could not well enjoy himfelf all the week after. Of all or moft of the company, when he frequented that meeting, the names are fet downe under the year 1656. As for thofe that came in after, and were now performers, and with whom Anthony Wood frequently played, were thefe: Charles Perot, M.A. fellow of Oriel college, a well-bred gentleman, and a perfon of a fweet nature; Chriftopher Harrifon, M.A. fellow of Queen's college, a maggot-headed perfon, and humourous; Kenelm Digby, fellow of All Soule's college, he was afterwards Dr. of L., he was a violinift, and the two former violifts; William Bull, M.A. for the viol and violin; John Vincent, M.A. a violift; Sylvanus Taylor, fellow of All Soule's college, violift and fongfter, his elder brother, captain Silas Taylor, was a compofer of mufick, played and fung his parts; Henry Langley, M.A. a violift and fongfter; Samuel Woodford, M.A. a violift; Francis Parry, M.A. a violift and fongfter; Chriftopher Coward, and Henry Bridgman, both mafters of arts; Nathan Crew, M.A. a violinift and violift, but alwaies played out of tune, as having no good eare, he was afterwards bifhop of Durham; Matthew Hutton, M.A. an excellent violift; Thomas Ken of New college, afterwards bifhop of Bath and Wells, he would be fometimes among them and fing his part; Chriftopher Jefferyes, a junior ftudent of Chrift church, excellent at the organ and virginals, or harpficon, having been trained up to thofe inftruments by his father George Jefferyes, organift to king Charles I. at Oxon.; Richard Rhodes, another junior ftudent of Chrift church, a confident Weftmonafterian, a violinift to hold between his knees."

"Thefe did frequent the weekly meetings, and by the help of publick mafters of mufick, who were mixed with them, they were much improved. Narciffus Marfh would come fometimes among them, but feldom played, becaufe he had a weekly meeting in his chamber, where mafters of mufick would come, and fome of the company before-mentioned. When he became principal of St. Alban's hall, he tranflated the meeting thither, and there it continued, when that meeting at Mr. Ellis's houfe was given over, and fo it continued till he went over to Ireland, where he became afterwards archbifhop of Tuam.

"After his majefty's reftoration, when the mafters of mufick were reftored to their feveral places that they before had loft, or gotten other preferment, the weekly meetings at Mr. Ellis's houfe began to decay, becaufe they were only held up by fcholars who wanted directors and inftructors. So that thefe meetings were not continued above two or three yeares, and I think they did not go beyond 1662."

Our Oxford annalift terminates his account of the mufical tranfactions of that univerfity, during the interregnum, by the following anecdote.

"In October 1659, James Quin, M.A. and one of the fenior ftudents of Chrift church, a Middlefex man borne, but fon of Walter Quin, of Dublin, died in a crazed condition. Anthony Wood had fome acquaintance with him, and hath feveral times heard him fing with great admiration. His voice was a bafs, and he had a great command of it. 'Twas very ftrong and exceeding trouling, but he wanted fkill, and could fcarce fing in confort. He had been turned out of his ftudent's place by the vifitors; but being well acquainted with fome great men of thofe times, that loved mufick, they introduced him into the company of Oliver Cromwell, the protector, who loved a good voice and inftrumental mufick well. He heard him fing with very great delight, liquored him with fack, and in conclufion faid, 'Mr. Quin, you have done very well, what fhall I do for you?' To which Quin made anfwer with great compliments, of which he had command with a great grace, that 'your highnefs would be pleafed to reftore him to his ftudent's place;' which he did accordingly, and fo kept it to his dying day."

If this minute and indifcriminate antiquary and biographer is fometimes thought to want tafte and felection fufficient to give his records due weight, it muft be afcribed to the conftant habit he was in of journalizing, collecting anecdotes, and making memorandums of every perfon, tranfaction, and circumftance, that arrived at his knowledge, in the uncouth and antiquated language of his early youth. For this dialect being inelegant and vulgar, even when he learned it, renders his writings frequently ridiculous, though they contain fuch information as can be nowhere elfe obtained. But the few opportunities he had of knowing the gradual changes in our colloquial dialect, by converfing with men of the world, or even the language of elegant books by his favourite courfe of reading, degrade him to a level with writers infinitely his inferiors both in ufe and entertainment. An excellent apology has been made for his imperfections by the editor of his life, written by himfelf, and publifhed in 1772; which is fo interefting, that he muft be an incurious inquirer, indeed, who, having dipped into it, is not fufficiently fafcinated by the original fimplicity of the ftyle and importance

of

of many of the anecdotes, to give it an entire perufal before he lays it down. Anthony Wood was credulous, and perhaps too much an enthufiaft in mufic to fpeak of its effects with critical and philofophical precifion ; however, without his affiftance, the ftate of the art at Oxford, and the academical honours beftowed on its profeffors, as well as memorials of their lives and works, would have been difficult to find. Upon his decifions in matters of tafte, we are not always perhaps implicitly to rely. The high character he has given Dr. Wilfon's productions and abilities may have proceeded from want of experience, knowledge, and penetration into the finer parts of the art ; and as to Dr. Rogers, his judgment of him feems to have been manifeftly warped by friendfhip. Yet, upon the whole, it muft be allowed that it is only from fuch minute records as thofe of Anthony Wood that any true and fatisfactory knowledge can be acquired of the characters, manners, and domeftic occurrences of our anceftors. The great features of hiftory, and the events which occafion the ruin or profperity of a ftate, muft be nearly the fame in every age and country ; but comforts, conveniences, and the diftreffes of private life, furnifh the mind with reflections far more varied and interefting to the generality of mankind, than the rife of ftates or downfall of kings and heroes.

Wood, ——, a performer on the violin, who led the band many years at the theatre in Covent Garden, and father of —— Wood, his fucceffor in that orcheftra, organift of St. Giles's, and of Chelfea college. They were both active profeffors ; but though performers only of the fecond clafs, they conftantly ranked themfelves of the firft. Burney.

Wood, in *Vegetable Anatomy*, is that more or lefs hard and compact fubftance, which makes up the bulk of the trunk and branches of a tree or fhrub, and is concealed from view by the bark. When cut tranfverfely, the wood is found to confift of numerous concentric layers, very diftinct in the fir, and the trees of cold or temperate countries in general ; lefs fo in thofe appropriated to a tropical climate. The external part of each circular layer being much the moft hard and compact, often with fomewhat of a horny appearance, diftinguifhes the limits of each. Scarcely any two layers of the fame tree are precifely alike, in the proportion which this compact part bears to the reft ; nor does any one layer exhibit a precife uniformity of diameter in its whole circle. On the contrary, each layer is broader on that fide of a tree where the expofure has been moft favourable to its growth, where, confequently, there have been more branches and leaves, fo as to yield a greater depofit of woody matter. Hence the layers being all, for the moft part, broadeft on one fide of a tree, their aggregate difproportion throws the common centre, or pith, very much out of the actual centre of the trunk. It having been remarked in felling trees, that the greateft breadth of the concentric circles is very often on their fouth fide, a rule has been propofed for travellers to afcertain thereby the direction of the compafs. But travellers muft be ftrangely at a lofs, if they could find no eafier method of judging. Nor is the mode in queftion infallible. It would indeed fhew on which fide the growth of each particular tree had been moft favourable, whether from its expofure, or the nature of the foil which its roots had met with ; but this may not always be towards the fouth. We muft ftay to fell great part of a foreft, to form a precife opinion ; and the procefs would be, as it were,

"—— to tell what hour o' the day,
The clock did ftrike—by algebra."

The number of thefe concentric layers, in any tree, if it be found to the heart, very correctly demonftrates the number of years the trunk has been growing. This is a general opinion, and undoubtedly correct, provided the layers are well marked. The obferver muft be aware that each annual layer is compofed of a great number of thinner and fcarcely diftinguifhable ones, which occafionally affume a more confpicuous appearance than ufual, in confequence of fluctuating feafons, or any accidental checks in the growth of a tree, as hard winters render the outfide, or horny part, of each circle, more decided ; while favourable fummers make the circle itfelf altogether broader. But there is always a fufficient diftinction between fummer and winter, beyond the tropics, to eftablifh the above rule. Ever-greens, for the moft part, and trees of hot countries, exhibit flighter traces of thefe concentric layers ; but they may be difcerned in every mahogany table. Monocotyledonous plants have been faid to be entirely without any fuch annular ftructure. But there is no reafon why they fhould neceffarily be fo. Mr. Salifbury once demonftrated this ftructure to us in a *Dracæna ;* and its abfence in palms and ferns is to be attributed to a peculiar mode of depofiting wood in thefe plants, rather than to their being monocotyledonous. What has been faid already under the articles Circulation *of Sap*, and Cortex, will fufficiently explain this. As the inner furface of the bark depofits the matter of the wood, it muft lie in concentric circles ; and in proportion as this operation goes on more conftantly and uniformly, thefe layers muft be the more homogeneous and uninterrupted. Perennial roots of herbaceous plants often exhibit concentric circles, of annular formation, even in hot climates, as may be feen in Jalap. Each circle, no doubt, marks the increafe which has taken place in each fucceffive feafon ; and while the herb is not growing, nothing is added to the root.

The theory of vegetation, as explained in the articles juft cited, fhews the reafon of the fpiral-coated veffels being found in the young wood only, and not in the bark. Thofe veffels, formerly fuppofed to contain air alone, are the real arteries of the plant, and convey its fap, or blood, through the wood, to be returned through the bark, where it depofits particular fecretions. This theory alfo explains why the *alburnum*, as being the layer of unhardened wood for the prefent year, is tender, and even a mere jelly, at one period. But the bark is in the fpring of the year, before the depofit of wood begins, moft readily ftripped from the tree ; though it alfo readily, and without harm to the tree, comes off in winter, while vegetation is at a ftand.

We fcarcely need here detail the experiments of Du Hamel, to determine whether the wood forms the bark, or the reverfe. Thin metallic plates introduced between thefe two parts, and carefully bound up, fhewed, after a few feafons, when the branch thus treated was cut acrofs, that the bark had depofited layers of wood on the outfide of thefe foreign fubftances, with little or no prejudice to the growth of the plant. But Dr. Hope's experiment (fee Cortex) is ftill more ftrikingly decifive. The Linnæan hypothefis, that the pith added a layer every year to the wood internally, is thus entirely fet afide. Indeed nothing but a preconceived theory, of the great importance of the pith, and its analogy to the medullary or nervous fyftem of animals, (for the fupport of which opinion arguments are not wanting,) could have led to fo erroneous a conclufion. It is fufficient to remark, what indeed could not efcape the intelligent author of this hypothefis, that trees grow vigoroufly, though their heart is is become rotten by age, when the pith, with numerous adjoining layers of wood, have long ſince been obliterated.

A tranſverſe ſection of the wood of a tree diſplays various veſſels, and other parts, which microſcopic authors take delight in exhibiting; but, without a ſcientific explanation, little is to be learned from their plates, however beautiful to the eye. Siliceous petrifactions, of oak-wood eſpecially, fine ſpecimens of which are brought from Hungary, ſhew its vaſcular ſtructure in the greateſt perfection. In the ſections to which we have juſt alluded, the pith, with its highly cellular texture, makes a conſpicuous appearance in the centre. In the body of the wood, the ſap-veſſels are generally the largeſt and moſt numerous. Theſe, when young and tender, eaſily diſplay their ſpiral coats, if pulled aſunder longitudinally; but are not found at all in the bark. Among them, in the reſinous trees like the fir, or any that abound with ſecreted fluids, as the fig, much larger veſſels are interſperſed through the wood and bark, in which the peculiar ſecretions are lodged. But beſides the determinate and continued concentric layers of wood above-deſcribed, numerous thin plates are interſperſed, known to workmen, eſpecially in oak-wood, by the name of the SILVER GRAIN. (See that article.) Mr. Knight, who is there quoted, further remarks, that if a board of Engliſh oak be cut for a floor, in ſuch a direction, that the *laminæ* of the ſilver grain lie parallel with the ſurface of the board, it is rarely or never ſeen, when properly laid, to deviate from its true horizontal poſition. But a board ſawed, on the contrary, acroſs the ſilver grain, "will, during many years, be incapable of bearing changes of temperature, and of moiſture, without being warped; nor will the ſtrength of numerous nails be ſufficient entirely to prevent the inconvenience thence ariſing. That ſurface of a board of this kind which grew neareſt the centre of the tree, will always ſhew a tendency to become convex, and the oppoſite one concave, if placed in a ſituation where both ſides are equally expoſed to heat and moiſture." *Knight*, *Phil. Tranſ. for* 1801, 345. This writer adds, that the ſmall clefts in the ſurface of an oak-tree, ſtripped of its bark, and expoſed to the ſun and air, are cauſed by the plates of the ſilver grain having parted from each other. They will long continue to open and cloſe again with the changes of the weather. In the middle of a dry day they are open, but much leſs ſo during the night. After long expoſure to the air and light, wood loſes this property. *Knight* as above.

A different degree of hardneſs, and in ſome trees a remarkable difference of colour, exiſts between a number of the external concentric layers of the wood, and about as many or more of thoſe next the centre. Theſe latter are called the heart of the timber; the former the ſap or *alburnum;* but theſe are vulgar appellations, and the latter eſpecially are improper. The true *alburnum* is the layer of new unhardened wood of the preſent year, which alſo workmen often term the ſap. The SAP, properly ſo called, is the fluid from which all their ſecretions, and even the wood itſelf, are formed. (See that article.) Thoſe who uſe wood for mechanical purpoſes are well aware of the above difference between its different parts, however incorrect the names by which they are diſtinguiſhed. The ſofter external layers have little durability in compariſon with the heart. They retain more of the vital principle, and more of the peculiar juices of the plant in a fluctuating condition, liable to be acted upon by external or internal cauſes, and not yet united, in a fixed ſtate, to the ſolid body of the old wood. This change, however, is not limited in any particular kind of tree to a determinate period in the age of each layer of its wood, nor even to any determinate ſeries of the concentric circles of any individual tree. It often extends to a greater number of rings on one ſide than on another. The more vigour there is in a tree, or in any ſide or portion of its trunk, the ſooner is the *alburnum*, to uſe its popular denomination, made perfect wood, or heart.

The term wood, philoſophically ſpeaking, is not confined to the ſubſtance of a tree. The central part of a root, diſtinguiſhed from its bark, is the wood, and in many perennial roots conſiſts, as we have already mentioned, of ſeveral diſtinct layers. In a carrot, the yellow part is the wood, encompaſſed by a thick reddiſh bark. In a turnip, the woody part is of ample dimenſions, while the bark is thin.

A moſt remarkable difference exiſts between the ſolidity of the wood in ſome trees and in others. Some wood is ſo heavy as to ſink in water; ſome is as light as cork, or even lighter. In general, wood of different trees, of the ſame natural order, poſſeſſes ſimilar properties and the ſame degree of value. But there is often, in the ſame genus, a moſt remarkable difference between the fitneſs of the wood of different ſpecies, for particular purpoſes. The oaks (ſee QUERCUS) abundantly exemplify this fact. The very hard and ponderous timber of *Q. Ilex*, the live oak, however laſting in a dry ſituation, is ſo prone to deſtruction when expoſed to wet, as to be among the moſt worthleſs in the world; its hardineſs and heavineſs only rendering it the leſs fit for uſe, where it would be likely to endure. On the other hand, many of this genus afford timber more or leſs uſeful in every circumſtance and ſituation, among which our Engliſh *Q. Robur* ſtands pre-eminent. See TIMBER.

All kinds of wood are to be preſerved from the worm, and from many other occaſions of decay, by oily ſubſtances, particularly the eſſential oils of vegetables. Oil of ſpike is excellent, and oil of juniper, turpentine, or any other of this kind, will ſerve the purpoſe; theſe will preſerve tables, inſtruments, &c. from being eaten to pieces by theſe vermin, and linſeed-oil will ſerve in many caſes to the ſame purpoſe; probably nut-oil will do alſo, and this is a ſweeter oil, and a better varniſh for wood.

The ingenious Dr. Hales, whoſe attention was uniformly directed to ſchemes of domeſtic or national benefit, was induced by the great damage done to ſhipping by worms to propoſe various methods for preventing it. Oily, unctuous materials, he apprehends, are not likely to penetrate deep into oak, which has a watery ſap; but oil is known to penetrate far into fir, and to give it a very conſiderable degree of toughneſs. He therefore propoſes to mix with oil applied to the fir-boards with which ſhips are ſheathed ſome ingredient that is diſagreeable to the worms; and he apprehends that a ſmall proportion of verdigriſe uſed in the operation of paying would be of great ſervice: or if copper-filings were mixed with the paying, ſea-water would turn them into verdigriſe. It might be uſeful to ſoak planks in water ſtrongly impregnated with verdigriſe.

Mr. Reid recommends the trial of the acid juice of tar, prepared either with copperas or ochre, for preſerving ſhips either from rotting or worms.

In the Eaſt Indies, it is ſaid, they have an effectual way of preventing worms from deſtroying their ſhips, by paying them firſt with a mixture of muſtard, oil, and lime of ſhells, and hog's blood: they then ſheath the ſhip, and renew it after ſome years.

The following receipt has been recommended by a perſon who never knew it fail of ſucceſs. Take 100 lbs. of the fineſt

fineſt pitch ; melt it over a ſlow fire of coal, and add to it, when melted, 30 lbs. of rolled brimſtone groſsly bruiſed, and boil the whole till 30 lbs. are waſted. The matter thus prepared muſt be kept in caſks in a dry place ; and when it is to be uſed, melt 100 lbs. of it, and add gradually 35 lbs. of brick-duſt or marble-duſt, ſifted and well heated. The compoſition, when uſed, muſt be very hot, and the boards dry.

An ingenious ſhip-builder obſerves, that turpentine and brimſtone form the beſt compoſition he has met with, and comes home from a voyage with leaſt damage.

Eaſt India ſhips are firſt ſheathed, and that ſheathing is filled with ſmall broad-headed nails, which is a ſafe and effectual defence from the worms, and ſoon becomes a continued cake of ruſt, and not liable to be damaged by cables, or common accidents. See Pay and Ships.

The following, ſays Dr. Hales, is an approved method of preſerving the boards and timber of out-door work : *viz.* melt 6 lbs. of pitch, and add, by ſifting, 1 lb. of dried brown Spaniſh, or whiting, and a quart of linſeed oil. Hales's Ventilators, part i. p. 164. part ii. p. 289, &c.

Dr. Lewis obſerves, that though tar has been uſed for preſerving wood, and alſo for coating common tiles, in imitation of the black glazed tiles, which are ſold at a much higher price, both tar and pitch are of themſelves too ſoft for theſe intentions, being liable to be melted off by the ſummer heat : and, therefore, different powdery ſubſtances, as aſhes, ochres, and other mineral pigments, have been mixed with them.

In the Swediſh Tranſactions for 1740 and 1742, two compoſitions are recommended, which are ſaid to be firm, durable, and gloſſy. One is prepared by melting the tar over a gentle fire, ſo as to make it fluid, but not to boil, and ſtirring in as much coal-duſt or powdered charcoal as will render it thick : the other is prepared by mixing the melted tar with a ſufficient quantity of lamp-black. Coatings formed of theſe mixtures are, however, liable to be conſiderably ſoftened by the heat of the ſun. The mixture of powdered pit-coal and melted tar, made of ſuch a conſiſtence as to be freely ſpread while warm with a bruſh, is leſs liable to ſoften than either of the other two. The tar obtained from coal, in the method lately diſcovered by the earl of Dundonald, appears from various teſtimonies of thoſe who have tried it to be much better calculated to preſerve wood and iron, as well on land as in water, than vegetable tar. It has alſo this peculiar advantage, that it will not admit or harbour thoſe worms that are ſo injurious to the bottoms of ſhips at ſea. See an Account of the Qualities and Uſes of Coal and Coal-varniſh, &c. by the Earl of Dundonald, 8vo. 1785.

Mr. Parkes recommends, for the preſervation of wood, the tar which is obtained from the pyroligneous acid. See Tar.

Dr. Lewis obſerves, that the coating or painting of wood does not in all caſes contribute to its preſervation : unleſs the wood be very thoroughly dry, eſpecially thoſe kinds of wood whoſe juices are not oily or reſinous, the painting, by confining the watery ſap, haſtens the corruption. Com. Phil. Techn. p. 363, &c. On this ſubject, ſee Timber.

Some of the Weſt India trees afford a ſort of timber which, if it would anſwer in point of ſize, would have great advantages over any of the European wood, in ſhip-building for the merchant-ſervice, no worm ever touching this timber. The acajou, or tree which produces the caſhew-nut, is of this kind ; and there is a tree of Jamaica, known by the name of the *white-wood*, which has exactly the ſame property, and ſo have many other of their trees. Phil. Tranſ. N° 36.

To ſeaſon wood expeditiouſly for ſea-ſervice, it has been uſual to bake it in ovens.

The art of moulding wood is mentioned by Mr. Boyle as a deſideratum in the art of carving. He ſays he had been credibly informed of its having been practiſed at the Hague ; and ſuſpects that it might have been performed by ſome menſtruum that ſoftens the wood, and afterwards allows it to harden again, in the manner that tortoiſe-ſhell is moulded. Or, perhaps, by reducing the wood into a powder, and then uniting it into a maſs with ſtrong but thin glue. And he adds, that having mixed ſaw-duſt with a fine glue made of iſinglaſs, ſlightly ſtraining out what was ſuperfluous through a piece of linen, the remainder, formed into a ball and dried, became ſo hard as to rebound when thrown againſt the floor. Works abr. vol. i. p. 130. See Glue.

The people who work much in wood, and that about ſmall works, find a very ſurpriſing difference in it, according to the different ſeaſons at which the tree was cut down, and that not regularly the ſame in regard to all ſpecies, but different in regard to each. The button-mould makers find that the wood of the pear-tree, cut in ſummer, works tougheſt ; holly, on the contrary, works tougheſt when cut in winter ; box is melloweſt when it has been cut in ſummer, but hardeſt when cut about Eaſter ; hawthorn works mellow when cut about October, and the ſervice is always tough if cut in ſummer. Merret's Notes on Neri, p. 263.

It is a very well-known quality of metals to be longer and larger when hot, and ſhorter and ſmaller when cold ; a thouſand experiments prove this, and the books of experimental philoſophy have ſufficiently expatiated upon it ; on the contrary, it is found to be the property of wood, that it is longeſt in cold weather and ſhorteſt in hot ; this change is owing to the remains of the ſap yet in the wood, which being condenſed by cold, is enlarged in its ſurface, as all liquors are, when frozen into ice ; and ſhrinks into a leſs ſpace or bulk again, when liquated by heat.

It follows from this that all wood muſt change its ſurface more or leſs, according as it contains more or leſs ſap, and this may be made a teſt of great uſe for the determining what kinds of wood have moſt, and what leaſt ſap. This would be a very valuable piece of knowledge, ſince there are many uſes for which that ſort of wood muſt always ſerve beſt, which has the ſmalleſt quantity of ſap remaining in it. See Hygroscope.

Thus, in the great article of preſerving flour, no barrels are at preſent uſed but thoſe of ſeaſoned dry oak ; the whole advantage of this wood is, that it contains leſs ſap than others ; for the ſap in the wood makes the flour damp, and it then becomes rancid, and breeds worms. (See Meal.) So that if any other wood can by this means be found out to contain leſs ſap, when dried in the common way, than oak does, it will be ſo much the better for this purpoſe ; or, if a cheaper wood ſhould be found only to contain as little ſap as the oak, it would do as well, and the price of oak would be ſaved in theſe veſſels.

A proper way of trying when the ſap was ſufficiently exhaled out of trees, might alſo be found by this experiment, and much benefit would accrue from it ; for our ſhips, when made of timber not ſufficiently dried, prove injurious to the health of people on board ; and it has been remarked, both by the French and ourſelves, that many more men in general die in the firſt voyage of a new ſhip than in the ſame time in an old one ; and indeed the firſt ſix months are uſually obſerved

ſerved in this caſe to be moſt fatal. The exhalation of the ſap from the wood of the veſſel is certainly the occaſion of this, and if it could be contrived to have this ſap properly exhaled before the timber was uſed, it would not only prevent this mortality among the men, but the veſſel itſelf would be the ſounder and the better for it. Deſlandes, Trait. de Phyſ.

Woods are diſtinguiſhed into divers kinds, with regard to their natures, properties, virtues, and uſes. Of wood, conſidered according to its qualities, whether uſeful, curious, medicinal, &c. the principal is that called timber, uſed in building houſes, laying floors, roofs, machines, &c. See TIMBER.

Woods valued on account of their curioſity are, *cedar*, *ebony*, *mahogany*, *walnut-tree*, *box*, *calambo*, &c. which, by reaſon of their extraordinary hardneſs, agreeable ſmell, or beautiful poliſh or grain, are made into cabinets, tables, combs, beads, &c.

The *medicinal woods* are, *guaiac*, which the Spaniards call *ligno ſancto*; *aloes*, or *agallochum*; *ſaſſafras*, *nephriticum*, *ſantal*, *logwood*, *aſpalathum*, *eagle-wood*, or *pao d'aquilo*, &c.

Woods uſed in dyeing are, the *Indian wood*, *Braſil*, *Campeche*, &c.

In extracting the colouring-matter of dye-woods, and in making ſome other colours for the uſe of calico-printers, Mr. Parkes obſerves (Chem. Eſſ. vol. ii.), that it is of great conſequence to heat the veſſels by ſteam; for by this method of preparing decoctions, the workmen are prevented from ever giving the materials a greater heat than that of 212°; and the injury which was formerly done by the burning of the groſſer matters at the bottom and ſides of the copper is avoided. Several manufacturers, ſays this ingenious chemiſt, have now adopted this method. This leads us to take notice of a beneficial application of charcoal, as a ſlow conductor of caloric, for preſerving an equable temperature. Ground charcoal, it is ſaid, will conduct heat more ſlowly than even dry ſand, in the proportion, according to Guyton, of three to two. Accordingly, all thoſe veſſels which are heated by ſteam, if they were made double, and the ſpace between the inner and outer veſſel filled with ground charcoal, the heat would be ſo prevented from eſcaping, that any given temperature might be maintained for a long time, and thus there would be a material ſaving in the article of fuel. Moreover, when churches or other large buildings are to be warmed by ſteam, thoſe parts of the conducting-pipes which are not within the buildings ſhould be always ſurrounded in this manner, and then no heat could eſcape until it had been conveyed to the ſpace which it was intended to warm by it. Thus alſo in the manufactories of ſtarch, paper, gunpowder, blue, and a variety of other articles, every part of the apparatus for drying theſe by ſteam, and which is not actually within the drying-rooms, ought to be ſecured in the ſame way. The common ſteam-working apparatus, and other culinary utenſils, would be much improved by being fitted with double covers, and by filling up the intermediate ſpaces with carbonaceous matter. Moreover, by ſecuring the conducting-pipes in this manner, buildings might be effectually warmed, and proceſſes conducted at any diſtance from the boiler, as ſteam is the moſt faithful carrier of heat that can poſſibly be; for it cannot depoſit it on any bodies that have already acquired the temperature of 212°. It is alſo this non-conducting property of charcoal that renders it ſo common, ſays Fourcroy, cited by Parkes, in France as a material for coating furnaces, and for confining the heat, to which uſe its incombuſtible nature adapts it in a peculiar manner, as it is the moſt refractory body that is known, provided it be excluded from oxygen. Charcoal is applicable to other purpoſes in domeſtic economy; ſuch as the preſerving of animal food from taint, by covering it with a few pieces of freſh-burnt charcoal, and the recovery of it by boiling it for ſome minutes in water with a few ounces of ſuch charcoal. By the ſame means, molaſſes or treacle may be deprived of its diſagreeable taſte, ſo that it might be uſed inſtead of ſugar. A patent has likewiſe been taken out for refining ſugar by means of charcoal by M. Cronſtat, who required for it, of the joint body of ſugar-bakers in London, a remuneration of 50,000*l.*; and Mr. Parkes apprehends, that in a ſmall concern of this kind eſtabliſhed in the metropolis, which manufactures double loaves of a finer quality than thoſe of any other houſe, the purpoſe is effected by the ſame means. The empyreumatic flavour acquired by ſome brandies in diſtillation may be removed, ſays the ingenious writer now cited, by digeſting them in charcoal; and common malt-vinegar, boiled on charcoal, becomes colourleſs, without loſing its ſtrength. Water, which in long voyages acquires a diſagreeable taſte and ſmell from long ſtanding in the wooden caſks, may be purified by filtration through ground charcoal; or it may be kept ſweet in caſks that have been charred withinſide.

For the above-mentioned purpoſes, the charcoal ſhould be freſh made, or heated red-hot under a cover of ſand, immediately before it is uſed; and the requiſite quantity ſhould be previouſly aſcertained by experiment. In ſome caſes, it ſhould be uſed in the form of powder, having been pounded immediately from the fire, before it has been expoſed to the air, and the reſidue ſhould be preſerved for future uſe in bottles cloſely ſtopped. For other uſes to which charcoal is applied, ſee CHARCOAL and CARBON.

Wood uſed for fuel is required of various kinds, in regard to the various works to be performed by it.

Neri every where commends oak for the wood to be burnt in the glaſs-houſes, as the propereſt wood for making a ſtrong and durable fire with a good flame.

Imperato, on the contrary, commends aſh on the ſame occaſion; becauſe, as he ſays, it gives a ſubſtantial rather than a great flame: and Camerarius deſervedly commends juniper wood, as affording a laſting, ſtrong, and ſweet fire, could plenty of it be had. Among the ancients, Pliny commends light dry wood; and Plutarch, the tamariſk in particular, for making the glaſs-houſe fires; but glaſs-making requires ſo great a fire, as cannot be eaſily made from ſuch wood. Nor can aſh be proper, becauſe, though it gives a good fire, it ſoon decays. Merret's Notes on Neri, p. 275.

If wood be burnt in the open air, the greateſt part of it will be diſſipated in gas. Common oak, properly charred, will loſe only from $\frac{2}{3}$ds to $\frac{7}{10}$ths of its weight; whereas, if the ſame kind of wood be burnt in an open fire-place, the reſiduum of the combuſtion will not be more than about $\frac{1}{50}$th, or $\frac{1}{75}$th of the original weight of the wood employed. Dr. Watſon ſays, that he obtained 22 grains of charcoal from 96 of dry oak: others have given different reſults. From Neumann (Chem. vol. ii.) we learn, that for the reduction of the metallic oxyds, the charcoal of the heavier woods, *e. g.* that of the oak and beech, is preferable; and that, for common fuel, ſuch charcoal gives the greateſt heat, and requires the moſt plentiful ſupply of air to keep it burning, while thoſe of the lighter woods preſerve a glowing heat with a much leſs draught of air; and that for purpoſes which require a ſteady and ſtill fire, charcoal made from wood previouſly diveſted of its bark ſhould be employed, as it is the cortical part which crackles and flies off

off in ſparks during combuſtion, which the coal of the wood itſelf ſeldom does. The charcoal of wood is ſaid to be eſſential to the perfection of bar-iron; but when wood became ſcarce, and government reſtricted its uſe, cinders and coke were ſubſtituted for it; and thus the quality of Engliſh iron was ſo much debaſed, that Ruſſian and Swediſh iron, which is prepared by means of the coal of wood, are employed by thoſe who work in this metal. The ſuperiority of the iron made with charcoal is attributed by M. Haſſenfratz to its combination with potaſſium. It was by 1 Eliz. c. 15. that it was enacted, that no oak, beech, or aſh-timber, one foot ſquare at the ſtub, ſhould be converted into charcoal for making iron in any part of England or Wales, except in the county of Suſſex, the weald of Kent, and certain pariſhes in the county of Surrey. This reſtriction led to the practice of making bar-iron with the coke of pit-coal, the method of preparing which was kept a ſecret from the generality of the trade. When Mr. Henry Horne publiſhed his "Eſſays on Iron and Steel," in the year 1773, he gave directions for a better method than they had before known of charring pit-coal, ſo as to make it a proper ſuccedaneum for wood-charcoal in the manufacture of iron. Since that time the coke of pit-coal has come into very general uſe, ſo that the conſumption of this ſubſtance is now very conſiderable. (See Coke.) Crayons of charcoal are beſt made of the willow; whereas the coals of the hard woods, ſuch as box and guaiacum, are much harder than others, whilſt the charcoal of the kernels of fruits is quite ſoft and friable. As a pigment, the coal of ivory, or that which is procured by burning real ivory in cloſed veſſels, is the moſt intenſely black, and the moſt beautiful. The beſt charcoal for uſe as a powder for cleaning the teeth is made from the ſhell of the cocoa-nut. The difference between the charcoals of animal and vegetable ſubſtances may be determined by the following teſt. A vegetable coal will burn on a red-hot iron into white aſhes, which will be readily diſſolved by ſulphuric acid into a bitteriſh liquor; whilſt the aſhes of animal ſubſtances are little affected by that acid, and form with it a compound with a very different taſte. (See Ashes, Carbon, Charcoal, and Gun-*Powder*.) For the method of charring wood, ſee Timber and Charring *of Poſts*. This appears to have been a very ancient practice. The piles that formed the foundations of the Temple of Diana at Epheſus, not long ſince taken up, appeared to have been charred; and about fifty years ago ſome oak-ſtakes were found in the bed of the Thames in the very ſpot where Tacitus ſays that the Britons fixed a number of ſuch ſtakes, to prevent the paſſage of Cæſar's army; and theſe ſtakes, which were charred to a conſiderable depth, had completely retained their form, and were firm at the heart. About ſixty years ago one of the timbers that ſupported Trajan's bridge over the Danube, near Belgrade, was taken up, and the outer part, to the depth of half an inch, was found to be converted into an agate, the inner parts being ſlightly petrified, and the central being ſtill perfect wood, though this timber had been in the water 1700 years. (See Kirwan's Geological Eſſays, cited by Parkes in his Eſſays, vol. ii.) Many other inſtances occur of wood petrified and converted, more or leſs, into agates of various colours. Writers on this ſubject have recommended the practice of charring every piece of wood before it is placed in the ground. Dr. Watſon, (late biſhop of Landaff,) in his "Chemical Eſſays," vol. iii. ſuggeſts the propriety of charring all the wood that is uſed in mines and ſubterraneous drains, and particularly that which covers troughs, through which a current of water paſſes, and which rot in a few years by the alternate change of wet and dry. In this connection we may add, on the authority of Chaptal, in his "Chemiſtry applied to the Arts," that when old cheſnut and other trees are rotted within the trunk, and threatened with ſpeedy deſtruction by the progreſs of the carious trunk, it may be ſtopped by applying fire to the decayed part, ſo as to char the whole of the neighbouring ſurfaces.

Wood, in *Gardening*, is a term uſed to ſignify the ſhoots or branches left in fruit-trees. See Pruning, &c.

Wood, an epithet applied to various ſorts of weeds. See Weed.

Wood *and Bark of Trees*, *Canker or Eroſion of*, in *Agriculture* and *Gardening*, a diſeaſed ſtate in theſe parts of them. It has been ſtated by a late philoſophical writer, that the cauſe ſeems to be an exceſs of alkaline and earthy matter in the deſcending ſap, as he often found carbonate of lime on the edges of the canker in apple-trees; and that ulmin, which contains fixed alkali, is abundant in the canker of the elm. The old age of a tree, in this reſpect, is, it is thought, faintly analogous to the old age of animals, in which the ſecretions of ſolid bony matter are always in exceſs, and the tendency to oſſification great.

It is ſuggeſted, that perhaps the application of a weak acid to the diſeaſed part might be of uſe; or that where the tree is of great value, it might be watered occaſionally. See Canker.

Wood, *Lignin?* in *Chemiſtry*, the ſubſtance which conſtitutes the baſis of wood uſually ſo called.

To obtain this ſubſtance in a ſtate of purity, it is neceſſary to digeſt wood in a ſufficient quantity of water and afterwards of alcohol, by which means all foreign ſubſtances ſoluble in theſe fluids will be removed; the ſimple *woody fibre* will thus remain, which poſſeſſes the following properties.

It is compoſed, in general, of longitudinal fibres eaſily ſeparable from one another. Theſe fibres, when very much ſubdivided, become ſomewhat tranſparent. They have no ſmell nor taſte, and are not altered by expoſure to the atmoſphere.

The woody fibre is inſoluble in water and alcohol. It is ſoluble in a weak alkaline ſolution without being decompoſed, and may be again ſeparated by an acid. Concentrated alkaline ſolutions render it brown, and decompoſe it, eſpecially when aſſiſted by heat.

When heated it becomes black without melting, exhales ſtrong acrid fumes, and leaves a charcoal, retaining exactly the form of the original maſs. When diſtilled in cloſe veſſels it yields an acid liquor, of a peculiar taſte and ſmell, called the *pyroligneous acid*, and which was properly conſidered as a diſtinct acid. Fourcroy and Vauquelin, however, long ago demonſtrated, that it conſiſts of nothing but the acetic acid combined with an empyreumatic oil. (See Acetous and Pyroligneous *Acid*.) Pure acetic acid is now prepared from wood both in this country and France.

The fibre of different woods has been analyſed by Gay Luſſac and Thenard by means of the oxymuriate of potaſh. The following are the reſults:

	Oak.	Beech.	Mean.
Oxygen	41.78	42.73	42.25
Carbon -	52.53	51.45	52.00
Hydrogen	5.69	5.82	5.75
	100.00	100.00	100.00

Wood when burnt with a ſmothered flame leaves, as is well

well known, a quantity of charcoal behind. The following is the proportion yielded by one hundred parts of different woods, according to the experiments of Prouſt:

Black aſh - - -	25
Guaiacum - - -	24
Pine - - - -	20
Green oak - - -	20
Heart of oak - - -	19
Wild aſh - - -	17
White aſh - - -	17

Count Rumford, by continuing a very moderate fire for ninety-ſix hours, procured much larger proportions of charcoal from different woods than were obtained in the above experiments of Prouſt. According to this chemiſt, one hundred parts of different wood yielded,

Poplar - - -	43.57
Lime - - -	43.59
Fir - - - -	44.18
Maple - - -	42.23
Elm - - -	43.27
Oak - - -	43.00

The woody fibre, when completely burnt, always leaves a certain proportion of earthy and ſaline matters, which conſtitute the *aſhes* of wood. Different woods yield very different proportions of aſhes. See Ashes and Charcoal, where other experiments by Mr. Muſhet on this ſubject are related.

The following Table exhibits the quantity of aſhes left by different woods, according to Sauſſure junior. Sauſſure has extended the inveſtigation to herbaceous and other plants; but we have omitted theſe, from their not being immediately connected with the preſent ſubject. See Carbon.

Table of Incinerations.				Conſtituents of 100 Parts of Aſhes.					
Names of Plants.	Aſhes from 1000 Parts of the Plant.		Water from 1000 Parts of the Plant. Green.	Soluble Salts.	Earthy Phoſphates	Earthy Carbonates	Silica.	Metallic Oxyds.	Loſs.
	Green.	Dry.							
Wood of a young oak, May 10 -	—	4	—	26.	28.5	12.25	0.12	1.0	32.58
Bark of ditto - - - - -	—	60	—	7.	4.5	63.25	0.25	1.75	22.75
Perfect wood of oak - - -	—	2	—	38.6	4.5	32.0	2.0	2.25	20.65
Albumum of ditto - - - - -	—	4	—	32.0	24.0	11.0	7.5	2.0	23.5
Wood of black poplar, Sept. 12 -	—	8	26	—	16.75	27.0	3.3	1.5	24.5
Bark of ditto - - - - - -	—	72	—	6.0	5.3	60.0	4.0	1.5	23.2
Wood of hazel, May 1 - - -	—	5	—	24.5	35.0	8.0	0.25	0.12	32.2
Bark of ditto - - - - - -	—	62	—	12.5	5.5	54.0	0.25	1.75	26.0
Perfect wood of mulberry, November	—	7	—	21.0	2.25	56.0	0.12	0.25	20.38
Albumum of ditto - - - - -	—	13	—	26.0	27.25	24.0	1.0	0.25	21.5
Bark of ditto - - - - - -	—	89	—	7.0	8.5	45.0	15.25	1.12	23.13
Perfect wood of hornbeam, November	4	6	346	22.0	23.0	26.0	0.12	2.25	26.63
Albumum of ditto - - - - -	4	7	390	18.0	36.0	15.0	1.0	1.0	29.0
Bark of ditto - - - - - -	88	134	346	4.5	4.5	59.0	1.5	0.12	30.38
Wood of horſe-cheſnut, May 10 -	—	35	—	9.5					

See Dr. Thomſon's Syſtem of Chemiſtry, vol. iv. 5th edit.

Wood, *On making Bread from*. Profeſſor Autenrieth, of Tubingen, has lately attempted to make bread from wood, and his experiments ſeem to have been attended with conſiderable ſucceſs. He had been led to form the opinion that the woody fibre was only rendered unfit for food from the foreign ſubſtances uſually attached to it, and from its compact aggregation. The firſt of theſe difficulties he attempted to obviate, by ſelecting thoſe woods which have little taſte and ſmell, and which conſequently contain leſs foreign matters; ſuch, for example, are the birch and beech, eſpecially the birch, which was the wood he chiefly employed in his experiments.

To render wood alimentary, it is neceſſary to reduce it to a ſtate of extremely minute diviſion, or abſolute powder. It alſo requires the repeated action of the heat of an oven, by which means it is not only better fitted for being ground, but probably alſo undergoes ſome internal change which renders it more digeſtible, as is evidently the caſe in regard to coffee. Wood prepared in this way acquires the ſmell and taſte of corn-flour. It is, however, never white, but always yellowiſh. It alſo agrees with corn-flour in requiring the addition of ſome leaven, to enable it to undergo the fermentative proceſs, and the ſour leaven of corn-flour is found to anſwer the beſt. With this it makes a perfectly uniform and ſpongy bread, like common brown bread; and when it is thoroughly baked, and has much cruſt, it has a much better taſte of bread than what in times of ſcarcity is prepared of bran and huſks of corn.

To make wood-flour in perfection, the wood, after being thoroughly ſtripped of its bark, is to be ſawed tranſverſely into diſks of about an inch in diameter. The ſaw-duſt is to be preſerved, and the diſks to be beaten to fibres in a pounding-mill. The fibres and ſaw-duſt mixed together are next to be deprived of every thing harſh and bitter, and which is ſoluble in water, by boiling them in a large quantity of water when fuel is abundant, or by ſubjecting them for a longer time to the action of cold water, as by placing them in a rivulet, for example, encloſed in a ſack. The whole is then to be completely dried, either by the ſun or fire, and repeatedly ground in a flour-mill till it paſs through the boulting-cloth.

The ground wood is next to be baked into ſmall flat cakes, with water rendered ſlightly mucilaginous by the addition of ſome decoction of linſeed, or any other ſimilar ſubſtance. Profeſſor Autenrieth prefers marſh-mallow roots, of of which one ounce renders eighteen quarts of water fufficiently mucilaginous, and thefe ferve to form four pounds and a half of wood-flour into cakes. Thefe cakes are to be baked in an oven until they are quite dry, and become of a brownifh-yellow colour on the furface. After this they are to be broken to pieces, and again ground repeatedly, until the flour pafs through a fine boulting-cloth, and upon the finenefs of the flour does its fitnefs to make bread depend. The flour of a foft wood, fuch as birch, will be fufficiently prepared by the procefs as defcribed; but the flour of a hard wood will require the fteps of baking and grinding to be repeated.

That the wood thus prepared is altered in its nature and rendered foluble, is proved by the quantity of real ftarch that is obtained from it by the fame procefs, by which it is feparated from wheat-flour. If wood-flour tied up in fine linen be long kneaded in a veffel of water, the water is rendered milky, and depofits flowly a quantity of ftarch, which with boiling water forms a thick, tough, trembling, tenacious jelly, like that of wheat-ftarch, and it is only neceffary to fee this ftarch to be convinced that the wood-flour is foluble and nutritious. This ftarch cannot be afcribed to the mucilaginous matter added to the ground wood before it is baked, as the added mucilage does not amount to more than the one-hundred and forty-fifth part of the wood, whereas the wood-flour lofes about half its weight by the feparation of the ftarch. The refiduum left in the linen feems to be the woody fibres unchanged, which have not been ground fufficiently fine.

Wood-flour does not ferment fo readily as wheaten-flour; but profeffor Autenrieth found fifteen pounds of birch-wood flour, with three pounds of four wheat leaven, and two pounds of wheat-flour, mixed up with eight meafures of new-milk, yielded thirty-fix pounds of very good bread. The beft mode of preparing it was to mix up the five pounds of wheat leaven and flour with a portion of the wood-flour and milk to a preparatory dough; let it ftand for fome hours in a moderately warm place to rife, and then to knead in thoroughly the reft of the wood-flour and milk. This dough is rolled out into thin cakes, allowed to ftand in a warm place to rife for a longer time than wheat-flour requires, and laftly to be put into the oven and baked thoroughly.

Profeffor Autenrieth made many experiments upon animals, as well as upon himfelf and family, in order to afcertain the nutritious properties of wood-flour, in the various forms of foup, dumplings, cakes, &c.; and he found that it was not only very palatable in all thefe forms (efpecially when combined with milk or fome fatty fubftances), but alfo fufficiently nutritious, and that it did not diforder the digeftive organs, or apparently produce any other ill effects.

From thefe experiments, it is obvious, fays the writer from whom we have made thefe extracts, that in cafes of neceffity wood may be made to furnifh a confiderable quantity of nourifhment; but it is no lefs obvious, that the procefs is fo troublefome and expenfive, that it never can become an article of food, except where there is an abfolute fcarcity of provifions. On fuch occafions the labour is of very fecondary importance, and at any rate cannot be fo profitably applied as in procuring the means of fubfiftence.

In fome diftricts of Norway and Lapland, the bark of the fir is manufactured into a fpecies of bread, apparently much inferior in quality to the bread of wood-flour, and this with dried fifh and a little rein-deer tallow conftitute the chief articles of food among the lower claffes, during the protracted and rigorous winter of thefe inhofpitable climates. See Von Buch's Travels in Norway and Lapland.

Wood, *Diftillation of.* See Charcoal, Colour, Gun-*Powder*, Pyroligneous *Acid*, and Wood *fupra.*

Wood, *Tenacity and Strength of.* See Cohesion and Strength *of Materials.*

Wood *and Wood*, a term in fhip-building, implying that when a tree-nail, &c. is driven through, its point is directly even with the infide furface, whether plank or timber.

Wood, *Cord*, denotes wood for the fire, generally the branches or loppings of trees, piled up in order. See Cord.

Wood, *Foffil, Subterraneous.* There are divers places where wood is found under ground: fuppofed to have been overturned, and buried there from the time of the Deluge, or at fome other period.

Whole trees, or parts of them, are very frequently found buried in the earth, and that in different ftrata; fometimes in ftone, but more ufually in earth; and fometimes in fmall pieces loofe among gravel. Thefe, according to the time they have lain in the earth, or the matter they have lain among and in the way of, are found differently altered from their original ftate; fome of them having fuffered very little change, and others being fo highly impregnated with cryftalline, fparry, pyritical, or other extraneous matter, as to appear mere maffes of ftone or lumps of the common matter of the pyrites, &c. of the dimenfions, and more or lefs of the internal figure of the vegetable bodies, into the pores of which they have made their way.

The foffil wood, which we find at this day, may, according to thefe differences, be ranged into three kinds: 1. The lefs altered. 2. The pyritical. And, 3. The petrified.

Of the trees or parts of them lefs altered from their original ftate, the greateft ftore is found in digging to fmall depths in bogs, and among what is called peat or turf-earth, a fubftance ufed in many parts of the kingdom for fuel. In fome places there are whole trees fcarcely altered except in colour; the oaks in particular being ufually turned to a jetty black: the pines and firs remain as inflammable as ever, and often contain between the bark and wood a plain refin. Parts of trees have been alfo found unaltered in the ftrata of clay and loam, among gravel, and fometimes even in folid ftone. See *Foffil* Plants, and *Bog* Wood.

It is idle to imagine, that thefe have been thus buried either at the Creation, or, as many are fond of believing, at the univerfal Deluge: at the firft of thefe times the ftrata muft have been formed before trees were yet in being, and the peat wood is fo far from being of antediluvian date, that much of it is well known to have been growing within thefe three hundred years, in the very places where it is now found buried. See Morass.

The fubftances that are more altered are the larger and longer branches of trees found bedded in the ftrata of ftone, and partly affuming its nature; and the fhorter and fmaller branches found in pits of blue clay, which externally bear the refemblance of what they once were, but, having their pores filled with the matter of the common vitriolic pyrites, internally appear to be maffes of that matter.

The irregular maffes or fragments of wood are principally of oak, and moft ufually found among gravel, but varioufly altered by the infinuation of cryftalline and ftrong particles. Thefe make a beautiful figure when cut and polifhed, as they commonly keep the regular grain of the wood, and fhew the feveral circles which mark the different years growth. Thefe, according to the different matter which has filled their pores, affume various colours, and the appearance of the various foffils that have impregnated them. Of thefe fome pieces have been found with every pore filled

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with pure pellucid cryſtal, and others in large maſſes, part of which is wholly petrified, and ſome mere ſtone, while the reſt is crumbly and unaltered wood.

All theſe pieces of petrified wood are uſually capable of a high and elegant poliſh. Hill.

Wood has been found in ſalt-mines, incloſed in a maſs of hard ſalt, and its pores filled with the matter of the ſalt in which it lay. Wood has likewiſe been found converted as it were into iron, or thoroughly impregnated with the particles of this metal. Act. Erud. ann. 1710.

Wood, *Petrified*. The opinions of the judicious part of the world have been very different in regard to the bodies preſerved in the cabinets of the curious, under the name of petrified wood; ſome affirming theſe bodies to have been only pebbles, or flints accidentally formed in this ſhape, and with veins reſembling thoſe of the wood; and others affirming with equal warmth, that they have been really wood, into which ſtony matter has been brought by water.

Many ſubſtances, it is certain, have been preſerved in the cabinets of collectors, under the title of petrified wood, which have very little right to that name. But where the whole outer figure of the wood, the exact lineaments of the bark, or the fibroſe and fiſtular texture of the ſtriæ, and the veſtiges of the utriculi and tracheæ or air-veſſels are yet remaining, and the ſeveral circles yet viſible, which denoted the ſeveral years growth of the tree, none can deny ſuch ſubſtances to be real foſſil wood.

Many good arguments have been produced on both ſides the queſtion, but M. De la Hire has attempted to bring the diſpute to a certain concluſion, by means of ſome peculiarly happy ſpecimens, which were of the palm-tree petrified, found in the deſarts of Africa: theſe on comparing them with pieces of the palm-tree cut out of the recent wood, appeared to have every where the beautiful and regular veins of that wood, and left no room to doubt but that they certainly had been once the vegetating wood of that tree, though now converted into hard ſtone; the petrified pieces were perfect ſtone, in all its qualities; they had its hardneſs, its ſound when ſtruck upon, and were, as many other ſtones are, opake in ſome places, and tranſparent in others; they were found on weighing them to be often of the ſpecific gravity of recent pieces of the palm wood of the ſame dimenſions.

Father Duchat alſo, an author of unqueſtioned credit, affirms, from his own perſonal knowledge, that in the kingdom of Ava there is a river whoſe waters petrify recent wood into flint; and that he has often ſeen trees ſtanding in it, whoſe bottom part, ſo far as covered with the water, has been true flint, while all above was mere dry wood, and fit for firing. Mem. Acad. Par. 1692.

Wood, *Shining*. There are a great many things in which a piece of rotten wood that ſhines in the dark agrees with a burning coal; and there are alſo many things in which they differ. They agree in theſe particulars: 1. They have light reſiding in them, and are not like bodies which are only luminous according to the quantity of light which falls upon them from other bodies, and which they reflect. 2. Both ſhining wood and burning coals require the preſence of the air to keep them ſhining, and both require alſo an air of a conſiderable denſity; and both having been deprived of their ſhining quality by the pumping out of the air, will recover it again on the admitting of freſh air to them. 3. Both of them will eaſily be quenched by putting them into water, and many other liquors. And, 4. As a live coal will not be extinguiſhed by any coldneſs of the air, neither will the ſhining wood be deprived of its light on any additional coldneſs in that element.

However, they differ in the following particulars: 1. A burning coal is eaſily put out by compreſſion, the treading on it and ſqueezing it together readily diveſting it of its light; on the other hand, compreſſion or cruſhing of any kind ſeems not to have any effect upon the ſhining wood; its bruiſed parts ſhining as brightly as its entire ones. If a piece of this ſhining wood be ſqueezed between two glaſſes, this experiment will be moſt fairly tried; and in this caſe, though the contexture of the whole be evidently broken, and the parts ſeparated, the light is as ſtrong in them as while the piece was entire. 2. A burning coal extinguiſhed by the drawing out of the air will, after a few minutes, be irrecoverable, on the admiſſion of air in any manner; but, on the contrary, the ſhining wood, when thus extinguiſhed and kept extinct for half an hour, will be immediately re-kindled on admitting the air to it. 3. A live coal, included in a ſmall glaſs, will continue ſhining but a few minutes; but a piece of ſhining wood, in the ſame circumſtances, will continue bright for ſeveral days. 4. The coal, while it burns, ſends forth ſmoke and other exhalations; the rotten wood ſends out none, and conſequently a coal all the while that it is ſhining waſtes itſelf at a great rate; but the rotten wood does not waſte itſelf at all. And finally, the burning coal is actually and vehemently hot; the rotten wood, though it ſhines, is not ſo much as warm. Phil. Tranſ. N° 32.

The light of ſhining fleſh and fiſh, when putrefied, is wholly of the ſame nature with that of rotten wood, as to its dependence on the air for its ſplendour; and in the ſame manner loſes its light in the exhauſted receiver, and regains it on the admiſſion of the air into it again, in the ſame ſudden manner. Phil. Tranſ. N° 31. See Light, and Putrefaction.

Wood, *Bog*, or *Subterraneous*, a name given by the inhabitants of many parts of this kingdom to ſuch wood as is found buried in the earth in boggy places, and which is found hard and ſtrong at this time. See *Foſſil* Wood *ſupra*.

We have in the Philoſophical Tranſactions (N° 275. p. 983, &c.) an account of vaſt quantities of this ſort of wood found under ground in Hatfield Chace. Many of the roots and bodies of trees are found there; which are of all growths, and are moſtly ſuch trees as are the growth of our own ſoil, ſuch as oaks, firs, birch, beech, yew, holly, willow, aſh, and the like. The roots of all theſe trees ſtand in their natural poſitions as when growing, and ſtand as thick together as they could grow in a foreſt. The bodies are uſually broken off, and laid all along juſt by them.

The large trees are uſually found fallen in a north-eaſt direction, and the ſmaller ones lying all ways; the fir-tree or pitch-tree is more common than any other kind, and is found ſometimes of twenty, thirty, and thirty-five yards long, and ſo ſound and firm that many of them have been ſold to make maſts for ſhips. Oaks have been found of the ſame length, though wanting ſome yards of their natural tops; theſe have been ſold at ten or fifteen pounds a piece, and are as black as ebony, and very ſound and laſting in whatever ſervice they are put to. The aſh-trees do not preſerve their firmneſs in this manner, many of them are ſo ſoft that the workman's ſpade cuts through them; and when expoſed to the air, they uſually fall to pieces; but the willows, though a much ſofter wood than the aſh, preſerve their texture, and are found very ſtrong and firm. In ſome of the fir-trees it is very obſervable, that they have ſhot

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outſide branches after they were fallen, which have grown into large trees. Many of theſe foſſil-trees appear plainly to have been burnt; the fir-trees are particularly very common in this ſtate: and of theſe ſome are burnt quite through, others only on one ſide. Some of theſe alſo have been found with the plain marks of human work upon them; many with their branches chopt off, and their trunks cut into two or three pieces. Some ſquared and others in part cleft, and the wooden wedges uſed in cleaving them are ſtill found remaining in the cracks. Stones are found in ſome of them in the place of wooden wedges, but in none iron ones. The heads of axes are alſo ſometimes found; they are of a ſtrange form, and ſomewhat repreſent the ſacrificing axes of the ancients. Theſe are found at ſuch depths, that it is impoſſible they ſhould have ever been lodged there ſince the time of this place's being a foreſt; nor ever could have been found, but by means of the ground's being drained by a late invention. The general opinion as to theſe trees is, that they were buried in this manner at the time of the univerſal Deluge; but they are plainly of later origin as foſſils, the coins of ſome of the Roman emperors having been found buried under them.

The earth of bogs is not the only ſoil that preſerves theſe trees; for in the low parts of Lincolnſhire, between the towns of Burningham and Brumley, there are ſeveral large hills compoſed only of looſe ſand, and as this blows away there are continually diſcovered whole trees, or parts of trees, and particularly the roots and ſtumps of firs, and ſome other kinds, all with the marks of the axe upon them, and looking as freſh as if done but yeſterday. Under theſe hills, and in the bogs before-mentioned, not only the wood of the fir-tree, but its cones are found in immenſe number; many buſhels being often laid in a heap together. In cutting a drain for a river of a conſiderable depth, there were found at the very bottom ſeveral parcels of cut wood, in poles, beams, and the like; the head of an axe was alſo found ſomewhat reſembling the ancient battle-axe, and a coin of the Roman emperor Veſpaſian; but what was yet more remarkable was, that what they were now ſunk to ſeemed to be the original ſurface, the ground not being looſe, like all above it, but ſound and firm, and lying in ridges and furrows, with the evident marks of having formerly been ploughed. So that all the bog-earth above ſeems plainly to have been added ſince; and that the foſſil wood, ſuppoſed of antediluvian origin, is but of the time of the ancient Romans, or leſs than that.

All the bogs in this kingdom afford in like manner foſſil-trees; and not only thoſe, but other places, have at all times accidentally diſcovered them. Giraldus Cambrenſis tells us, that ſo long ſince as in king Henry the Second's time, the ſands on the ſhores of Pembrokeſhire were driven off by peculiar ſtorms and tempeſts, and that deep under thoſe ſands there were then diſcovered great numbers of the roots and bodies of trees in their natural poſtures; and many of theſe had the ſtrokes of the axe upon them, the marks at that time remaining as plain as when firſt made. Some of theſe reſembled ebony; and many other ſuch trees were diſcovered at Neugall in the ſame county, in the year 1590. Camden tells us of ſuch wood found in the bogs in Somerſetſhire, Cheſhire, Lancaſhire, Weſtmoreland, Yorkſhire, Staffordſhire, and Lincolnſhire; and ſince his time many other counties have been found to be as fruitful in it. Dr. Plot mentions them in many parts of his Hiſtory of Staffordſhire, and by their ſtanding in their natural poſtures, as to the roots at leaſt, properly concludes, that they certainly once grew there, and were not brought from elſewhere.

Dr. Leigh, in his Hiſtory of Lancaſhire, gives an account of the ſame ſort of trees found in the draining of the boggy lands at Martin-Meer; and determines them not to have been of the ancient date many pretend, in referring them to the Deluge.

He obſerves, that they are plainly of no older date than the time of the ſavage inhabitants of England, about the time of the Roman conqueſts; for in this place, beſide the roots and bodies of trees and their fruit, there were found eight canoes, or ſmall boats, ſuch as the wild inhabitants uſed at that time. And in another moor in the ſame county, a braſs kettle, with a ſmall mill-ſtone, and ſome beads of wrought amber. In the ſame place were alſo found ſeveral human bodies whole and entire, at leaſt to outward appearance, and the whole head of an hippopotamus, or river-horſe. This is perhaps the hardeſt thing to be accounted for of the whole ſet, as to its coming there. The boggy places in Angleſea, and the Iſle of Man, are all full of buried trees of the ſame kind; and the bogs of Ireland abound no leſs with them. England, and its adjacent iſlands, are not the only places where this buried wood is found; for Verſtegan tells us, that the moors in the Netherlands abound with them; they all lie north-eaſt, as our's do. Helmont alſo mentions the Peel there, a moraſs of eight or nine miles broad, which is full of them. The French naturaliſts tell us of foſſil-trees alſo in their country; and in Switzerland and Savoy; but all in the low grounds.

Ramazzini tells us, that in the territories of Modena, which are now a dry and fruitful country, yet in the time of the Cæſars were only a great lake, there are found at the depth of thirty, forty, and even fifty feet, the ſoil of a low marſhy country, with ſedges, water-graſs, and other marſh-weeds; and under this there lie the trunks of trees, and their roots ſtand near them in as natural a poſture as when growing. Many old coins of the Roman emperors are alſo found there; as alſo ſeveral buſts, wrought marble, and ſquared ſtones, evidently ſhewing the work of ſuch tools as the Romans have been known to uſe. Some of the trees in theſe places ſtand upright. See more on this ſubject under the article MORASS.

WOOD, *Cutting of.* See CUTTING.

WOOD, *Meaſure of.* See MEASURE.

WOOD, *Stack of.* See STACK.

WOOD, *Staining of.* See DYEING *of Wood*, &c.

Wood may be ſtained yellow, by bruſhing it over ſeveral times with the tincture of turmeric root, made by putting an ounce of the powdered root to a pint of ſpirit, and after it has ſtood ſome days, ſtraining off the tincture. A redder caſt may be given to the colour by adding a little dragon's blood. A cheaper, and leſs bright and ſtrong yellow may be given to wood by rubbing it over ſeveral times with the tincture of French berries, made boiling hot; and when the wood is dry, bruſhing it over with a weak alum-water uſed cold.

In order to render theſe ſtains more beautiful and durable, the wood ſhould be bruſhed after it is coloured, and then varniſhed with the ſeed-lac varniſh, or with three or four coats of ſhell-lac varniſh.

For a bright red ſtain for wood, make a ſtrong infuſion of Braſil in ſtale urine, or water impregnated with pearl-aſhes in the proportion of an ounce to a gallon; to a gallon of either of which add a pound of the Braſil wood. With this infuſion, after it has ſtood, with frequent ſtirring, two or three days, ſtrained and made boiling hot, bruſh the wood over till it appears ſtrongly coloured; and while it is wet, bruſh it over with alum-

 water

water made in the proportion of two ounces of alum to a quart of water.

For a lefs bright red, brufh over the wood with a tincture made by diffolving an ounce of dragon's blood in a pint of fpirit of wine.

For a pink or rofe red, add to a gallon of the above infufion of Brafil wood two ounces of pearl-afhes, and ufe it as before: obferving to brufh the wood over often with the alum-water. Thefe reds may be varnifhed as the yellows.

Wood may be ftained blue by means either of copper or indigo. The brighter blue may be obtained by brufhing a folution of copper (fee VERDITER), while hot, feveral times over the wood: and then brufhing a folution of pearl-afhes in the proportion of two ounces to a pint of water hot over the wood. It is ftained blue with indigo, by brufhing it with the indigo prepared with foap-lees as when ufed by the dyers, boiling hot; and then with a folution of white tartar or cream of tartar, made by boiling three ounces of either in a quart of water, brufhing over the wood plentifully before the tincture of indigo be quite dry. Thefe blues may be brufhed and varnifhed as the reds, if neceffary.

Wood may be ftained green by diffolving verdigrife in vinegar, or the cryftals of verdigrife in water, and with the hot folution brufhing over the wood till it be duly ftained.

A light red-brown mahogany colour may be given to wood by means of a decoction of madder and fuftic wood, ground in water, in the proportion of half a pound of madder and a quarter of a pound of fuftic to a gallon, or, inftead of the fuftic, an ounce of the yellow berries may be ufed. Brufh over the wood with this folution, while boiling hot, till the due colour be obtained. The fame effect may to a confiderable degree be produced by the tincture of dragon's blood and turmeric root, in fpirit of wine.

For the dark mahogany, take the infufion of madder as above, and fubftitute for the fuftic two ounces of logwood: and when the wood has been brufhed over feveral times, and is dry, brufh it over flightly with water in which pearl-afhes have been diffolved, in the proportion of about a quarter of an ounce to a quart. The wood, in the better kind of work, fhould be afterwards varnifhed with three or four coats of feed-lac varnifh; but for coarfe work, with the varnifh of refin and feed-lac, or they may be well rubbed over with drying oil.

Wood may be ftained purple by brufhing it over feveral times with a ftrong decoction of logwood and Brafil, made in the proportion of one pound of the logwood and a quarter of a pound of the Brafil, to a gallon of water, and boiled for one hour or more. Let the wood, well coloured, dry, and be then flightly paffed over by a folution of one drachm of pearl-afhes in a quart of water. A folution of gold in fpirit of falt or aqua regia will give a durable purple ftain to wood.

For a deep black the wood is brufhed over four or five times with a warm decoction of logwood, made as above without the Brafil, and afterwards as often with a decoction of galls, made by putting a quarter of a pound of powdered galls to two quarts of water, allowing it to dry thoroughly between the feveral applications of the liquors: thus prepared, it receives a fine deep black colour, from being wafhed over with a folution of vitriol in the proportion of two ounces to a quart: in the room of which fome ufe a folution of iron in vinegar, keeping the vinegar for this purpofe upon a quantity of the filings of the metal, and pouring off a little as it is wanted. A pretty good black is alfo obtained, more expeditioufly, by brufhing over the wood, firft with the logwood liquor, and afterwards with common ink.

A very fine black may be produced by brufhing the wood feveral times over with a folution of copper in aqua fortis, and afterwards with the decoction of logwood, repeated till the colour be of fufficient force, and the greennefs produced by the copper overcome. The blacks may be varnifhed as the other colours.

Where the ftains are defired to be very ftrong, as in the cafe of wood ufed for fineering, it is generally neceffary it fhould be foaked, and not brufhed; for which purpofe the wood may be cut into pieces of a proper thicknefs for inlaying. Lewis's Phil. Com. Techn. p. 97. 434. Handmaid to the Arts, vol. i. p. 508, &c.

WOOD, *Stealing of*. See LARCENY.

WOOD, *Engraving on*. See WOOD-ENGRAVING, *infra*.

WOOD, *Painting on*. See PAINTING.

WOOD, *Sculpture in*. See SCULPTURE.

WOOD, *Sylva*, in *Geography*, a multitude of trees, extended over a large continued tract of land, and propagated by nature, or without culture.

Many great woods only confift of trees of one kind. At Cape Verd, in Africa, are woods of orange and lemon trees; in Ceylon, are woods of cinnamon-trees; in the Molucca iflands, woods of clove-trees; in the iflands of Nero, Lontour, Lofgain, &c. woods of nutmeg-trees; in Brafil, woods of Brafil-trees, &c.; in Numidia, woods of date-trees; in Madagafcar, woods of tamarind-trees, &c.

WOOD-*Afhes*, in *Agriculture*, the afhes which are formed by burning wood.

The afhes of fome forts of wood, too, are found to be more powerful as a manure than thofe of others, as thofe from the afh and fome other fuch trees.

It is faid by fome that they are an excellent dreffing for improving cold wet pafture land; and that poor hungry paftures have been very profitably benefited by them, to near double their former value; that nothing equals them on low fpongy pafture land. Others, however, have tried them on grafs-lands with little or no effect.

The difference in the burning and forming of them may probably caufe this difference in the effects which they have on land.

WOOD-*Bound*, a term ufed to fignify fuch land as is encumbered with tall woody hedge-rows, fo as to prevent the free circulation of air and admiffion of the fun, by which the natural fertility and ftrength of it cannot be fully exerted or brought into action. See WOOD-*Land*.

WOOD-*Coppices*. In the firft raifing of coppices, two things are to be confidered; firft, the nature of the foil, that fuch trees may be planted in it as will thrive well there; and fecondly, the ufes that the wood is intended to be fold for, that fuch kinds may be planted as will be moft proper for thofe ufes.

If the principal vent for wood be for the fire, the beft trees for fire-wood muft be planted, fuch as the oak, beech, hornbeam, or other hard wood. Thefe are the moft profitable for felling as fire-wood, and one or more of thefe grow in any foil.

If there be a demand in the country where the coppice is to be planted for hoops and hop-poles, then the afh, the chefnut, the oak, alder, and hazel, are to be planted.

According

According to the profits of the underwood, the thicknefs of the ftandard-trees is to be regulated; for as they ftand more or lefs thick, they more or lefs injure the underwood. It is alfo to be confidered at what growth the underwood is to be fold. The taller and larger the underwood of a coppice in general is, the more profitable will it be for firing, and all other ufes, and the ftandards will be the better for its being left to grow to a proper height, for their bodies will be always, unlefs very great accidents occur, carried up ftraight as far as they are fhaded by the coppice-wood.

A deep foil makes the fhrubs as well as trees grow more vigoroufly than any other, and they will be fooner fit for cutting in fuch places. The perfon who owns thefe woods muft contrive to cut down only a certain quantity of them every year, and regulate this fo that he may have a conftant fucceffion of a like quantity; that part of the wood which was at firft felled, may be grown up to its fize for felling again by the time the laft is cut. This is, in different places, to be calculated to all the various numbers between eight years and twenty or thirty.

The cutting of wood feldom yields the more and the better timber; but the cutting of it oftener has greater advantages, in that it makes it grow thicker, and gives the feedlings time to come up. If many timber-trees grow in the coppice, and are to be cut down, they and the underwood fhould be felled together, cutting off the ftumps as clofe to the ground as may be, in the trees, and in the fhrubs and underwood the ftumps fhould be left about half a foot high, and cut flanting and very fmooth.

Sawing is the beft method of felling timber-trees; but it fometimes kills the root; and if this is obferved to be the cafe in the coppice, no new fhoots arifing from the root, then it is proper to ftub up the root, that it may not unneceffarily encumber the ground, and that the other young plants may have the benefit of it.

In the firft raifing of coppices from feed, the ground muft be prepared by good tillage, as much as if it were intended for corn. The feeds of the feveral trees are to be fown in February, and if the foil be fhallow, the ground fhould be ploughed into great ridges: this will make the foil lie the thicker upon the top of each ridge, by which means the roots will have more depth to run to for nourifhment, and in a few years the furrow will be filled up to the level of the reft with the dead leaves; and thefe, as they rot at the bottom, will make a kind of foil, through which the young fhoots will fpread, and be conducted from one ridge to another, and fo the whole ground will be occupied by them. If the coppice be to be raifed on the fide of a hill, plough the ridges crofs-way of the defcent of the hill, that the water may be detained among them, and not fuffered to run off, as it otherwife would by the furrows; but if it happen that the ground be over-wet, which is more rarely the cafe, then the contrary method is to be obferved, and the furrows ploughed deep and ftraight downwards, that all water may be carried off by them, as by fo many trenches or drains.

Some fow a crop of corn along with the feeds of the underwood, for the advantage of the firft year; but as the feafon of fowing the feeds of the trees is too late for the fowing of the corn, it feldom turns to much advantage. It is better to fow the trees alone, and keep them well weeded the two firft years; after which they are ftrong enough to take care of themfelves againft fuch enemies.

In very barren ground, where the young trees can hardly ftand the heat in fummer, it is proper, after fowing them, to fcatter a quantity of furze-feed over the land; the furze will grow quick, and over-top the trees at firft, but it will ferve as a guard to them at this time, defending them from injuries, and keeping the ground moift about their roots. In a few years the trees will grow up beyond thefe bufhes, and they will then foon deftroy them by their dropping.

In the raifing of coppices, the neareft diftance for the plantations ought to be five feet for the underwood, but as to what number, and fcantlings of timber are to be left on each acre, the ftatutes in this cafe direct; but it is an ordinary coppice, which will not afford three or four firfts, fourteen feconds, twelve thirds, and eight wavers, according to which proportion the fizes of young trees in coppices are to fucceed one another. In coppice or underwood felled at twenty-four years growth, there are to be left twelve ftore-oaks upon every acre, or, in defect of them, the fame number of elms, beech, or afh: thefe are to be ftraight-bodied trees, and are to be left till they are ten inches in diameter, at a yard from the ground; but it is better for the owner to have a much greater number of timber-trees, efpecially in places where underwood is cheap; and as to the felling, it is always neceffary to begin regularly with one fide, that the carriages, neceffary to the taking off the wood, may come on without injury to the reft: and in large woods, a cart-way fhould always be left in the middle, quite through the wood. The timber of the underwood may be cut from the month of October to February; but the laft month is much the beft, in places where there is but a fmall quantity to be felled, and it can all be got down before the fpring is too much advanced. All the wood fhould be carried out by Midfummer, and made up by April at the lateft; for when the rows and brufh lie longer than this unmade up, and unbound, many of the fhoots and feedlings are fpoiled by them. It is always worth the owner's while to inclofe the coppice well the winter before felling, to keep out the cattle, which would elfe greatly damage the fupply from the feedlings and young fhoots.

New-weaned calves are the leaft prejudicial to newly cut woods of any creatures, and may be put in where there is much grafs; the next in harmleffnefs to thefe are young colts, which, at about a year old, may be put in to feed in the fame manner; but about May they muft all be put out.

If the woods happen to be cropped by cattle, it is beft to cut them up, and they will make new fhoots; for that which has been bitten by the cattle will not grow for feveral years in any degree.

If the coppice-woods are too thin, this is to be remedied by laying down the longeft and fmalleft fhoots of thofe fhrubs or trees which are the moft advantageous, in the place, or of fuch as are neareft the bare place; thefe will each fend forth a great number of fuckers, and the whole wood will be thickened as much as defired in a very little time. Mortimer's Hufbandry, vol. ii. p. 64. See Coppice.

Wood, *Almiggim*. See Almiggim.

Wood *Anemone*. See Anemone.

Wood-*Bine*, or *Wood-bind*, in *Botany*, a fpecies of *lonicera;* which fee.

Wood-*Bind*, *Spanifh*, a fpecies of *ipomoea;* which fee.

Wood-*Chat*, in *Ornithology*, *lanius minor primus* of Aldrovandus, a fpecies of butcher-bird, wth a horn-coloured bill; the feathers at the bafe are whitifh; above is a black

black line drawn acrofs the eyes, and then downwards on each fide the neck; the head and hind part of the neck are of a bright bay; the upper part of the back dufky; the coverts of the tail grey; the fcapulars white; the coverts of the wings dufky; the quill-feathers black, having a white fpot at the bottom; the throat, breaft, and belly of a yellowifh-white; the legs black. In the female, the upper part of the head, neck, and body, are reddifh, ftriated tranfverfely with brown; the lower parts of the body are of a dirty white, rayed with brown; the tail of a reddifh-brown, marked near the end with dufky, and tipt with red. Pennant.

Wood-*Cock*, *Scolopax ruflicola* of Linnæus, called by other writers *la becaffe*, a well-known bird diftinguifhed by its fize, which is fomewhat fmaller than that of the partridge, and by its colour, which is on the back a variegation of black, grey, and a reddifh-brown; on the forehead the black predominates; the quill-feathers are dufky, indented with red marks; and on the belly a pale grey, variegated with tranfverfe ftreaks of brown. Its beak is three inches long, dufky toward the end, and reddifh at the bafe, and the upper chap a little longer than the under: the tongue flender, long, fharp, and hard at the point; the eyes large, and placed near the top of the head, that they may not be injured when the bird thrufts its bill into the ground: from the bill to the eyes is a black line; the forehead is a reddifh afh-colour; the chin is of a pale yellow; the tail confifts of twelve feathers, dufky or black on the one web, and marked with red on the other; the tips above are afh-coloured, below white: the legs and toes are livid, the latter divided almoft to their origin, baving only a very fmall web between the middle and interior toes.

Thefe birds, during fummer, are inhabitants of the Alps, Norway, Sweden, Polifh Pruffia, the Mark of Brandenburg, and the northern parts of Europe; whence they emigrate at the approach of winter into milder climates, where the ground is open and adapted to their manner of feeding. The time of their appearance and difappearance in Sweden coincides exactly with that of their retreat from and arrival in Great Britain. They live on worms and infects, which they fearch for with their long bills in foft ground and moift woods. They generally arrive here in flocks, taking advantage of the night or a mift; they foon feparate: but before they return to their native haunts, pair. They feed and fly by night; beginning their flight in the evening, and returning the fame way to their day-retreat.

They leave England the latter end of February, or beginning of March; though they have been known to continue here accidentally. In Cafewood, near Tunbridge, a few breed almoft annually. During incubation they are very tame. They come over to the coaft of Suffolk fparingly in the firft week of October, the greater number not arriving till the months of November and December, and always after fun-fet. They are determined in their flight by the wind, and arrive feparate and difperfed. When the red-wing appears on the coaft in autumn, the wood-cocks are at hand; and when the Royfton crow is arrived, they are come. Between the 12th and 25th of March they flock towards the coaft to be ready for their departure, having the red-wings for their harbingers in fpring, as in autumn. If the wind be favourable, they immediately depart; but otherwife, they are detained in the neighbouring woods, or among the ling and furze on the coaft: as foon as a fair wind fprings up, they are fuddenly gone.

In the fame manner they are known to quit France, Germany, and Italy; making the northern and cold fituations their general fummer rendezvous. In the winter they are found as far fouth as Smyrna and Aleppo, and alfo in Barbary; and fome have appeared as far fouth as Egypt, which feems to be the limit of their migration in that way. In Japan they are found very common. Thofe that refort into the countries of the Levant probably come from the defarts of Siberia or Tartary, or the cold mountains of Armenia.

Our fpecies of wood-cock is unknown in North America; but they have a fort of wood-cock refembling ours in its general appearance; about half its fize, and wanting the bars on the breaft and belly. Pennant.

They hate flying high, and they are afraid to fly among trees, becaufe, like the hare, they fee but very badly ftraight before them; and it is owing to this imperfection in their fight, that they are fo eafily taken in nets fpread in their places of refort.

The draw-net, in countries which are very woody, is extremely profitable in this fport, it being no uncommon thing to take ten or a dozen wood-cocks at a time in it.

There is another method of taking thefe birds in high woods, with thofe nets called *hays*, of the nature of the rabbit-hays, only with fmaller mefhes. The wood-cocks are to be driven into thefe, and there fhould always be at leaft two or three of them planted together. When the fportfman has provided himfelf with nets, he is to take five or fix perfons into the wood with him. The proper woods for this purpofe are thofe of feven or eight years' growth; and the people are to go into fome part of them near the middle. The nets or hays are to be placed in the fame manner as they are for taking of rabbits, but two or three joining together at the end, and hanging over flopewife that way which the wood-cocks are intended to be driven.

The nets being thus fixed, let the company go to the end of the wood, placing themfelves at about ten rods diftance from one another; they muft all have fticks in their hands, and they are to move forward flowly towards the nets, making a noife by ftriking the fticks againft the trees and branches, and by hallooing with their voices: in this manner they are to move up to the net; and the wood-cocks in that part of the wood will all be terrified before them, but will not take wing, but run along upon the ground, and thus be driven along like a drove of beafts, fo that when the company come up, they will find almoft all of them in the net. When that part of the wood is thus driven, the nets are to be turned the other way, and placed flopewife in the contrary direction, and the company retiring to the other end of the wood, are to drive the wood-cocks that are in that part with the fame noife, till they have fent them into the nets in the fame manner.

Thus all the wood-cocks in the wood may be taken with very little trouble, and this may be done equally at any time of the day.

Another way of taking this bird is by means of noozes or fpringes.

The wood-cock and the fnipe are both eafily taken with bird-lime, when their places of refort are known, but they are not fo eafily found as many other birds.

The cuftom of the wood-cock is ufually to be upon the banks under hedges, and by the fides of ditches toward the fun; and they will fuffer the fportfmen to come nearer them in the day-time after a moon-fhiny night, than after a dark one. The reafon of which is, that having fed well by moon-light, they are only fit for reft the day following;

but

but when the night has been dark, they are feeking food all day long.

The fnipes naturally lie by the fides of rivers, when the plafhes and ponds are frozen, and they always lie with their heads up or down the ftream, never tranfverfely.

In order to take either of thefe birds by bird-lime, the fportfman muft be provided with a large number of fmall and fmooth twigs, neatly and evenly covered with good bird-lime. Thefe muft be placed floping, fome one way, fome another, and the whole place about where they refort muft be covered with them. The fportfman then muft conceal himfelf very carefully, that the fight of him may not frighten away the game. See Cock-*Road*.

Wood-*Cock Apple*, in *Rural Economy*, a fine cyder fruit. See Apple-*Tree*.

Wood-*Cock Shell*, a name given by the Englifh naturalifts to a peculiar kind of the purpura. It is called in French, *becaffe*, from the length of its beak. There are two fpecies of this, a prickly and a fmooth one.

The prickly kind is an extremely beautiful and elegant fhell. It is of a yellowifh colour; and its tail or beak (for the hinder extremity of the fhell, which runs out into an immoderate length, is fometimes called by the one, fometimes by the other of thefe names) is furnifhed with four rows of large and very long fpines: between the rows of thefe, there are alfo rows of fmall and fhort fpines. The body of the fhell is furrowed very deep, with a number of tranfverfe circular lines; and both this and the clavicle are befet with feveral rows of long fpines.

The fmooth becaffe, or wood-cock fhell, is a very elegant fpecies, but much lefs fo than the other. It is of a yellowifh colour, radiated with black and grey lines. It is all over deeply furrowed, and the ridges are befet with tubercles, the clavicle is elevated, and the tail extremely long, and hollowed into a fort of tube. The mouth of this, as well as of the other, is fmall and roundifh, and in this fpecies is of a light flefh-colour.

Wood-*Cock Soil*, in *Agriculture*, a term applied to fuch land as has the mould of a dapple-brownifh colour, and which is faid not to be of a good quality for many purpofes. See Soil.

Wood-*Corn* is a certain quantity of oats, or other grain, anciently given by cuftomary tenants to their lord, for the liberty to pick up dead or broken wood.

Wood-*Evil*, or *Cramp in the Legs*, a difeafe among fheep, which is fo named in confequence of its being fuppofed in general to arife from the drippings of trees in cold and wet weather. It fhews itfelf by feizing the legs of the fheep, and making them totally incapable of walking; and will fometimes all at once fpread through the whole flock.

In regard to the means of cure, a tea-fpoonful of the flour of muftard has been advifed to be given every night and morning. The affected parts fhould alfo be well rubbed with warm flannel, and the fheep be kept dry, which are very effectual aids. The ufe of a little oil of turpentine externally may often alfo be advantageous, where the other mode of rubbing does not fucceed: and in bad cafes the ufe of mild mercurials with opium may be had recourfe to with much benefit.

Wood-*Fuel, Saw for cutting of*, in *Rural Economy*, a tool ufed for this purpofe. On the continent they employ an improved inftrument of this kind, the iron part of which confifts of a faw, three inches in breadth, and fixteen inches in length, double toothed, in the manner of the gardener's pocket faw, and fixed in a frame of tough afh-wood, as below. The edge part of the faw is made broader than the back, in order that it may work more freely and with greater eafe.

The frame of the faw at the top part has a ftrong cord tied round each fide of it, fo as to tighten the faw and keep it from bending, being capable of being twifted tighter by a fmall thin piece of wood put between the double cord, and which may be kept from untwifting by being refted againft the crofs-bar in the upper part, which is mortifed and firmly faftened into the two fide pieces, being the only means that keeps the frame together in a fafe manner. The fide pieces are each twelve inches in length; and the additional length of the handle part of one of them five inches. It is evident that this faw will, on the principle of leffening friction, and of keeping the cutting part from bending, work with much greater facility and expedition than the common carpenter's faw.

With this wood-faw twice as much work may be done in a day as with the common hand-faw that is in general ufe in this country.

Wood-*Geld*, *Woodgeldum*, in our ancient cuftoms, the gathering or cutting of wood within the foreft. Or it may denote the money paid for the fame to the forefters. Sometimes it alfo feems to fignify an immunity from this payment, by the king's grant. Crompton fays exprefsly, it fignifies to be free from the payment of money for taking of wood in a foreft. See Geld.

Wood-*Hay*, an ancient cuftom at Exeter; by which a log out of every feam of wood brought over Ex-bridge is taken towards the reparation of that bridge. Antiq. of Exeter.

Wood-*Land*, in *Agriculture*, a term ufed by the farmers of many counties of England for a fort of foil, from its conftant humidity and dark colour, refembling the foil in woods, which, of whatever nature it originally is, will always be made to appear thus from the continual dropping of trees, and the want of a free air and fun, together with the fall of leaves, deftroyed and wafhed to pieces by the wet.

This foil in the open countries has a confiderable quantity of clay in it, and holds the water a long time that once falls upon it: in wet weather it fticks firmly to the ploughfhare, and in dry is very apt to crack. In uncultivated places it ufually produces rufhes and rufh-grafs. A moift and dripping year is extremely detrimental to this fort of land.

As to the clearing of wood-land in order to bring it into a ftate of cultivation and improvement, the firft ftep is that of properly digging out the roots of whatever forts they may be, after the wood has been cut off, to prepare the ground for the operation of the plough, without mixing the under ftratum of the land with the fertile furface mouldy layer of earth. The hollows and pits are then to be filled and levelled.

In fome inftances it may be beneficial to encourage and promote the fward and herbage by fowing over the furface fuitable grafs-feeds, after it has been broken and fpread over with the collected and decayed or burnt woody and leafy matters, ftocking the land hard with fheep, and mowing off occafionally the wood-fhoots that may arife; thus keeping the whole in a ftate of clofe pafturage, until the fmaller root parts that may have been left in the land become fufficiently decayed, to render them obedient to the plough, when the land may be broken up for corn. The ufe of lime and calcareous fubftances in mixture with thefe matters, or fpread alone over the land, would alfo ferve to encourage the finer forts of herbage, the delight of fheep; and, of courfe, induce them to eat the grafs more clofe,

and

and bring the land fooner into the ftate of a thick fet fward, the productive matrix of corn-crops.

Wood-*Lark*, in *Ornithology*. See *Wood*-Lark.

Wood-*Layer*, in *Agriculture*, a term ufed to fignify the young oak or other timber plants which are laid down into hedges, among the white thorn or other plants ufed in fences. See Hedge.

Wood *of Life*, in *Botany*. See Guaiacum.

Wood-*Lock*, in *Ship-Building*, a piece of elm, clofely fitted and fheathed with copper, in the throating or fcore of the pintle, near the load-water-line; fo that when the rudder is hung, and the wood-lock nailed in its place, it cannot rife, becaufe the latter butts againft the underfide of the brace and butt of the fcore.

Wood-*Loufe*. See Millepedes.

Wood-*Meil*, a coarfe, hairy kind of ftuff, made of Iceland wool, with which the fhip-carpenters, in fome of his majefty's yards, line the ports of fhips of war.

Wood-*Mite*, in *Natural Hiftory*, the name of a little animal frequently made the fubject of microfcopical obfervations, and by fome called the *wood-loufe;* though that lefs properly, as there is another larger animal generally known by that name.

The wood-mite is in fhape and colour very like a loufe, and is frequently found running very nimbly, but always by ftarts and jumps, on old books and rotten wood. The eyes of this creature are of a fine gold colour, and can be thruft out or drawn in at pleafure; and when examined by the microfcope the periftaltic motion of the guts is feen very diftinctly, and beautifully; and what is more wonderful, there is obferved a very diftinct and regular motion in the brain.

This probably is the fame animal with the pediculus pulfatorius, defcribed by Dr. Derham, as one of the death watches. Baker's Microfcope, p. 185.

Wood-*Men*, certain foreft-officers appointed to take care of the king's woods.

Wood-*Mote*, the ancient name of that foreft-court, now called the court of attachment.

Wood-*Pecker*, in *Ornithology*, the Englifh name of fome fpecies of picus.

The green wood-pecker, *picus viridis* of Linnæus, called alfo the rain-fowl and pluvialis avis, weighs about fix ounces and a half, is thirteen inches long, and twenty and a half broad; the bill is dufky, triangular, and near two inches long; the crown of the head is crimfon, fpotted with black; the eyes are furrounded with black, beneath which the males have a crimfon mark; the back, neck, and leffer coverts of the wings, are green; the rump of a pale yellow; the greater quill-feathers are dufky, fpotted on each fide with white; the tail confifts of ten ftiff feathers with black tips, and barred alternately with dufky and deep green; the whole hinder part of the body is of a very pale green; the thigh and vent are marked with dufky lines; the legs and feet all of a cinereous green.

The greater-fpotted wood-pecker, *picus major* of Linnæus, called alfo *witwall*, weighs two ounces three-fourths, is nine inches long, and fixteen broad; the bill is one inch and a quarter long, of a black horn colour; the irides are red; the forehead is of a pale buff colour; the crown of the head of a gloffy black; the hind part marked with a rich deep crimfon fpot; the cheeks white, bounded beneath by a black bar paffing from the corner of the mouth, and furrounding the hind part of the head; the neck is encircled with a black colour; the throat and breaft are of a yellowifh-white; the vent-feathers of a light crimfon; the back, rump, and coverts of the tail, and leffer coverts of the wings, are black; the fcapular feathers and coverts, adjoining to them, are white; the quill-feathers black, elegantly marked on each web with round white fpots: the four middle feathers of the tail are black; the next tipt with yellow; the bottom of the two outmoft black, the upper parts a dirty white; the exterior feather marked on each fide with two black fpots; the next with two on the inner web, and one on the other; the legs are of a lead colour. The female wants the crimfon fpot on the head. This fpecies is much more uncommon than the preceding; and keeps altogether in the woods.

The middle wood-pecker, or *picus medius* of Linnæus, agrees with the preceding in fize and colours, except that the crown of the head in this is of a rich crimfon; the crown of the head in the male of the former being black, and the crimfon in form of a bar on the hind part.

The leffer-fpotted wood-pecker, *picus minor* of Linnæus, is alfo called *hickwall*, and has all the characters and actions of the greater kind, but is more rare. Pennant.

Wood-*Pigeon*. See *Ring*-Dove.

Wood-*Plea Court*, is a court held twice a year in the foreft of Clun, in Shropfhire, for determining all matters relating to wood, and the feeding of cattle there. Perhaps it was originally the fame with wood-mote court.

Wood-*Pucerons*, in *Natural Hiftory*, a name given by M. Reaumur to a fmall fpecies of infect of the puceron kind, of a greyifh colour, and diftinguifhed by its two hollow horns on the hinder part of its body.

Thefe animals very much refemble, both in fhape and fize, the pucerons of the alder; but as thofe live always on the furface of the ftalk, thefe make their way deep into the wood of a tree.

M. Reaumur found large quantities of thefe lodged at a confiderable depth in the wood of fome elms, after they were cut down; the paffages, by which they had made their way in, were not to be found; but they were lodged in large and long holes, of the diameter of a goofe-quill, and running many inches along the tree in a longitudinal direction.

All the pucerons found in thofe places appear to be females, and none have wings; they all have vaft numbers of young ones of different degrees of maturity within them, and thefe may be forced out with preffing their bodies. Reaum. Hift. Infect. vol. vi.

Wood-*Roof*, or *Wood-ruffe*, in *Botany*. See Asperula.

The leaves and roots dried have been efteemed aperient and diuretic; and recommended in obftructions of the liver, and thence fuppofed efficacious in the jaundice: but they are now difufed.

Wood-*Sage*. See Sage.

Wood-*Soot*, in *Agriculture*, a fubftance of the foot kind, which has been found highly beneficial as a manure in cafes of cold clayey or ftiff loamy foils or lands, when in either the ftate of pafture or in that of tillage for grain, or other arable crops.

It is ftated to be ufed in thefe proportions on different forts of land. On light loams, when for pafture, from twenty-two to twenty-four bufhels on the acre; when for barley, from thirty-three to thirty-four; for turnips, from thirty-three to thirty-fix.

On chalky loams, when for pafture, from twenty-three to twenty-fix bufhels on the acre; when for turnips, from thirty-three to thirty-eight; for barley, from thirty-five to forty.

On ftrong loams, when for pafture, from twenty-two to twenty-

twenty-six bushels on the acre; when for artificial grasses, or green crops, from twenty-eight to thirty-four. See Soot and *Wood*-Soot.

Wood-*Sorrel*, in *Botany*. See *Wood*-Sorrel.

Wood-*Spite*, in *Ornithology*, an English name given by many to the common green wood-pecker.

Wood-*Wash*, in *Agriculture*, a name sometimes applied to dyer's-broom by farmers.

Wood, *Waxen*, in *Gardening*. See Genista.

Wood, in *Geography*, a county of Virginia, with 3036 inhabitants.

Wood *Creek*. See Preston's *Creek*.

Wood *Creek*, a river of New York, which runs into the Hudson, near Fort Edward.—Also, a river of New York, connected with the Mohawk by the canal at Rome, through which the navigation is extended into Oneida lake.—Also, a river of New York, which rises in Kingsbury, and runs N. by Port Anne village, into lake Champlain, at Whitehall landing, formerly Skenesborough.

Wood *Island*, a small island near the coast of Maine; 15 miles N.E. of Cape Porpoise. N. lat. 43° 26′. W. long. 70° 24′.

Wood *River*, a river of North America, which runs into the Mississippi, N. lat. 44°. W. long. 92° 25′.—Also, a river of North America, which runs into the Mississippi, N. lat. 38° 25′. W. long. 90° 58′.

WOODBERRY, a township of Pennsylvania, in the county of Huntingdon, with 1107 inhabitants.

WOODBRIDGE, a large and populous market-town in the hundred of Loes, and county of Suffolk, England, is situated on the banks of the river Deben, at the distance of 8 miles E.N.E. from Ipswich, and 77 miles N.E. by E. from London. It is said to have taken its name from a wooden bridge built over a hollow way to make a communication between two parks, separated by the road which leads towards Ipswich; and near the spot where this bridge is supposed to have stood is a house, which to this day retains the name of the Dry Bridge. But when it is considered that in ancient times this town was written Oddebruge, or, as in Domesday-book, Udebruge, it may with greater probability be supposed thence to have derived its present appellation. The principal streets in Woodbridge, one of which is nearly a mile in length, contain many good houses, and are well paved. The market-place is well-built, and in the centre of it is an ancient shire-hall, where the quarter sessions for the liberty of St. Ethelred are held; under which is the place for the corn-market. A weekly market, granted in the reign of Henry III., is held on Wednesdays, and here are two annual fairs. The only manufactures are those of sack-cloth and salt: but the commerce is of great importance. The Deben, which towards its mouth is called Woodbridge-haven, is navigable up to the town, which thereby carries on a very considerable traffic in corn, flour, malt, and various other articles, with London, Hull, Newcastle, and the continent: here are several docks for building vessels, with commodious wharfs and quays. In the population return of the year 1811, Woodbridge is stated to contain 702 houses, occupied by 4332 persons. The church, a spacious structure, is considered to have been built in the reign of Edward III. by John, lord Seagrave. It consists of a nave, chancel, and two side aisles, the roofs of which are supported by fourteen beautiful slender pillars. The exterior walls are of black flints, as is also a large quadrangular tower, 108 feet in height; near the top, the flint and stone are curiously intermixed in various devices. On the south side of the church formerly stood a priory for black canons of the Augustine order. At the dissolution the scite was granted by Henry VIII. to John Wingfield. After passing through several families, the estate was divided and sold, when the capital mansion, called the abbey or priory, was purchased by Francis Brooke, esq. of Ufford. The town contains meeting-houses for Independents, Quakers, and Methodists; also a free grammar-school for ten boys, sons of the poorer inhabitants of the town, who are to be instructed in Latin and Greek, and fitted for the university. Here is likewise an alms-house, worthy of particular notice, which was founded and endowed in 1587, under a patent of queen Elizabeth, by Thomas Seckford, esq. for thirteen men and three women. The endowment was an estate in Clerkenwell, London, then let for 112*l.* 13*s.* 4*d.*; but leased in 1767 for sixty years at 563*l. per annum*, clear of all charges. And as vast sums have been recently expended upon the estate, it may reasonably be supposed that a considerable advance will take place at the expiration of the lease. The governors are the master of the rolls and the chief justice of the common pleas, who are empowered to make such regulations as from time to time shall be necessary. By the last ordinances, the annual allowance to the residents in the alms-house was increased to 27*l.* for the principal or nominal governor, and 20*l.* to each of the other twelve poor men, besides wearing apparel, and a chaldron and half of coals. The three women are appointed as nurses and attendants on the men, and receive 12*l. per annum*, and clothing. The men wear a silver badge, with the Seckford arms, and are required to attend divine service at the parish-church on Sundays, Wednesdays, and Fridays, and all holidays.—Kirby's Suffolk Traveller, 8vo. 1764. Beauties of England and Wales, vol. xiv. Suffolk, by F. Shoberl.

Woodbridge, a town of New Jersey; 4 miles N. of Amboy.

Woodbridge, a township of Connecticut, in the county of New Haven, with 2030 inhabitants; 7 miles N.W. of New Haven.

WOODBURY, a town of the state of Connecticut, in the county of Lichfield, with 1963 inhabitants; 30 miles S.W. of Hartford.—Also, a town of the state of New Jersey, on the E. side of the Delaware; 9 miles S. of Philadelphia. N. lat. 39° 51′. W. long. 75° 15′.—Also, a town of Vermont, in the county of Caledonia, with 254 inhabitants; 20 miles N. of New Haven.—Also, a township of Pennsylvania, in the county of Bedford, with 1658 inhabitants.

WOODCHESTER, a parochial village in the hundred of Longtree, and county of Gloucester, England, is situated $2\frac{1}{2}$ miles S.W. from Stroud, $12\frac{1}{2}$ S. from Gloucester, and 104 W. by N. from London. In 1811 the number of houses in the parish was 162, and the inhabitants 845. By its name Woodchester indicates its having been originally a Roman station, and many Roman antiquities have been frequently discovered there, of which the most remarkable is a mosaic pavement, partially laid open by digging graves in the church-yard under which it lies. It appeared to have formed a square of 48 feet 10 inches; and for size and richness of ornament is certainly superior to any similar tessellated pavement hitherto discovered in Britain. The tesera were imbedded in a cement about 8 inches thick: and under all were flues crossing each other at right angles. Besides this curious work, others have been occasionally discovered at Woodchester: particularly in 1795 and 1796, the ground-plot of a very extensive Roman building was laid open, of which the remains in the church-yard formed the N. extremity, and the other parts extended under an adjoining orchard and field. The plan of this building comprised two

courts,

courts, which, with the great room, containing the principal pavement, ran through the middle, having numerous apartments of different dimenfions branching out from them. In three large rooms on the N. fide of the great or firft court were found fragments of columns, ftatues, and marbles. The fecond or inner court had galleries on three fides. The great mofaic pavement feemed to have belonged to the *cavaedium*, an interior court or hall, which communicated with feveral fuites of rooms. Various parts of the building appear to have belonged to the apartments allotted for baths, exercife, &c. That thefe remains were portions of a fplendid Roman villa is fcarcely to be doubted; and from their character the villa may have been the refidence of the proprætor, while Britain was fubject to Rome. Fragments of ftatues, pottery, ftags'-horns, glafs, and coins, have been found among the ruins. Of the coins, the oldeft was one of Hadrian, and the lateft of Valens. A dagger of iron, much corroded, two fpurs of the fame metal, a fmall brafs hatchet, a fibula, a key apparently of hardened clay, &c. were alfo difcovered. The manor of Woodchefter belongs to lord Ducie, who has a feat at Spring-park, in the parifh, now deferted. It is romantically fituated amidft fine woods. A full account of the Roman villa, with plates, has been publifhed by S. Lyfons, in imperial folio.

WOODCOCK, ——, in *Biography*, one of the Hereford waits, with a ftrong hand on the violin, fo famous in our youth for playing Vivaldi's Cuckoo concerto, that he was fent for far and near to perform it at country concerts. See VIVALDI.

WOODCUTTER's CREEK, in *Geography*, a river of Eaft Florida, which runs into the Atlantic, N. lat. 29° 57'. W. long. 81° 40'.

WOODEN, a town of Poland, in the palatinate of Lublin; 52 miles N. of Lublin.

WOODEN *Ball*, a fmall American ifland, near the coaft of Maine. N. lat. 43° 50'. W. long. 68° 40'.

WOODEN *Frames, for preferving and retarding the Bloffoms of Fruit-trees*, in *Gardening*, fuch as are contrived for the purpofe of protecting the bloffoms of them from the deftructive effects of fpring-frofts, &c. In this intention nets of different kinds, and fcreens of canvas rolled up in the day-time and let down at night, or in the time of heavy rains, have been moftly employed while the trees are in flower; but thefe frames are found to be fuperior, efpecially in expofed northern fituations. By means of thus retarding and defending the bloffoming of thefe forts of tender trees, until the frofts be chiefly over, much advantage is faid to be gained in the fetting of the fruit.

Thefe frames are conftructed in a fimple cheap manner; the revolving parts of which are covered with the branches of the filver fir, or thofe of fome other fuch tree, which are found to anfwer the purpofe very effectually; and when they are properly formed, they will open and fhut with the greateft eafe and expedition. They are in ufe from about the middle of February until towards the end of April, or later in fome cafes; being only opened as there may be a neceffity in the ftate of the bloffoms.

They have been employed with great fuccefs for peaches and apricots, and may be ufed for many other forts of tender fruit-trees.

In forming them, the upright pofts are made of wood, two inches fquare, and fourteen feet fix inches long, into which crofs-bars are mortifed; the poles ftanding fix feet afunder. The upper leaves, which open outward on their pivots, are made of inch-deal, by an inch and a quarter in breadth. There are fmall pieces of wood nailed on the infides of the upper and middle bars, to prevent the leaves of the frames from falling inward on the wall. The lower leaves of the frames, which open out above, in order to admit the rays of the fun to the lower parts of the wall, revolve on pivots. The bottom or low end of the frames ftand out two feet from the wall, and every other pole in them is fixed at the top, with an iron holdfaft immediately under the coping of it. The leaves of the frames are covered with branches of the filver fir, fo as to wholly occupy the vacant fpaces at the end, middle, and fides of them. The crofs-bars are made of inch and quarter wood, and of a breadth to correfpond with the upright poles into which they are mortifed. There are fmall wooden pins in the ends of the crofs-bars, to hold the frames tight when they are up. The fpace between the wall and the frames fhould have a fort of partition at every twelve feet, formed by the filver fir-branches, tied to the trees and every fecond pole, which will prevent a too free circulation of air along the wall, and preferve a degree of ferenity very effential to the fetting of the fruit.

Thefe frames may be found very beneficial in many open and expofed afpects of garden-grounds. See a paper on the fubject in the firft volume of the "Memoirs of the Caledonian Horticultural Society."

WOODEN *Hoop for Cheefe*, in *Rural Economy*. See DAIRYING.

WOODEN *Horfe*, in *Military Language*. See HORSE, *Wooden*.

WOODEN *Horfe-Collar*. See COLLAR.

WOODEN *Saddle*. See PACK-*Saddle*.

WOODEN's *Ifland*, in *Geography*, a rocky iflet in the North Pacific ocean, on the S. coaft of King George III.'s Archipelago: fo called by captain Vancouver, from Ifaac Wooden, one of his crew, who fell overboard near it, and was drowned, a little to the eaft of Cape Ommaney.

WOOD-ENGRAVING, or *Xylography*, is the art of making fuch incifions and hollows, imitative of natural or ideal objects, at the will of the defigner, on a block or tablet of wood, as may afterward yield impreffions on paper, its furface being fupplied with printers'-ink in the manner of letter-types.

The wood of the apple or pear-tree, either of them occafionally, but more frequently the pear-tree, was ufed by thofe engravers of the European continent, who flourifhed during the 14th, 15th, and 16th centuries, and is believed to have been ufed for the fame purpofe, from a much earlier period, in China. The reafon of this preference is the fuperior compactnefs of the texture of thofe woods: but the wood of the box-tree has latterly—for the fame reafon, namely, becaufe it is yet more compact than the pear-tree in its grain, and harder in its fubftance—fuperfeded it; at leaft for the fmaller purpofes of fuch book-blocks as are intended to be combined in the letter-prefs, and printed at the fame operation with alphabetic types.

The inftruments ufed in this art are few and fimple; and are probably the fame now, with a few improvements of no great importance, that have been in ufe from the very commencement of the art: namely, *gravers*, more or lefs fquare or lozenge in their proportions, according to the breadth and depth of the lines required to be cut; *fcrapers*, of various fizes, both flat and round, but chiefly the latter; *knife-tools* and *fpit-fickers*, for the finer lines, pecks, or ftipplings; and *gouges*, for the broader and deeper hollows, which are intended to be left untouched by the ink and paper in the procefs of printing.

The defigns which formed the fubjects of the more ancient engravers in wood, confifted either of pure outlines, or very little more than outlines; the engraved blocks or tablets

tablets furnifhing merely the lineaments of the figures, &c. reprefented, and the colourift, or illuminift, (as he has fometimes been termed,) fupplying the reft. By degrees a few light hatchings were introduced, thinly fcattered upon the folds of the draperies, fhadows of the flefh, and other parts of the defign; and occafionally, when the opening of a door or a window, or the mouth of a cavern, was to be expreffed, the block was left untouched, that it might print black in fuch places, and thereby diminifh the tafk of the colourift. It was foon difcovered, that with little additional labour of the wood-engraver, much more might be accomplifhed. It was eafy to reprefent the bugbear figure of Lucifer with its appropriate blacknefs, and at the fame time to exprefs the internal markings of his body and limbs, by means of thin lines cut in the block, and which would be rendered white in the impreffion.

The ornamental borders which, in fome inftances, furrounded the devotional cuts of thofe times, were rendered more attractive to the eye, by the oppofition of broadifh white and black lines; and fometimes intermediate fpaces of greater extent were enlivened by large white dots cut out, or perhaps punched at equal diftances, on the block; or decorated with fprigs of foliage, or fmall flowers, relieved by a fimilar procefs, upon a black ground. Gradations of fhadow next began to be attempted in the figures and other parts of wood-engravings, by means of white dots, differing from each other in their magnitude and proximity according to the degree of fhade or darknefs required.

This mode of finifhing engravings in wood appears to have been practifed at Mentz, among other places, at an early period of the invention of typography, and was afterwards occafionally reforted to by the wood-engravers of other countries; efpecially thofe of Paris, where, at the clofe of the 15th and commencement of the 16th centuries, numerous fmall books of devotion were printed by Antoine Verrard, Simon Voftre, and others, in which the borders furrounding the pages were decorated by figures very delicately engraved, and relieved upon a black ground, fpecked over, with extreme nicety of workmanfhip, with minute white dots, fuch as have been defcribed.

Thefe innovations or improvements in the art of wood-engraving, were fuch as involved but little additional labour or difficulty in the execution; at the fame time, they were calculated to give to the decorations of books a fhewy effect: but the artifts of Germany, finding or fancying them to be incompatible with the purpofe of imitating by wood-cuts the appearance of their original defigns, the former and more fimple method was again reforted to.

It appears to have been at the earlier period of the art the practice of thofe mafters, who furnifhed defigns for the wood-engravers to work from, carefully to avoid all crofs-hatchings, which it is probable were by many perfons confidered as beyond the power of the xylographift to reprefent. Wolgemuth perceived that though it was difficult to effect crofs-hatchings, it was not impoffible; and in the cuts of the Nuremberg Chronicle,—the execution of which he doubtlefs fuperintended, befide furnifhing the defigns,—a fuccefsful attempt was firft made to imitate the bold hatchings of a pen-drawing, croffing each other, as occafion prompted the defigner, in various directions. To Wolgemuth belongs the praife of having been the firft who duly appreciated the powers of this art; and it is more than probable that he proved with his own hand, to the artifts who were employed under him, the practicability of the ftyle of workmanfhip that he required.

Engraving on wood now offered inducements to its practice, which had not before been contemplated. Albert Durer early applied himfelf to the ftudy and further advancement of an art which at once promifed to reward his labours with fame and fortune; and fo well had Nature qualified him for the tafk, that before the termination of the 15th century, he produced his feries of wood-cuts of the Apocalypfe; a work which it cannot be doubted was received throughout Europe with wonder and univerfal applaufe.

Mr. Bartfch ftrongly infifts that neither Durer, Schauflein, Burgmair, nor the other great defigners of the German fchool, who were contemporaneous, or nearly fo, ever engraved in wood themfelves; but that all they did was to furnifh the defigns, leaving the tafk of cutting them upon the tablets to the ordinary engravers in wood. Mr. Ottley is, however, perfuaded that this opinion is in a great meafure erroneous, notwithftanding the infcriptions which Bartfch refers to, written anciently upon the backs of fo many of the engraved tablets of the celebrated triumph of Maximilian, and other works defigned by Hans Burgmair, and recording the names of the individual wood-engravers who were employed to execute particular pieces of thofe extenfive undertakings.

One hundred and thirty-five of the folio tablets of Maximilian's triumph are ftill preferved in the imperial library at Vienna, where an edition of them was ftruck off in the year 1796. According to Bartfch, they were engraved from the defign (for the whole forms but one long proceffion) not of Albert Durer, as had formerly been fuppofed, but of Hans Burgmair, in 1516 and the three following years. The names of the different wood-engravers employed are written, fays Mr. Bartfch, upon the backs of feveral of the blocks, in the following manner. Upon N° 18. of the edition juft mentioned, "Der kert an die Ellend. hat Wilhalm gefchitten;" *i. e.* this block joins to that which reprefents the elks. It was engraved by William: and fo of the reft.

The names or initials of engravers found upon the backs of thefe extraordinary tablets are feventeen in number, and are as follow: 1. Jerome André, furnamed Refch, or Röfch (one of the moft eminent engravers of Nuremberg.) 2. Jan de Bonn. 3. Cornelius, (perhaps Cornelius de Bonn.) 4. Hans Frank. 5. Saint German. 6. Wilhelm. 7. Corneille Liefrink. 8. Wilhelm Liefrink. 9. Alexis Lindt. 10. Joffe de Negker. 11. Vincent Pfarkecher. 12. Jaques Rupp. 13. Hans Schaufelien. 14. Jan Taberith. 15. F. P. 16. A monogram, compofed of H. F. 17. W. R.

The imperial library likewife poffeffes an hundred and twenty-two blocks, engraved from the defigns of Burgmair, reprefenting the faints, male and female, of the family of Maximilian. One hundred and nineteen of thefe were republifhed in the year 1799; and upon the backs of the blocks were found the names of the eight following engravers on wood; *viz.* 1. Hans Frank. 2. Corneille Liefrink. 3. Alexis Lindt. 4. Joffe de Negker. 5. Wolfgang Refch. 6. Hans Taberith. 7. Wilhelm Taberith. And, 8. Nicholas Seeman. Probably no writer who has entered upon a critical examination of thefe early works has been fo well qualified to judge of them as Mr. Ottley: and that gentleman, while he admits that thefe infcriptions of names fufficiently prove that the great bulk of the numerous wood-cuts bearing the initials of Burgmair, were not cut upon the wooden blocks by his own hand; and that by parity of reafoning it might be fair to conclude the fame of a large proportion of thofe bearing the monograms or initials of Durer, and other eminent defigners; yet he can by no means perfuade himfelf that the abilities of the ordinary wood-engravers, who abounded in Germany at the

 clofe

close of the 15th century, could have been such as to render them in any material degree instrumental in bringing about that sudden and considerable improvement which took place in their art at that period. They had been accustomed to manufacture the barbarous wood-cuts used by the illuminists and venders of playing-cards, and were probably incapable of comprehending or appreciating those delicate, but free and masterly touches, which characterize the designs of a great and finished artist like Durer; and if so, wholly unqualified to represent them with any tolerable degree of fidelity. We may, therefore, readily believe that the numerous and flourishing school of wood-engravers, which we find spreading over Germany, and from thence to Italy, in the early part of the 16th century, owes its excellence to the great designers of that time; and especially to Albert Durer, who during his youth assiduously applied himself to the practice and improvement of the art, and afterward taught it to numerous pupils, who, already grounded in the principles of design, and working continually under the eye of their master, by degrees became qualified to assist him greatly in his numerous works of this kind. The intelligence, the delicacy, and the feeling, which we observe in the execution of most of the wood-cuts of Albert Durer, can only, Mr. Ottley thinks, be accounted for in this way; and the reader will probably admit that his opinion on the subject is not a little strengthened by the circumstance of Durer having been himself the publisher of all his chief works of this kind, more especially when added to the fact, that of the years 1509, 1510, and 1511, during which so large a proportion of his wood-engravings were executed, we have scarcely any thing by his hand engraved in copper.

The sudden and considerable improvement of which we have spoken, consisted of a superior style of execution, as well as of design. The meagre and miserable forms derived from the legends of superstition, and the Greek painters of the dark ages, began to give way to a clearer view of nature; and the few and scanty single-lined hatchings, which rather indicated than expressed shadow, were superseded by those bold courses of lines, as if hatched with a pen, and crossed with second and in some instances with third courses of lines, which Wolgemuth introduced, and Durer improved.

This mode of execution appeared to many persons so very difficult, and requiring so much more of pains and patient labour than they were warranted by other parts of these engravings in believing to have been bestowed on them, as to have excited considerable doubts whether the prints which contain these dark crossings were really impressed from wooden blocks. They were by some persons rather supposed to have been printed from casts, for which the engraved blocks served perhaps as matrixes; and a controversy hinging on this doubt has been for some time carried on by antiquarian inquirers, with sufficient boldness on both sides. The truth, however, could only remain with one party, and the subsequent production by Mr. Ottley, of some of the engraved blocks of wood themselves, either from the hands of Albert Durer, or those of his disciples, has proved that the dark crossings were actually delivered from wood, and settled the controversy, as far as respects that artist and his contemporaries, if not his successors.

The readers of our account of the German school of engraving, may have observed that ourselves were among the number of sceptics. As the truth was our object, we willingly confess our earlier mistake now that the fact is ascertained; and have too much respect for truth and the public to feel the least backwardness in recording it. Whether we flatter ourselves that we can afford this record out of the stock of our reputation, is for our private feelings. If from our expression of doubt, research in the right direction, and satisfactory ascertainment, have resulted, our scepticism has not been in vain; nor have we been in vain anxious to tell what we believed, as well as what we knew. Respecting the dark cross-hatchings which so frequently occur in the works of Albert Durer, Mr. Ottley's argument is conclusive: yet there are two things in his book on engraving, for which we cannot award to him the same approbation; and these are, his discontinuing his history precisely at the same epoch where Mr. Landseer had been obliged to break off a course of (published) lectures that are confessedly imperfect; and his mis-stating both the words and meaning of that writer, in the only place where he professes to have quoted him.

We shall next proceed to describe the modes of workmanship, or execution, which have prevailed among the more modern practitioners of the art; beginning with that which is in use for the more common or ordinary purposes, and following with those refinements of the art which are practised only by its superior professors. Our account will be followed by some anecdotes and remarks relative to the earlier history of the art, which we hope will prove in no small degree worthy of the notice of the connoisseur and print-collector.

Before the artist begins his engraving, the surface of the block or tablet which is to receive it, must, by means of an instrument termed a *scraper*, succeeding to a fine watch-spring saw, be made level, and sufficiently smooth for the reception of the design which is intended to be represented. Should this design be very simple in its nature, such as a small geometrical diagram, for example, being previously drawn on paper either with a black-lead pencil, or Indian ink, it is sometimes laid on an engraver's sand-bag, or other such hard cushion, and the block being carefully placed over it, a smart blow struck on the back of the block with a broad-faced hammer, will transfer the lines from the paper to the wood, in a manner sufficiently plain and accurate for such purposes, when by means of the gravers, gouges, scrapers, &c. which have been before mentioned, the engraver begins his work of incisions and hollows, scooping away the whole surface of the block, except the diagram, or other simple design required.

In other cases, the design to be engraven is either traced by passing a blunted steel-point over the outlines, the back of the drawing being rubbed with powdered red-chalk, or is sketched out with a black-lead pencil, and the different shades washed in with Indian ink, in the same manner as a chiaro-scuro drawing on paper. This method is used in making drawings for cuts to be introduced in common and cheap publications, in which a bold shewy effect is chiefly required. In engraving such drawings made on the wood, the artist renders the several forms and tints by incisions cut in the block; and the principle on which he proceeds may be readily conceived by recollecting (what we have alluded to in an earlier part of this article), that were the block to be printed before the engraver commenced his operations, it would yield merely a black spot: every incision therefore made in the block will produce the impression of a white line or hatching, and thus afford the means of introducing any portion of light that may be required. By the multiplication of these white lines or hatchings, the engraver lightens the tint at his pleasure; and by the various widths, thicknesses, crossings, and intertextures of the incisions thus made in the wood, not only the forms and various gradations of shadow from light to darkness, but also the textures or external

external characters of the various objects which may enter into the compoſition, may be very well repreſented.

Another mode of proceeding is occaſionally reſorted to in caſes where engravings of a ſuperior and more elaborate character are required, and which we have reaſon to believe was firſt practiſed in England by our countryman, Mr. John Thurſton. In theſe caſes, all the light and curious part of the deſign are hatched in, line by line, by the draftſman or deſigner himſelf, on the block, and which is performed either with a pen and Indian ink, after the manner of thoſe ancient artiſts of the German ſchool of whom we have treated, or elſe with the more modern and elegant inſtrument, a black-lead pencil. In ſome inſtances we have known the whole compoſition in all its details, both of light and obſcurity, thus finiſhed upon the wood in the moſt elaborate manner, before the engraver began his work of inciſion and ſcooping; but in moſt inſtances, the ſhadows and parts requiring leſs definition, and where the engraver may with more ſafety be left to the guidance of his own judgment, are merely waſhed in with a camel's-hair pencil and Indian ink, as in the foregoing method. Or elſe the deſigner uſes a black-lead pencil, with which he rubs or ſcumbles in the leſs important tints. And the drawing on the wood being thus prepared, the engraver proceeds with the manual and linear portion of it, by cutting away the interſtices between the pencilled or penned lines, as in the ancient manner, and the waſhed portion is treated in the modern method which we have deſcribed above.

Conſiderable ſkill on the part of the engraver is ſometimes requiſite in finiſhing the work, in order to unite and harmonize the whole, in which the deſigner's aid is not unfrequently required, who on a proof impreſſion taken for the purpoſe hatches and works, with a fine camel's-hair pencil and white paint, over the diſſonant parts, regulating at the ſame time the general effect, the drawing of the parts, and the ſtyle of execution. This touched-proof, viewed in the reverſing glaſs, is carefully copied by the engraver on his block, which concludes the proceſs.

There is, however, in the nature of things, no reaſon whatever why theſe two characters of engraver and deſigner may not exiſt united in the ſame individual; nor are the inſtances of ſuch union unfrequent in fact. Mr. Bewick, of Newcaſtle,—whoſe highly-enriched volumes of engravings of birds and quadrupeds, adorned with delightful vignettes, are maſter-pieces of the art, and have merited and found a place in almoſt every library,—poſſeſſes, with his xylographic powers, a fund of exquiſite humour, an originality of thought, and an accuracy of obſervation of the details of nature; together with an adequate talent of expreſſing thoſe obſervations, which are really as ſurpriſing as they are diverting and inſtructive.

We believe that this artiſt, or his deceaſed brother, was the firſt who adopted an expedient which the preſent writer has been informed was originally ſuggeſted by Mr. Bulmer, proprietor of the Shakſpeare printing-office,—that of lowering a little the ſurface of his engraving, by means of a very broad flat ſcraper, in thoſe parts where tenderneſs and delicacy of impreſſion were more peculiarly deſirable; a thing trivial in itſelf, yet of ſufficient importance in works that have pretenſions to be regarded as highly finiſhed, to have been ſubſequently imitated by moſt of the other engravers in wood. Among thoſe who in modern times have united in themſelves the characters of deſigners and wood-engravers, ſhould alſo be mentioned Mr. Clennell, who has executed ſome of his own energetic compoſitions in a vigorous and maſterly ſtyle, which few have been able to ſurpaſs.

Mr. Thurſton,—more verſed in all the technic varieties of linear practicability, and more accompliſhed in his academic powers of delineating the human form through all its gradations of action, character, and expreſſion, than any of his predeceſſors in the xylographic art,—in his habits of thought and ſtyle of deſign, is poetical, didactic, profound, allegoric, recondite, ideal. Of the profeſſors of imitative art, who have wiſely employed their talent to a moral purpoſe, few have improved and delighted us ſo much, or cauſed us to reflect ſo variouſly or ſo deeply. But though Mr. Thurſton has engraved very ſucceſsfully on copper, we believe that he has always entruſted his deſigns on wood to be executed by others, (ſome of them latterly by a ſon of promiſing talents,) and from the black-lead drawings of this artiſt, performed on the blocks themſelves, have been produced the beſt engravings of the London and Liverpool ſchools. We ſubjoin the names and monograms of the principal of thoſe artiſts who have been engaged in their execution:—T. Clennell, C. Neſbit, R. Branſton, J. Thompſon, H. F. P. Hole, W. Hughes.

By the two latter of theſe we have ſeen landſcape ſubjects of recent execution, which have excited in us no ſmall degree of admiration of their profeſſional powers. In a park-ſcene after Cuitt, engraved by Mr. Hughes, (who profeſſes to have ſtudied under Mr. Hole,) the trees more eſpecially,—which have been generally and juſtly regarded as objects more difficult to expreſs in this mode of art, than almoſt any other ſpecies of objects whatever,—are treated with a degree of looſeneſs, freedom, and local knowledge of the characters of their various foliage, and modes of branching and ramification, that we believe is quite unprecedented, and much more reſembling an etching on copper from the needle of Waterloo or Middiman, than any former production of the wood-engravers' art. And there has alſo very lately appeared a book, entitled "The Club," after the deſigns of Thurſton, which is not leſs excellent in its way. It conſiſts of twenty-four characteriſtic head-pieces of the ſeveral members of the club, a title-page repreſenting the club collectively, beſide various tail-piece vignettes, and impreſſes us with a depth of philoſophical penetration into the human character in all its varieties both natural and aſſumed; for here the nicer phyſiognomical traits which mark the leſſer diſcriminations between wit, humour, and ridicule, in their various modifications, are faithfully rendered: indeed with a degree of delicacy and fidelity which until now we had not conceived to lie within this province of art.

In wood-engravings, like the beſt of theſe modern productions which we have mentioned, there is more original feeling, more of the truth of nature, and the blandiſhments of art, than in all the dry, monkiſh, legendary rubbiſh put together, toward which the dealers in and writers on ſuch rarities (who are frequently the ſame perſons) are ſo very anxious to attract and retain the public attention, and which are ſo ardently ſought after by the wooden and would-be connoiſſeurs of the day.

Some few connoiſſeurs there are, neverthleſs, that with great ſenſibility to the beauties of meritorious works of this kind, collect alſo the early rarities of the art as curioſities, and as intereſting ſteps in tracing the march of European xylography, from its rude outſet towards its preſent attainments: but the idle occupation which ſo many expenſive books have ridiculouſly promoted, the affected exquiſiteneſs of regard for what is merely ſcarce, and which, if it were plentiful, would be juſtly eſteemed as mere rubbiſh, can ſcarcely be too ſeverely reprehended, when we obſerve that

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by giving an erroneous direction to the public tafte, it operates as the very bane of modern merit, and of all principled encouragement of the art.

A man who collects thefe early rarities, and thefe only, may be pretty certainly pronounced to be a perfon of no intrinfic relifh for the productions of art, and by no remote analogy may be eafily perceived to be in the predicament of Rochefoucault's man of gravity, who affumes a myfterious carriage of the body to cover the defects of the mind.

Between the territories of Error and Truth, there is no neutral ground; neither can be made to recede without the other's advancing. Among the caufes that, concurrently with the above, have retarded the progrefs of the art of wood-engraving, indifferent and bad printing ought firft and chiefly to be mentioned; for this evil is feverely felt by all modern defigners and engravers on wood, (and, like moft other evils, by far the moft heavily by the beft,) the delicate parts of whofe moft elaborate performances are fo frequently marred by this operation.

The bad printing of wood-cuts generally proceeds from one or more of the following miftakes, to ufe the mildeft term that occurs to us: Printers being unable of themfelves to judge of the effect required in an impreffion; their being generally too much reftricted in price by the publifhing-bookfellers to afford the neceffary attention, even were they better informed; the falfe refpect exacted by opulence, which renders them too ignorantly proud to fubmit to the direction of artifts, who are generally poorer men than themfelves; with which caufe, prejudice in favour of old methods of practice is always ready to unite itfelf; the practice of over-damping Englifh, French, and even India paper. To which may be added the ufe of blanketing, and the neglecting to have the engravings properly made ready under the direction of the artift: all of which lead to the general corollary, or inference, that the engraver fhould always fuperintend the printing of his own works.

Wood-Engraving, *Origin and Ancient Hiftory of.* Father Du Halde adduces very fatisfactory reafons for our believing that the art of engraving on wood exifted and was practifed in China for feveral centuries before its appearance in Europe. Whether it is of Chinefe tranfplantation, or fpontaneous European growth; whether it was introduced by the Venetian traders and travellers to India, or was re-invented, as the baron Heinnekin fuppofes, in Germany, by the Briefmalers and Formfchnieders, who fabricated playing-cards, and the miferable legends of monkifh fuperftition; or whether it was not difcovered, as Papillon has afferted, at Ravenna, as early as the year 1285; have been examined with great critical attention, and at leaft as much perfeverance as the public will fympathize with, by the abbé Zani, Mr. Ottley, and others. To the works refpectively of the Italian abbé, and the Englifh hiftorian and connoiffeur, we refer thofe who may be defirous of obtaining more local and detailed information concerning the early curiofities of the art than belongs to the plan of our Cyclopædia. The ftory of the two Cunio, which they have repeated at great length from Papillon, and illuftrated by their own more profound knowledge of the fubject, is romantic in the extreme: fo much fo, that the antiquarian intereft which the reader may feel with us on the fcore of the curious wooden blocks from "the life of the great and magnanimous Macedonian king," merges in the chivalry and fine art, the poetic and pictoral fervour, and the tragic fate, of the twin brother and fifter, the ancient pride of Ravenna, and of the illuftrious houfe of Cunio.

Papillon relates, that when he was a young man, he "difcovered an epoch of engraving prints and characters on wood, certainly much more ancient than any hitherto known in Europe;" and the ftory of his difcovery is, that being employed about a century ago in papering a clofet for a Swifs captain of the name of De Greder, in the village of Bagneux, near Mont-Rouge, the captain, finding he poffeffed a tafte for fuch matters, fhewed him two or three very ancient volumes, and they converfed together concerning the prints contained in them, and the antiquity of engraving on wood. Papillon proceeds to give the defcription of the principal, *i. e.* the moft ancient, of thefe volumes, as follows:—Upon a cartouch, or frontifpiece, decorated with fanciful ornaments, and meafuring about nine inches in width by fix in height, with, at the top of it, the armorial bearings no doubt of the family of Cunio, are rudely engraven the following words, in bad Latin, or ancient Gothic Italian, with many abbreviations, which were rendered and explained to him by M. de Greder.

"*The heroic actions reprefented in figures, of the great and magnanimous Macedonian king, the bold and valiant Alexander; dedicated, prefented, and humbly offered to the moft holy father pope Honorius* IV., *the glory and fupport of the Church, and to our illuftrious and generous father and mother, by us, Aleffandro Alberico Cunio, cavaliere, and Ifabella Cunio, twin brother and fifter: firft reduced, imagined, and attempted to be executed in relief, with a fmall knife, on blocks of wood, made even and polifhed by this learned and dear fifter, continued and finifhed by us together, at Ravenna, from the eight pictures of our invention, painted fix times larger than here reprefented; engraved, explained by verfes, and thus marked upon the paper to perpetuate the number of them, and to enable us to prefent them to our relations and friends, in teftimony of gratitude, friendfhip, and affection. All this was done and finifhed by us when only fixteen years of age.*"

The cartouch mentioned above is enclofed in a fquare formed by a fimple black line, one-twelfth of an inch in thicknefs; a few light hatchings, irregularly placed, and executed without precifion, indicate the fhadows of the ornaments. "Immediately following this frontifpiece (fays Papillon) are the eight pictures, engraved in wood, of the fame dimenfions, and furrounded by a fimilar fillet: they have alfo a few faint hatchings, to indicate the fhadows. At the bottom of each of thefe prints, between the broad line or fillet which bounds the fubject, and another parallel line diftant from it about the breadth of a finger, are four Latin verfes engraved upon the block, which poetically explain the fubject; and above each is its title. The impreffions of all of them are of a grey tint, and fpotty; as if the paper had not been damped or wetted before it was laid upon the engraved blocks. The figures, which are paffable in refpect to their outlines, although of a femi-gothic tafte, are fufficiently well characterized and draped; one may perceive by them that in Italy the arts of defign were then beginning by degrees to experience melioration. The names of the principal perfonages reprefented are engraved under their figures, as Alexander, Philip, Darius, Campafpe, and others."

Papillon next defcribes the eight engravings feverally, which bear the names refpectively of the twins Alexander and Ifabel Cunio, and it would appear from his defcriptions that Ifabel was the fuperior artift of the two.

Upon the blank leaf which follows the laft print, badly written in old Swifs characters, and with ink fo pale as to be fcarcely legible, is the following memorandum.

"This precious book was given to my grandfather, Jan. Jacq. Turine, a native of Berne, by the illuftrious count di Cunio, magiftrate (podefta) of Imola, who honoured

noured him with his liberal friendſhip. Of all the books I poſſeſs, I eſteem it the moſt, on account of the quarter from whence it came into our family; and on account of the ſcience, the valour, the beauty of the amiable twins Cunio, and their noble and generous intention of thus gratifying their relatives and friends. Behold their ſingular and curious hiſtory in the manner in which it was ſeveral times related to me by my venerable father, and according to which I have cauſed it to be written more legibly than I myſelf could have done it." What follows is written in a better hand, and with blacker ink.

"The young and amiable Cunio, twin brother and ſiſter, were the firſt children of the ſon of the count di Cunio, which he had by a noble and beautiful Veroneſe lady, allied to the family of pope Honorius IV., when he was only a cardinal. This young nobleman had eſpouſed this young lady clandeſtinely, without the knowledge of the relations of either of them; who, when they diſcovered the affair by her pregnancy, cauſed the marriage to be annulled, and the prieſt who had married the two lovers to be baniſhed. The noble lady, fearing equally the anger of her father and that of the count di Cunio, took refuge in the houſe of one of her aunts, where ſhe was delivered of theſe twins. Nevertheleſs the count di Cunio, out of regard to his ſon, whom he obliged to eſpouſe another noble lady, permitted him to bring up theſe children in his houſe, which was done with every inſtruction and tenderneſs poſſible, as well on the part of the count as on that of his ſon's wife, who conceived ſuch an affection for Iſabella Cunio, that ſhe loved and cheriſhed her as if ſhe had been her own daughter; loving equally Aleſſandro Alberico Cunio her brother, who, like his ſiſter, was full of talent, and of a moſt amiable diſpoſition. Both of them made rapid advances in various ſciences, profiting by the inſtruction of their maſters; but eſpecially Iſabella, who, at thirteen years of age, was already conſidered as a prodigy; for ſhe perfectly underſtood and wrote Latin, compoſed verſes, had acquired a knowledge of geometry, was ſkilful in muſic, and played upon ſeveral inſtruments; moreover, ſhe was practiſed in drawing, and painted with taſte and delicacy. Her brother, urged on by emulation, endeavoured to equal her; often, however, acknowledging that he felt he could never attain to ſo high a degree of perfection. He himſelf was, nevertheleſs, one of the fineſt young men of Italy; he equalled his ſiſter in beauty of perſon, and poſſeſſed great courage, elevation of ſoul, and an uncommon degree of facility in acquiring and perfecting himſelf in whatever he applied to. Both of them conſtituted the delight of their parents, and they loved each other ſo perfectly, that the pleaſure or chagrin of the one or the other was divided between them. At fourteen years of age, this young gentleman could manage a horſe, was practiſed in the uſe of arms, and in all exerciſes proper for a young man of quality; he alſo underſtood Latin, and had conſiderable ſkill in painting.

"His father having, in conſequence of the troubles of Italy, taken up arms, was induced, by his repeated ſolicitations, to take him with him the ſame year, (*viz.* at the age of 14,) that under the eyes of his father he might make his firſt campaign. He was entruſted with the command of a ſquadron of twenty-five horſe; with which, for his firſt eſſay, he attacked, routed, and put to flight, after a vigorous reſiſtance, almoſt two hundred of the enemy; but his courage having carried him too far, he unexpectedly found himſelf ſurrounded by many of the fugitives; from whom, nevertheleſs, with a valour not to be equalled, he ſucceeded in diſengaging himſelf, without ſuſtaining any other injury than that of a wound in his left arm. His father, who had flown to his ſuccour, found him returning with one of the ſtandards of the enemy, with which he had bound up his wound: he embraced him, full of delight at his glorious achievement, and at the ſame time, as his ſon's wound was not conſiderable, and as he was deſirous to reward ſuch great bravery upon the ſpot, he ſolemnly made him a knight, (*i. e.* a knight-banneret,) although he was already one by his birth; dubbing him in the ſame place where he had given ſuch proofs of his extraordinary valour. The young man was ſo tranſported with joy at this honour conferred on him in the preſence of the troops commanded by his father, (who, in conſequence of the death of *his* father, which had recently happened, was now become the count di Cunio,) that, wounded as he was, he inſtantly demanded permiſſion to go and ſee his mother, that he might inform her of the glory and of the honour which he had juſt acquired; which was granted by the count the more readily, as he was glad to have this opportunity of teſtifying to that noble and afflicted lady (who had always remained with her aunt a few miles from Ravenna) the love and eſteem which he ever continued to entertain for her; of which he certainly would have given more ſolid proofs, by re-eſtabliſhing their marriage, and publicly eſpouſing her, had he not felt it his duty to cheriſh the wife his father had obliged him to marry, by whom he had ſeveral children.

"The young knight, therefore, immediately ſet out, eſcorted by the remains of his troop, out of which he had eight or ten men killed or wounded. With this equipage, and theſe attendants, who bore teſtimony to his valour wherever he paſſed, he arrived at the reſidence of his mother, with whom he ſtaid two days; after which he repaired to Ravenna, to ſhew a ſimilar mark of reſpect to the wife of his father, who was ſo charmed by his noble actions, as well as by his attentions towards her, that ſhe herſelf led him by the hand to the apartment of the amiable Iſabella, who, ſeeing him with his arm bound up, was at firſt alarmed. He remained a few days in that city; but impatient to return to his father, that he might have an opportunity of diſtinguiſhing himſelf by new exploits, he ſet off before his wound was yet healed. The count reprimanded him for not having ſent back his troop, and for not remaining at Ravenna till he was cured, and would not permit him to ſerve again during the reſt of the campaign: ſhortly after, when his arm was perfectly healed, he ſent him home, ſaying to him pleaſantly, that he did not chooſe to be outdone by him all the remaining time the troops would continue in action that year. It was ſoon after this that Iſabella and he began to compoſe and execute the pictures of the actions of Alexander. He made a ſecond campaign with his father, after which he again worked upon theſe pictures, conjointly with Iſabella, who applied herſelf to reduce them, and to engrave them on blocks of wood. After they had finiſhed and printed theſe pieces, and preſented them to pope Honorius, and to their other relations and friends, the cavalier joined the army for the fourth time, accompanied by a young nobleman, one of his friends, called Pandulfio; who, enamoured of the lovely Iſabella, was deſirous to ſignalize himſelf, that he might become more worthy of her hand before he eſpouſed her. But this laſt campaign was fatal to the cavalier Cunio: he fell, covered with wounds, by the ſide of his friend, who, whilſt attempting to defend him, was alſo dangerouſly wounded. Iſabella was ſo much affected by the death of her brother, which happened when he was not yet nineteen, that ſhe determined never to marry: ſhe languiſhed and died, when ſhe had ſcarcely completed her twentieth year. The death of this beautiful and learned young lady was followed by that of her lover, who had always hoped that his attentions and affections towards her would be rewarded by her conſent at length to become his,

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and alfo by that of her mother, who could not furvive the lofs of her beloved children. The count di Cunio, who had been deeply afflicted by the death of his fon, could fcarcely fupport that of his daughter. Even the countefs di Cunio, who loved Ifabella with great tendernefs, fell ill of grief for her lofs; and would have funk under it, had fhe not been fupported by the manly fortitude of the count. Happily the health of the countefs was, by degrees, re-eftablifhed. Some years afterwards, the generous count di Cunio gave this copy of the actions of Alexander, bound, as it now is, to my grandfather; and I have caufed the leaves of paper to be inferted, upon which, by my orders, this hiftory was written."

From the name of pope Honorius IV. being engraved on the frontifpiece of thefe ancient prints, it is certain that this precious monument of the art of engraving on wood was executed between the years 1284 and 1286; becaufe that pope governed the church only for the fpace of two years, ending in April 1287. The epoch, therefore, of this ancient fpecimen of engraving, is anterior to all the books printed in Europe that have been hitherto known. Papillon adds, that it is very probable that the copy of the work, which is recorded to have been prefented to pope Honorius, may very poffibly be preferved in the library of the Vatican.

The baron Heinnekin and our countryman Strutt diftruft the truth of this ftory of the twins and their ancient work; but the latter has let efcape that he read the original French with hafty inattention, and the former, after offering his objections, is compelled to add, "ftill there muft be fomething true in Papillon's account; for, from my knowledge of his character, and his manner when I converfed with him, I am firmly perfuaded that he did not invent that which he told me."

On the other hand, Zani confeffes his entire belief of the account of Papillon, finding in it, as he ftates, "every mark of truth:" and Mr. Ottley conclufively adds, that "Papillon from his infancy had begun to collect materials for illuftrating the hiftory of his favourite art, of which, as is well known, he became a profeffor of fome eminence, having been inftructed in it by his father, who was alfo an engraver on wood. This practical experience combined with refearch could not but give him great advantages, and render him the lefs liable to be deceived in his decifions.

"His remarks, indeed, are thofe of a man well accuftomed to examine ancient prints. The blocks, he fays, appear to have been printed by means of the preffure or friction of the hand, with a light tint of Indigo in diftemper; he defcribes the impreffions to be granulous in fome places, as if the paper had been applied to the engraved block without being firft damped. Now, it is well known that many of the very early wood-prints were printed without any mixture of oil in the colours ufed for the purpofe; and there is good reafon alfo to believe that the paper was often applied in its dry ftate. The obfervations of Papillon are, therefore, not only evidence that he examined thefe prints with great attention, but that his eye was habituated to very nice difcrimination, touching all thofe particulars which, perhaps, more than any others that could be named, are guides to enable us to judge of the antiquity of wood-engravings. And the probity of Papillon's character feems to preclude the idea that he had any intention to deceive."

The general corollaries refulting from thefe elaborate inquiries, which have been purfued to much greater length than we have chofen to follow, are, that the *origin* of *European* wood-engraving is unknown, (that is to fay, that no perfon is acquainted with the precife facts of *who* firft engraved on wood in this part of the world, or *when* it was done); and the reluctant acknowledgment that it cannot be fhewn to be an European difcovery at all.

Notwithftanding the detailed prolixity with which the chevalier Cunio's own account of his graphic enterprize is written, and though he ftates that himfelf and his fifter invented the eight defigns or pictures from which their tablets were engraven, he fays nothing of the far more important fact, had it been fo, of their having invented an art of multiplying thofe defigns, fo much more likely to have been announced by an ardent youth of fixteen, had there been the leaft foundation for fuch an announcement. No. He was too fincere: and he probably knew alfo that pope Honorius, and his noble relatives, were too well acquainted with fimilar proceffes employed by the Italian carvers, fealers, bookbinders, and other artifans of Venice and Ravenna, (for the bindings of books were even then ornamented by means of heated iron ftamps,) to have believed him, had he been lefs attentive to truth. He evidently regarded, and expected that his readers would regard, what he terms in one place engraving, and in another execution in relief with a fmall knife, as an expedient which might have been adopted by any other perfon in the exifting ftate of that kind of knowledge, and which himfelf and fifter practifed—in all probability from the imperfect report of fome inexperienced reporter, who might be their inftructor in drawing.

At the period of which we are treating, Venice, as is well known, was the fplendid emporium of exotic luxuries; and the reader will not hefitate to believe, that, with the facilities of Italian intercourfe which then fubfifted, much of the imported knowledge would travel at leaft to Ravenna, along with thofe foreign commodities and that commercial enterprize which were then fpreading through Europe. The father and the uncle of Marco Polo, who had penetrated to Tartary and to China, returned from their nineteen years of travel in the Eaft, in the fame year in which the Cunio were born. Nothing, therefore, is more likely, under all the attendant circumftances, than that thefe travellers brought home the information neceffary to the rude practice of the wood-engravers' art from *China*, which we are inclined to deem the parent country of wood-engraving, paper, and printing; and that it thus became known, though through what particular medium cannot now be traced, to the illuftrious and romantic twins of Ravenna.

Should it be objected here, that Marco Polo has not noticed this art, in the account which he has left us of the marvels which he had witneffed in China; the anfwer is obvious. Marco did not himfelf travel thither until after the firft return of his father and uncle, nor did his book appear until ten years after that of "the heroic actions of the great and magnanimous Macedonian king," when wood-engraving would feem to have been no marvel. Marco very wifely preferred inftructing the public in matters with which they were not hitherto acquainted.

In corroboration of this account may be mentioned, that the manner in which the work of the Cunio is defcribed to have been performed, is precifely that in which the Chinefe have from time immemorial engraven on wood, and in which they ftill continue to practife that art, as may be feen by any perfon who may pleafe to indulge himfelf in the curiofity of infpecting thofe engraved or carved tablets of wood which are preferved in the mufeum of the Honourable Eaft India Company, in Leadenhall-ftreet.

We have purfued this mixture of fact and probability thus far, becaufe it appeared to us to contain the beft evidence on the fubject that is now obtainable; and becaufe even this feems to render the ufelefsly-protracted and never-ending difputes, which have been fo long kept up by certain interefted

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refted print-dealers and their prey, and their literary jackalls, about the fuperior pretenfions of Italy or Germany to the difcovery of this art; a mere recreation of idle credulity; a wafting of controverfial ink and ftrength in ftrenuous idlenefs; an affair of fpurious importance between "tweedle dum and tweedle dee."

If ridicule might find any other place in our Cyclopædia than under the letter R, we fhould here have recommended thefe rakers together of early German and Italian rubbifh; thefe difciples of their rival pretenfions; thefe admirers of the miferable virgins, and meagre faints and faviours of thofe dark ages of art, which preceded the refurrection of the antique fculpture; thefe complimenting and catalogue-making worfhippers of the pagods of tafteleffnefs, who affect fuch an exquifite feeling for their wooden prodigies, to be confiftent, and ufe their utmoft diligence in feeking after the chips of the twins of Ravenna, or the ftill earlier chips of the wood-engravers of China, and to tell the taftelefs and doting world of bibliographical cognofcenti, that thefe antique excifions are "graceful," or even more "elegant," than thofe which Cupid in fhaving from his bow, in the celebrated picture by Corregio, in the collection of the moft noble the marquis of Stafford.

In order to confer as much of factitious importance as might be found practicable on thofe relics of early European engraving and printing, for which thefe writers affect fo great veneration; and to keep up the delufive idea that xylography and block-printing were *invented* here rather than *feen* elfewhere, the difference between change of form and change of colour in rendering impreffions has been dwelt on with fome emphafis: but nothing in the procefs of impreffing ftamps is of more frequent and ordinary occurrence, than for fufficient dirt to accumulate in an intaglio ftamp that has lain by for any length of time, to produce a change of colour in the firft impreffion yielded after fuch lapfe of time. It muft even have been a common, becaufe obvious and efficient, mode of cleaning out the engraver's work. How frequently muft this have occurred in fealing, for example. How frequently does it occur now: and here, without genius or meditation, is the link fupplied at once in the chain of petty caufes and effects, that has been fo much magnified by the ftupidity and tafteleffnefs of modern dealers and collectors.

Of the impreffion of eight copies, mentioned by Papillon, of the life of Alexander, from the hands of the Cunio, it is not known that any remain; nor will this excite furprife, when we reflect that entire editions of fome works that have been fubfequently printed, have been fwept from the face of day. The wood-engravings which fucceeded thefe by the interefting twins of Ravenna, or were produced about the fame period, appear to have been honeftly thought of at the time; that is to fay, thought of very little, becaufe unworthy of being thought of much. From their non-importance, they have either all difappeared, or, from the fame caufe, not having been dated, the age of fuch of them as do remain, if any remain, is not known. The former of thefe is probably the chief reafon of their difappearance; for who would think of feeking for the tops of ballads, or the dying fpeeches of criminals, or dirty playing-cards, which were printed even fifty years ago, or of preferving fuch things if accidentally found? and the early European wood-engravings of which we are treating, until Michael Wolgemuth arofe, and introduced his better works of this kind into the Nuremberg Chronicle, were fcarcely of more confequence than thefe loweft objects of the notice of the vulgar.

But though the prints have difappeared, a decree of the fenate of Venice remains to atteft their former exiftence, and that "the art and myftery of making cards and printed figures had," *in the year* 1441, "*fallen to total decay*, and this in confequence of the *great quantity* of playing-cards and coloured figures printed, which are made out of Venice." The decree proceeds: "to which evil it is neceffary to apply fome remedy, in order that the faid artifts, who are a great many in family, may find encouragement rather than foreigners; let it be ordered and eftablifhed," &c. &c.

This edict, as Mr. Ottley has well obferved, fpeaks of "the art of making cards and printed figures in terms which would have been every way appropriate, had the edict had for its object the eftablifhment of the oldeft manufacture of Venice; and when coupled with other circumftances, efpecially the account of the two Cunio, furnifhes a ftrong ground for the conjecture that engraving in wood had from a very early period been practifed by the Venetians, who may eafily be fuppofed to have learnt it in the courfe of their commerce with the Chinefe."

The "printed figures," which are fpoken of along with the playing-cards in the Venetian edict, were of the fuperftitious or devotional character to which we have already alluded, and which are defcribed by Heinnekin as being foon afterward common in Germany and the Low Countries, when they were, — both the legendary wonders and the playing-cards,—defignated by the fame general term, and manufactured by the fame hands; that is to fay, cut in wood by the *Formfchnieders*, and coloured afterward by the *Briefmalers*. And to this teftimony of the German writer, the profeffor Fufeli adds, that "in the vulgar tongue of Zurich, and ftill more in that of the Roman Catholic cantons of Switzerland, *Helgen*, which is a corruption of *Heiligen*, meaning holy faints, is ufed to denote any hiftorical print." The reafon he gives for which is, "the firft prints reprefented the figures of faints, or other devotional fubjects, and were, on that account, termed *Helgen;* the term, in procefs of time, became generic, as others do, and is now ufed to denote prints of any kind, even thofe of profane fubjects."

Of thefe fuperftitious excitements of the vulgar, the baron ftates, that he faw feveral which he believes to be of ancient date in the library of Wolfenbuttel. "Thefe pieces," fays he, "are of the fame dimenfions as our playing-cards: they meafure three inches and a quarter in height, by two inches and a half in width." There are alfo in the fame library, at the end of the book entitled "*Ars Moriendi*," five prints, in which are engraved divers figures of angels, devils, dying perfons, faints, &c. fimilar to playing-cards, and of the fame fize, each figure being marked with a letter of the alphabet.

An engraved outline of a figure of this kind, of St. Bridget writing, with the Virgin and Child above, furrounded by a fort of cloud of Gothic fcroll-work, and behind her a pilgrim's hat, wallet, and ftaff, Mr. Ottley has brought forward from the collection of earl Spencer. Perfpective is grofsly violated here, and it is of more than twice the dimenfions of an ordinary playing-card; but this print, with another mentioned by M. Thierry as being in the library of the public Academy at Lyons, and which is faid to be dated 1384, Mr. Ottley thinks may help to fill up the chafm between the work of the Cunio; and the larger print of St. Chriftopher croffing the water with the facred Infant, which is dated 1423, is alfo in the collection of the fame noble earl, and will be found mentioned in a more particular manner in the commencement of our account of the German *School of Engraving*.

WOODFORD, in *Geography*, a county of Kentucky, bordering on the Ohio, with 9171 inhabitants, of whom 3179 are flaves. Verfailles is the chief town, containing 488 inhabitants, of whom 235 are flaves.—Alfo, a town of Vermont, eaft of Bennington, in the county of Bennington, with 254 inhabitants.

WOODGURRY, a town of Hindooftan, in Bednore; 35 miles N.E. of Simogu.

WOODIOUR, a town of Hindooftan, in Coimbetore; 10 miles N. of Daraporum.

WOODRIFF, a town of Tunis; 7 miles N.W. of Gabs.

WOODRUFF, Sweet, in *Agriculture*, a perennial plant, which is eat by different forts of live-ftock; and the aromatic flowers of which, when infufed in water, excel in flavour, it is faid, the fineft teas.

WOODS, *Lake of the*, in *Geography*, a lake of North America, fo called from the multiplicity of wood growing on its banks, fuch as oaks, pines, firs, &c. Its greateft length is about 70 miles, and greateft breadth forty. It contains but few iflands, and thofe fmall. N. lat. 49°. W. long. 90°.

Woods, a town of South Carolina; 32 miles W.N.W. of Georgetown.

Woods's *Bay*, a bay on the ftraits of Magellan; 15 miles W. of Cape Froward. S. lat. 53° 58′. W. long. 72° 55′.

Woods's *Ifland*, a fmall ifland near the north coaft of Jamaica. N. lat. 18° 12′. W. long. 76° 8′.

WOODSAMADRUM, a town of Hindooftan, in Golconda; 12 miles S. of Damapetta.

WOODSBOROUGH, a poft-town of Maryland; 75 miles N. of Wafhington.

WOODSIA, in *Botany*, owes its name to Mr. R. Brown, who dedicates this genus to the commemoration of Mr. Jofeph Woods, F.L.S., an excellent Britifh botanift. A valuable paper on the Rofes of this country, about to appear in the Tranfactions of the Linnæan Society, will abundantly prove Mr. Woods' claims to fuch a diftinction, even were it far lefs indifcriminately beftowed than ufual.—Brown Tr. of Linn. Soc. v. 11. 170. Sm. Compend. Fl. Brit. ed. 2. 152. Purfh 660.—Clafs and order, *Cryptogamia Filices*. Nat. Ord. *Filices dorfales*.

Gen. Ch. *Fructification* in roundifh *groups*, on the back of the leaf. *Involucrum* cup-like, open, fmall, nearly flat, jagged, fringed with awl-fhaped, incurved, jointed hairs. *Capfules* feveral, obovate, on fhort ftalks, crowded, in the centre of the involucrum, each bound by a vertical, jointed, elaftic ring, and burfting irregularly at one fide. *Seeds* numerous, kidney-fhaped, granulated, extremely minute.

Eff. Ch. Groups of capfules fcattered, roundifh, each feated on a capillary-fringed involucrum.

Obf. We gladly here adopt the term *group*, as technically fynonymous with Sorus, (fee that article,) inftead of dot, fpot, or line, which are liable to much exception.

1. W. *ilvenfis*. Long-leaved Woodfia. Br. n. 1. Purfh n. 2. (Acroftichum ilvenfe; Linn. Sp. 1528. Fl. Dan. t. 391. Polypodium ilvenfe; Swartz Syn. Fil. 39. Willd. Sp. Pl. v. 5. 198. "Schkuhr Crypt. 16. t. 19." Nephrodium lanofum; Michaux Boreal.-Amer. v. 2. 270. Lonchitis afpera ilvenfis; Dalech. Hift. 1221. f. 3.)—Frond pinnate; leaflets lanceolate, deeply pinnatifid, with numerous, nearly uniform, oblong lobes. This appears to have been firft difcovered in the Mediterranean ifle of Ilva, whence the fpecific name, which is very exceptionable, the fame fpecies being found on rocks in the north of Europe, as well as in North America, from Canada to Virginia. We have American fpecimens from Mr. Francis Boott, agreeing exactly with Siberian ones in the Linnæan herbarium. We know not of this fpecies having been detected in Britain. The *fronds*, five or fix inches high, grow erect, in denfe tufts. Their *ftalks*, not quite half that height, are brown, bearing, like the mid-rib of each principal *leaflet*, many ftrap-fhaped, taper-pointed, membranous fcales. The *frond* itfelf is oblong, or lanceolate, compofed of twelve or more pairs of oblong lanceolate *leaflets*, or *pinnæ*, oppofite or alternate, each about an inch long, numeroufly pinnatifid; their lower fegments wavy, nearly equal and uniform; upper confluent: their upper furface is even, nearly fmooth, of a fine green; lower covered with pale brown fcales, and crowded hairy *groups* of *capfules*.

2. W. *hyperborea*. Round-leaved Woodfia. Brown n. 2. t. 11. Purfh n. 1. Sm. Compend. 158. (Acroftichum hyperboreum; Liljeblad in Stockh. Tranf. for 1793. 201. t. 8. A. alpinum; Bolt. Fil. Brit. 76. t. 42. Polypodium hyperboreum; Swartz Syn. Fil. 39. Willd. Sp. Pl. v. 5. 195. Sm. Engl. Bot. t. 2023. P. arvonicum; Fl. Brit. 1115. P. ilvenfe; With. 774. Filicula pumila, Lonchitidis Marautæ fpecies Cambrobritannica; Pluk. Phyt. t. 89. f. 5.)—Frond pinnate; leaflets heart-fhaped, rounded, pinnatifid, lobes rounded, waved, unequal.—Native of alpine rocks, chiefly in the northern parts of Europe. It occurs, though rarely, on the higheft fummits of the Welfh and Scottifh mountains. A fmaller plant than the preceding, often not above an inch high, though generally about three inches. The *leaflets* are fhorter, and more rounded, as well as their lobes; of a thinner texture; much lefs deeply pinnatifid, except at their bafe, where the bottom pair of lobes are often fo deeply feparated, as to form two little *leaflets*, wavy, or obfcurely lobed, and fometimes of unequal fize. The *main ftalk* is fcaly; *leaflets* hairy on both fides.

We readily agree with Mr. Brown, that fome intermediate varieties of each fpecies render the fpecific characters of both confiderably difficult. Yet there feems no reafon to doubt their being diftinct plants. Mr. Bauer's delineation of this fern, in the Linnæan Tranfactions, excellently engraved by Warner, is one of the fineft illuftrations of a natural production that can any where be feen.

WOODSTOCK, (New,) in *Geography*, a borough and market-town in the hundred of Wootton, and county of Oxford, England, is fituated 8 miles N.N.W. from Oxford, and 62½ W.N.W. from London. It has a market on Tuefday, and fairs on the 5th of April, Tuefday in Whitfun-week, 2d of Auguft, 2d of October, Tuefday after the 1ft of November, and 17th of December. The town fends two reprefentatives to parliament, the mayor being the returning officer. The corporation confifts of a mayor, a high-fteward, a recorder, town-clerk, four aldermen, and fixteen common-council men. In 1811, the houfes in Woodftock were 235, and the inhabitants 1540. The fouth part of the prefent church is a fragment of an ancient chapel; but the northern face and the tower were erected in 1785. Adjoining to the church is a grammar-fchool, founded in 1585 by Mr. Cornwell, a native of the place; and near the fouthern entrance of the town is a range of alms-houfes, erected in 1793 by the duchefs of Marlborough, for fix poor widows. The town-hall, a ftone building, has under it the market-place, and was erected in 1766, from a defign of fir William Chambers, at the expence of the late duke of Marlborough. The principal manufactures of the town are thofe of gloves and of polifhed fteel. Various articles of this fteel have been executed with great delicacy, and fold at high prices. This manufacture was introduced into Woodftock at the beginning of the laft century; but it it has much declined, on account of the cheapnefs of the cutlery goods furnifhed by Birmingham and Sheffield. The glove-manufacture is of later date; but has increafed in the prefent day fo much, that from 300 to 400 pairs of gloves are made weekly in the town and the neighbouring villages, and thus afford employment for about 1400 women and girls, and 70 men. Old Woodftock, of which only one manfion and a few irregular houfes remain, ftood in a fheltered fituation on the little river Glyme, which fupplies the magnificent piece of water in Blenheim-park. The manor-houfe, or royal palace, on the N. bank of the deep valley of the Glyme, within the bounds of the park, was the refidence of Fair Rofamond, whofe romantic adventures are deeply interwoven with the hiftory of Henry II.; but the building has long difappeared. In this palace, that king, in 1164, received the homage of Malcolm, king of Scotland, and Rice, prince of Wales. In 1275 Edward I. held a parliament at Woodftock, and there was born his fecond fon, Edmund, as was alfo the renowned Black Prince. Woodftock was inhabited occafionally by Richard II., and there Henry III. narrowly efcaped affaffination by a fanatic prieft: an attempt was there alfo made by Morifco on the life of Henry VIII. The old palace was afterwards employed as a prifon for Elizabeth, his daughter. In the time of the civil wars it fuffered feverely from the parliament's party; and about a century ago the gate-houfe, the laft fragment of the edifice, was pulled down. But Woodftock is moft worthy of note for having produced Chaucer, who was born there about 1328. The houfe in which he afterwards refided, while the court was in the palace, ftood at the W. end of the town, near the ufual entrance into Blenheim-park. Some relics of this building are ftill pointed out.

The great object of attraction at Woodftock is the magnificent palace of Blenheim, with the furrounding grounds, water, and park. The honour and eftates of Woodftock, long belonging to the crown, were in 1705 conveyed by queen Anne, on the addrefs of the houfe of commons, to the illuftrious John, duke of Marlborough, to preferve the memory of his eminent fervices as a warrior and a ftatesman; particularly for the fignal victory obtained by him, and prince Eugene of Savoy, at Blenheim, in Germany, over the French and Bavarians, on the 2d of Auguft 1704. The houfe was erected by fir John Vanbrugh, at a convenient diftance from the S. brink of a deep dell, in which ran the Glyme. The general diftribution of this fuperb ftructure confifts of a central mafs of building, inclofing two fmall courts, and connected by colonnaded wings to two fpacious quadrangles, forming the grand court of entrance. The centre is ornamented with a Corinthian portico, furmounted by a pediment and military emblems. The wings are crowned with towers ferving at once to contain the chimneys, and to contribute to the picturefque grandeur of the edifice. The garden-front, extending from E. to W. 348 feet, is grand and magnificent. The interior of the manfion contains many noble apartments, adorned with paintings of eminent mafters; particularly with a feries of mythological pictures from the admirable pencil of Titian, prefented to the firft duke of Marlborough by the king of Sardinia, and with portraits of many eminent characters by the beft artifts. The library, occupying the whole of the W. front, 183 feet long and nearly 32 wide, is a magnificent room, originally deftined to be a picture-gallery, but afterwards furnifhed with the grand Sunderland collection of books, containing upwards of 17,000 volumes. At one end is a marble ftatue of queen Anne by Ryfbrack. In the W. wing is the chapel appropriately fitted up, and containing a monument, by the fame fculptor, of the firft duke, his duchefs, and their two fons, who died young. In the E. quadrangle of offices is the theatre, originally a green-houfe, calculated to accommodate 200 fpectators. Near the E. angle of the manfion an obfervatory was erected by the late duke of Marlborough, and provided with a complete apparatus for aftronomical obfervations by Ramfden; a grand telefcope by Herfchel was prefented to the duke by his majefty, after his vifit to Blenheim in 1786. The ftate-approach to the palace is by a ftraight avenue from the N. extremity of the park, over the river, by a bridge of one fpacious and two fmaller arches. Flowing in a deep dell, the fmall ftream is made to affume the appearance of a naturally-winding river, expanding below the bridge into a broad irregular lake; thus, with the bridge, according with the grandeur of the palace and the noble extent of the park. A lofty column is erected in the midft of the great avenue, furmounted by a ftatue of the great duke, and charged on the pedeftal with infcriptions ftating his fervices and rewards. In the N.W. part of the park of Blenheim, veftiges may be traced of the ancient road, Akeman-ftreet. Nearly two miles W. from the park is the village of Stonesfield, at which place was difcovered, in 1711, a teffellated pavement 35 feet by 20, reprefenting, among other figures, a Bacchus, with his thyrfus and cup, mounted on a tyger. In addition to this curious antique, in 1779 were difcovered, near the fame fpot, the areas of a number of other apartments paved in the fame manner; and adjoining were the remains of a bath with its hypocauft: Roman coins from Vefpafian downwards were found on the fame fpot. A plan and fome account of thefe remains have been publifhed by Henry Hakewill, efq. architect.—Beauties of England and Wales, Oxfordfhire, by J. N. Brewer, 8vo. 1811. The Blenheim Guide, by Dr. Mafon, 12mo. 1817. Havell's Views of Seats include two fine Engravings of Blenheim Palace, and a critical Account of the Houfe, Scenery, &c. folio, 1818.

Woodstock, a town of the ftate of Connecticut, in the county of Windham, with 2654 inhabitants; 57 miles S.W. of Bofton.—Alfo, a town of North Carolina, on the left bank of Pamlico river; 22 miles N.N.E. of Newbern. —Alfo, a poft-town of Virginia; 112 miles W. of Wafhington.—Alfo, a poft-town of Vermont, in the county of Windfor, with 2672 inhabitants; 5 miles N.W. of Windfor. —Alfo, a townfhip of New York; 46 miles S. of Albany. —Alfo, a poft-town of New Jerfey; 26 miles S.S.W. of Philadelphia.

WOODVILLE, William, M.D. in *Biography*, was born at Cockermouth, in the year 1752. Having received a good claffical education in his native town, he was placed with a refpectable apothecary, to whom he ferved a fhort apprenticefhip. He afterwards proceeded to Edinburgh, where, after the ufual refidence, he obtained, in 1775, the degree of M.D., having written and defended a very ingenious thefis "De irritibilitate fibrarum motricium." After paffing fome time on the continent, he returned and fettled near his native place, where he practifed his profeffion five or fix years. Dr. Woodville then came to London, and was foon appointed one of the phyficians to the Middlefex Difpenfary, the duties of which office he difcharged in an exemplary manner. In 1790 he publifhed the firft part, which was afterwards completed in four quarto volumes, of a highly valuable work, intitled "Medical Botany." In 1791 he was elected phyfician to the Small-pox Hofpital, in the room of the late Dr. Archer; and it may truly be faid, that no man ever devoted, more confcientioufly or zealoufly, time and great talents, to the promotion of an object, than did Dr. Woodville to improvement in the medical treatment of the patients, as well as in the general government of the eftablifhment. To the officers of the hofpital, and thofe governors who took moft intereft in its welfare, his merits were well known; and fome of the fruits of his genius and induftry are before the public in a volume which was publifhed in 1796, intitled "The Hiftory of the Small-pox in Great Britain, &c." This work, which it was the author's defign to occupy two volumes in 8vo., was well conceived, including a brief hiftory of the difeafe, and a review of all the publications on the fubject of inoculation, with an experimental inquiry into the relative advantages of the various meafures that had been recommended. Only the firft volume of this work, which is well written, and contains much valuable information, was publifhed, the happy difcovery of the efficacy of vaccination having, in the author's opinion, fuperfeded the neceffity of the fecond appearing. Dr. Jenner's grand difcovery made a due impreffion on the mind of Woodville; and as no other man had equal opportunities of witneffing and lamenting the ravages of the fmall-pox, fo no perfon could be more fincerely anxious and active in the adoption of thofe means that were found adequate to guard mankind againft that peftilence. It is very true, that on the fubject of vaccination he was, like every body elfe, at firft fceptical; but he fuffered no opportunity to be loft of afcertaining its efficacy, and then of proclaiming his belief in it. Unhappily, in fome of his early experiments an error was committed; he was not aware of the influence of the variolous atmofphere of the hofpital. The refult was, that in certain inftances, either pure fmall-pox matter, or a deteriorated vaccine lymph, had been inferted into the arms of fome patients. The effects were faithfully detailed; but being fo different from thofe that had been defcribed by Dr. Jenner, that excellent man and benefactor to the human race vifited Dr. Woodville, with whom he argued and remonftrated on the fubject. It is to be regretted that fome afperities of remark took place between them, although both were equally and honourably engaged in the developement of truth. The difcuffion, however, as is always the cafe, proved very ufeful in the diffemination of the new practice; and if Dr. Jenner had reafon to find fault with the refult of Dr. Woodville's early proceedings, he muft have been abundantly gratified by his fubfequent experiments and publications. The ample field in which Woodville was placed enabled him to vaccinate great multitudes, fome thoufands of whom he afterwards tefted by variolous inoculation, and thus gave that publicity to vaccination, and that confidence in it, which it could not otherwife have attained in the courfe of many years. He was alfo ardently engaged in the inquiry into the nature and origin of the vaccine lymph; and, at his requeft, the writer of this fhort article three times inoculated him with frefh greafe from the heel of a difeafed horfe. If in the heat and bitternefs of contention men feek an apology for unguarded expreffions and affertions, this cannot be granted to thofe who calumniate the dead; and therefore the ftatement in a late hiftory of vaccination of Dr. Woodville having fallen a victim to the drinking of ardent fpirits, is deferving of reprobation. Dr. Woodville cultivated the fociety of his profeffional brethren, by whom, on account of his talents and companionable qualities, he was held in high eftimation; and one of thofe who enjoyed the intimacy of his friendfhip, from the period of his fettling in London until the day of his death, contradicts the above unfounded calumny. His difeafe, which terminated in dropfy, had made fuch gradual advances during the laft year of his life, that he frequently talked of his death, which no man ever contemplated with greater equanimity, as likely to take place about a certain affigned period.

He died at the hofpital on the 26th of March 1805; and on the 3d of April, a warm and juft eulogium was pronounced over the body in the faloon by his friend Mr. Highmore. His parents having been Quakers, he by his own defire was interred in the Friends' burial-ground in Bunhill-fields, after a very appropriate addrefs at the grave by Mrs. Pryor.

The editor is indebted for the preceding article to his much-efteemed friend J. Norris, efq., no lefs diftinguifhed by his mental and moral qualities than by judgment and extent of reputation in his profeffion.

Woodville, in *Geography*, a poft-town of Virginia; 94 miles W. of Wafhington.

WOODWARD, John, in *Biography*, was born in Derbyfhire in 1664, and, being intended for trade, was apprenticed in London; but in a little while abandoned the fhop for the fake of fcientific purfuits. In 1687 Dr. Barwick took him into his family, and for the fpace of four years gave him inftruction in medicine and anatomy. He then recommended him to the medical profefforfhip in Grefham college, to which he was elected in 1692. Having directed his particular attention to foffils, with a view to which he had travelled through many diftricts of England, he publifhed in 1695 "An Effay towards a Natural Hiftory of the Earth and terreftrial Bodies, efpecially Minerals; as alfo of the Sea, Rivers, and Springs; with an Account of the Univerfal Deluge, and of the Effects that it had upon the Earth," 8vo. His preparatory knowledge for a work of this kind was very flight, and therefore the execution of it was attacked by Dr. Martin Lifter, and others. However, in the imperfect ftate of geology at that time, his performance engaged notice, and he was chofen in 1693 a fellow of the Royal Society. At this time he was in poffeffion of an ancient iron fhield, in the concavity of which was a fculpture reprefenting the ftory of Camillus and the Gauls at Rome; and as it was a great curiofity among the learned, Dodwell gave an account of it in a Latin treatife, entitled "De Parma equeftri Woodwardiana Differtatio." By this circumftance Woodward was led to increafe his acquaintance with a certain clafs of literati, though he did not efcape the ridicule of the wits. In 1695 he was created M.D. by archbifhop Tenifon, and in 1696 he obtained the fame degree from Cambridge; and thus honoured, he was prepared for an admiffion into the College of Phyficians as a fellow in 1702. But purfuing his inquiries into natural hiftory and antiquities, he publifhed fome pieces in thefe departments: *viz.* "Some Thoughts and Experiments concerning Vegetation," communicated to the Royal Society, and printed in the Philofophical Tranfactions for 1669; "Naturalis Hiftoria Telluris illuftrata et aucta: accedit Methodica Foffilium in Claffes Diftributio," 1714, intended as a grand reply to thofe who objected to his Natural Hiftory of the Earth, which had been tranflated into Latin by Scheuchzer at Zurich; and "An Account of fome Roman Urns, and other Antiquities, lately digged up near Bifhopfgate; with brief Reflections upon the ancient and prefent State of London: in a Letter to Sir Chriftopher Wren." In his medical capacity, he publifhed in 1718 "The State of Phyfic and of Difeafes, &c." 8vo., in which he advanced the notion, that the bile and its falts, re-abforbed into the blood, were the true caufe of life and animal motions, and that the fame fermenting in the ftomach were the caufe of difeafes; whence he was led to conclude that emetics to evacuate the morbid bile, and oily and unguinous medicines to correct it, were univerfal remedies. This publication produced a controverfy with Dr. Freind, in which Woodward was anfwered both ludicroufly and ferioufly, fo that he gained little credit by his medical theory or practice. His chagrin, however, was diverted by the ftudy of foffils, and the augmentation of his cabinet of fpecimens.

ſpecimens. He ſoon after fell into a decline, which terminated his life in his apartments at Greſham college in 1727, at the age of 63. He bequeathed his perſonal property to the univerſity of Cambridge, for the endowment of an annual lectureſhip, on a ſubject taken from his own writings in natural hiſtory or phyſic. Soon after his death were publiſhed an Engliſh edition of his "Method of Foſſils," with various additions; and "A Catalogue of Foſſils in the Collection of J. Woodward, M.D.," in 2 tomes, 8vo., a work of permanent eſtimation among geologiſts. In 1737 Dr. Templeman publiſhed Woodward's "Select Caſes and Conſultations in Phyſic," in which ſome valuable obſervations are interſperſed. One of his hypotheſes was, that the life reſides in the blood, and in the ſeparate parts of the body, not in the nerves; in confirmation of which he made many experiments, eſtabliſhing the vis inſita of muſcles. Biog. Brit. Haller. Gen. Biog.

Woodward, an officer of the foreſt, whoſe function is to look after the *woods*, and obſerve any offences either in vert, or veniſon, committed within his charge; and to preſent the ſame; and in caſe any deer are found killed, or hurt, to inform the verderor thereof, and preſent the delinquents at the next court of the foreſt.

Woodwards may not walk with bows and ſhafts, but with foreſt-bills. *Arcum et calamos geſtare in foreſta non licet, ſed* (*ut reſcripti utar verbo*) *hachetum tantummodo*. Term. Hil. an. 13 Ed. III.

WOODWARDIA, in *Botany*, a very fine and well-marked genus of ferns, dedicated by the writer of this article to the honour of his long and highly-valued friend, and botanical companion, Thomas Jenkinſon Woodward, eſq., LL.B., F.L.S., one of the beſt Engliſh botaniſts, whoſe ſkill and accuracy are only equalled by his liberality and zeal in the ſervice of ſcience. Mr. Woodward's name is well known as the important aſſiſtant of Dr. Withering in his national *Flora* (ſee Witheringia), as well as by his communications to the Linnæan Society; amongſt which, an eſſay on the *Britiſh Fuci*, written in conjunction with the preſent learned biſhop of Carliſle, and printed in the third volume of that Society's Tranſactions, ſtands conſpicuous.—Sm. Mem. de l'Acad. de Turin, v. 5. 411. t. 9. f. 3. Tracts 238. t. 1. f. 3. Willd. Sp. Pl. v. 5. 416. Swartz Syn. Fil. 116. Sprengel Crypt. Engl. ed. 131. t. 4. f. 29. Ait. Hort. Kew. v. 5. 523. Purſh 669.—Claſs and order, *Cryptogamia Filices*; ſect. annulatæ. Nat. Ord. *Filices dorſiferæ*.

Eſſ. Ch. Groups of capſules oblong, diſtinct, ſtraight, ranged in a ſimple row, in bordered cavities, parallel to each ſide of the rib. Involucrum ſuperficial, vaulted, ſeparating towards the rib.

Obſ. Mr. Brown has ſeparated from this genus, by the name of *Doodia*, Prodr. Nov. Holl. v. 1. 151, ſuch ſpecies as have a flat *involucrum*, unconnected at its inner margin, and originating from an interbranching, or connecting, vein, at its oppoſite ſide. In theſe the *capſules* are not ſunk into any bordered cavity, nor are the *groups*, with their *involucrums*, ſo turgid, or prominent. *Woodwardia caudata*, Cavan. Leccion. 264. Swartz Syn. Fil. n. 2. Willd. n. 2, belongs to this genus of *Doodia*; and Mr. Brown defines two others, *aſpera* and *media*, as likewiſe natives of New Holland, in which country, it ſeems, no true *Woodwardia* has been found.

1. W. *anguſtifolia*. Narrow-leaved Woodwardia. Sm. n. 1. Swartz n. 1. ("W. floridana; Schkuhr Crypt. 103. t. 111." W. onocleoides; Willd. n. 1. Purſh n. 1. Onoclea nodulosa; Michaux Boreal.-Amer. v. 2. 272. Swartz Syn. Fil. 111. Acroſtichum areolatum; Linn. Sp. 1526. A. n. 12; Linn. Am. Acad. 274. Oſmunda caroliniana; Walt. Carol. 257. Lonchitis major virginiana, folio vario, alis Polypodii in modum conjunctis; Moriſ. ſect. 14. t. 2. f. 24. Filix floridana, prælongis et anguſtis pinnulis, &c.; Pluk. Amalth. t. 399. f. 1.)—Fronds pinnate; leaflets linear, acute, entire; the barren ones finely ſerrated.—In cedar and cypreſs ſwamps, from New Jerſey to Florida, fructifying in Auguſt. Perennial, about a foot high. *Purſh*. The *root* is creeping, ſcaly and ſhaggy, bearing ſeveral ſtalked, upright, ſmooth *fronds*, of a lanceolate figure, with a long taper point: the barren ones conſiſting entirely of lanceolate, acute, finely ſerrated *leaflets*, decurrent at their baſe, and ſomewhat confluent: the fertile of rather fewer, more diſtant, longer and narrower ones, likewiſe ſlightly decurrent and confluent at their baſe, each *leaflet* being nearly covered at the back, on each ſide of the rib, with a cloſe ſeries of turgid, nearly cylindrical, *groups*, a quarter of an inch long, of numerous *capſules*, every *group* cloſely covered by its own convex *involucrum*. Each *group* is encompaſſed with a conſiderably elevated uninterrupted line, bordering the hollow in which it lies. Willdenow has moſt unadviſedly changed the eſtabliſhed ſpecific name, without any right or pretence, ſurely for the worſe rather than the better.

2. W. *japonica*. Blunt-lobed Japan Woodwardia. Sm. n. 2. Swartz n. 3. Willd. n. 3. Sprengel as above, f. 29. (Blechnum japonicum; Thunb. Jap. 333. t. 35. Linn. Suppl. 445.)—Frond pinnate; leaflets ſeſſile, half pinnatifid, with cloſe, obtuſe, ſerrated lobes. Rows of fructification extremely cloſe and crowded.—Gathered by Thunberg near Nagaſaki, and in other parts of Japan, fructifying in June. *Frond* two feet, or more, in height. *Stalk* roughiſh, and ſomewhat ſcaly, not ſmooth. *Leaflets* five or ſix inches long, pointed, quite ſeſſile, ſcaly at the baſe, each divided about half way to its rib into twelve pair, or more, of broad, bluntiſh, rounded, ſerrated lobes, above an inch long, and half an inch broad, quite cloſe and parallel at the ſides; paler beneath. *Groups* oblong, three or four in a continued line, cloſe to the rib on each ſide. The *involucrum* reflexed to one ſide, after the *capſules* are fallen, leaves the cavity expoſed, and like a box with its lid. The *capſules* appear all to be inſerted into that margin of the cavity to which the *involucrum*, or lid, is attached.

3. W. *orientalis*. Sharp-lobed Japan Woodwardia. Swartz n. 4. alſo p. 315. Willd. n. 4. ("Blechnum radicans; Houtt. N. Hiſt. v. 2. t. 97. f. 1.")—Frond pinnate; leaflets ſtalked, deeply pinnatifid, with ſpreading, acute, ſerrated lobes. Rows of fructification cloſe. Involucrum ſomewhat creſcent-ſhaped.—Gathered by Thunberg in Japan. Very diſtinct from the laſt, as well as from *W. radicans*. The *frond* is more coriaceous than either, and ſeems to be rather glaucous. *Stalk* ſmooth and naked, at leaſt in its upper part. *Leaflets* the ſize of the laſt, but tapering at their baſe into a ſhort ſtalk; their ſegments conſiderably diſtant from each other, except at the very baſe, and ſomewhat revolute; ſharply ſerrated, particularly at the point. *Groups* ſlightly lunate outwards, eſpecially the upper and ſhorter ones, about ſeven in each row, crowded, and cloſe to the rib. Perhaps it was from a ſpecimen of this, confounded with the preceding, that Profeſſor Thunberg deſcribed the main *ſtalk* as altogether ſmooth, and zigzag.

4. W. *virginica*. Virginian Woodwardia. Sm. n. 3. Swartz n. 7. Willd. n. 6. Ait. n. 2. Purſh n. 2. (W. Baniſteriana; Michaux Boreal.-Amer. v. 2. 263. Swartz n. 8. Blechnum virginicum; Linn. Mant. 307. Filix mas, vulgari ſimilis, pinnulis amplioribus planis, nec

 crenatis,

crenatis, virginiana; Pluk. Almag. 151. Phyt. t. 179. f. 2.)—Frond pinnate; leaflets feffile, deeply pinnatifid, with fpreading, obtufe, flightly crenate lobes. Rows of fructification accompanying their mid-rib as well as the ribs of the lobes.—In the fwamps and fhady woods of Virginia and Carolina. *Purfh.* We received it from Kew garden in 1785. The fructification is perfected in July and Auguft. The *frond* is eighteen inches, or more, in height, with a pale fmooth *ftalk. Leaflets* alternate, above a finger's length, and about an inch, or more, in width, bright green, fmooth; their numerous fegments fpreading moderately from each other, forming an acute angle at the bafe; their margin is fomewhat revolute, and very obfcurely crenate. *Fructification* moft abundant on the leaflets of the upper half of the frond, forming lines all along their principal rib, at each fide, as well as along the rib of each fegment; the *groups* finally confluent. The depreffions in which the groups are feated are very flight, though not imperceptible, and the *involucrum* of each is narrower, lefs vaulted, and fooner turned afide, than in any other fpecies with which we are acquainted, fo that the prefent plant is in fome meafure intermediate between *Woodwardia* and *Doodia*. Perhaps it may prove thefe two genera not to be diftinct, but while they remain fo, we concur with Mr. Brown in keeping this fpecies where it is. Plukenet's figure was drawn by Mr. Banifter, the original difcoverer of this fern.

5. W. *thelypterioides.* Small Woodwardia. Purfh n. 3. —"Frond pinnate; leaflets feffile, linear-lanceolate, pinnatifid; villous at the bafe: fegments of the barren ones oblong and bluntifh; of the fertile ones fhortened, triangular, and acute; all entire. Stalk downy, angular."—In fandy fwamps of South Carolina, near Charleftown, fructifying in July. Refembles the preceding, but is not half the fize. *Purfh.*

6. W. *fimbriata.* Fringed Woodwardia.—Frond pinnate; leaflets feffile, deeply pinnatifid, with fpreading, rather acute, lobes, fringed with fharp teeth.—Gathered by Mr. Menzies, on the weft coaft of North America. This is larger in every part than *W. virginica*, and diftinguifhed from that fpecies by its more acute fegments, whofe margin is very confpicuoufly and copioufly fringed with prickly teeth, directed towards the point. *Groups* of capfules large and turgid, ranged, a little obliquely, along the ribs of the fegments, from three to five pair on each fegment, none at the mid-rib of the leaflet itfelf. *Involucrum* ftrongly and permanently vaulted. The bottom lobe of each *leaflet*, at the lower fide, is fhortened, dilated, and half heart-fhaped, as is more rarely the cafe in *W. virginica*. Several of the upper *leaflets* are decurrent and confluent; the top ones undivided, and barren.

7. W. *radicans.* Rooting-ftalked Woodwardia. Sm. n. 4. Swartz n. 5. Willd. n. 5. Ait. n. 1. "Schkuhr Crypt. 104. t. 112." (Blechnum radicans; Linn. Mant. 307, excluding the reference to Plukenet, fee *W. virginica*. Filix italica non ramofa maxima glabra, polypodii folio, gallas ferens, D. Micheli; Till. Pif. 62. t. 24.)

β. W. *ftans.* Swartz n. 6. "Schkuhr Crypt. 104. t. 113." *Willd.*—Frond pinnate; leaflets nearly feffile, deeply pinnatifid, with parallel, taper-pointed, fharply ferrated lobes.—Native of deep clayey fiffures of rocks in Madeira, according to Koenig. Found alfo in Italy and Portugal. A hardy greenhoufe plant in England, and one of the moft handfome of its tribe. The *fronds* are two or three feet high, and a foot and a half or near two feet in breadth, of a fine green, fmooth, beautifully reticulated with veins, each main ftalk producing at the back, near the top, a round fcaly bud, or bulb, the origin of a young plant. *Leaflets* generally alternate, often a fpan long, fomewhat pectinate, with a long very flender point; their numerous fegments more or lefs crowded, flightly curved, lanceolate, minutely and fharply ferrated, each tapering to a fharp elongated point. *Groups* of capfules about feven pair on each fegment, (none at the mid-rib of the *leaflet*,) clofe, direct, fcarcely ever at all divaricated, turgid, pale brown, the cavities in which they lie very neatly and confpicuoufly bordered: uppermoft leaflets fimple and confluent, as in the foregoing fpecies. We know not how the *W. ftans*, which Cavanilles feems, by Swartz's work, to have firft noticed, is fuppofed to differ from the *radicans*; but Willdenow afferts, on a comparifon of numerous fpecimens, from different countries, that there is no fpecific diftinction between them.

8. W. *difpar.* Various-leaved Woodwardia. Willd. n. 7. (Filix latifolia, pinnulis ferè acuminatis, dentata; Plum. Fil. 13. t. 16.)—Fronds pinnate; leaflets feffile, lanceolate, pointed, pinnatifid, with elliptic-lanceolate, entire lobes. Fructification crowded on the much fmaller lobes, of a feparate narrower frond.—Found by Plumier in Martinico. Willdenow appears to have adopted this fpecies entirely from Plumier, a hazardous meafure, as its genus can only be gueffed from analogy. The barren *fronds* approach the laft fpecies in fize, but their fegments are fhorter, entire, rather obtufe, and by no means taper-pointed. Thofe *fronds* which bear fruit have *leaflets* fimilar in fhape and lobes to the others, but about one-third as large, at moft, bearing a fimple crowded row of *fructification* clofe to the rib of each fegment. The *groups* of capfules are fomewhat elliptical, and there is nothing adverfe to the generic character of a *Woodwardia*; but, on the other hand, there is no particular indication of that character.

The *root* is defcribed above an inch thick, and fix inches in length; externally black, with feveral vermicular branching fibres, clothed with tawny or golden pubefcence. *Stalk* of each *frond* near eighteen inches high, pale brown and fmooth, leafy from its middle part to the fummit, where it terminates in a large erect *leaflet*, conftructed exactly like the reft, being equal in fize to the larger lateral ones, and confiderably exceeding thofe immediately below it. Such is the habit of *W. anguftifolia*, but not of the other fpecies in general.

WOODY *Fibrous Matter*, in *Agriculture*, that which is produced from fmall particles of different forts of woody fubftances.

When merely formed of thefe parts, it is fuppofed to be the only vegetable matter that requires the aid of fermentation to render it nutritive to plants. The ufed bark of the tanner is a fubftance of this fort, which is very abforbent and retentive of moifture, but not penetrable by the roots of plants. See TANNERS' *Bark*.

Woody fibrous matter may likewife be prepared fo as to become a manure, by the action of lime upon it.

It is obferved in the "Elements of Agricultural Chemiftry," that as woody fibre confifts principally of the elements of water and carbon, the latter being in larger quantities than in the other vegetable compounds, any procefs that tends to abftract carbonaceous matter from it, muft bring it nearer in compofition to the foluble principles; and that this is done in fermentation, by the abforption of oxygen and production of carbonic acid; and that a fimilar effect is produced by lime. See LIME.

WOODY *Nightfhade*. See NIGHTSHADE.

WOODY *Head*, in *Geography*, a high cape on the coaft of New Zealand, in the South Pacific ocean. S. lat. 37° 42′.

WOODY *Iſland*, an iſland in the Eaſt Indian ſea. N. lat. 1° 46′. E. long. 106° 5′. See VICTOIRE.

WOODY *Point*, a cape on the weſt coaſt of North America. N. lat. 50°. W. long. 128° 5′.

WOODYCUTTY, a town of Hindooſtan, in Canara; 8 miles E. of Onore.

WOOF, among *Manufacturers*, the threads which the weavers ſhoot acroſs, with an inſtrument called the *ſhuttle*, between the threads of the warp, to form the web.

The woof is of different matter, according to the piece to be wrought. In taffety, both woof and warp are ſilk. In mohairs, the woof is uſually flax, and the warp ſilk. In ſattins, the warp is frequently wool, and the woof ſilk.

WOOFE, a name given in ſome parts of England to the ſea-wolf, or *lupus marinus;* which ſee.

WOOGINOOS, in *Botany*. See BRUCEA *Antidyſenterica*.

WOO-HOO-SHIEN, in *Geography*, a town of China, in the province of Kiang-nan, near the river Yang-tſe-kiang, a narrow cut leading from the river to the city, and flowing through the ſuburbs. This is a place of conſiderable trade; in the ſuburb there are ſeveral good dwelling-houſes, apparently belonging to perſons of diſtinction; and in the city itſelf there are many ſhops, which, it is ſaid, would not diſgrace the Strand or Oxford-ſtreet in London. Theſe ſhops are ſpacious, conſiſting of an inner and outward compartment, and well ſupplied with articles of all kinds, both of raw and manufactured produce. The porcelain ſhops are particularly large, and contain great varieties of the manufacture. The main ſtreet leading directly through the city is not leſs than a mile in length. Several ſtreets branch off from this, which are all paved, and contain good houſes. The number of ſhops that are filled with lanterns of all deſcriptions, both horn and paper, indicate manufactories of thoſe articles. The principal wall of the city extends on the north face; and the other is ſo overtopped with houſes, that it almoſt eſcapes notice in paſſing down the main ſtreet, which it croſſes. On the declivity of a hill to the northward are the temple and ancient tower. The temple, to which there is an aſcent by a very ſteep ſtone ſtair-caſe, reſembles that at Nankin, the god Fo being repreſented by the ſame attributes, and the principal hall being ſurrounded by ſimilar figures of ſages, in the ſame ſtyle. In another temple in the ſuburb there was a greater reſemblance to that of Nankin. Woo-hoo-ſhien does not ſeem to be populous in proportion to the number of ſhops, and the quantity of accumulated produce expoſed for ſale. The ſuburb near the city contains ſeveral good ſhops, which were crowded with people. Ellis's Journal of the late Embaſſy to China, vol. ii. Lond. 1818.

WOOJEDA, a town of Algiers, in the province of Tremecen, anciently called Guagida; 20 miles W.S.W. of Tremecen.

WOOL, in *Natural Hiſtory* and *Manufactures*, Latin *lana*, *lanicium*, Fr. *laine*, ſignifies ſoft hair or down, more particularly that of ſheep, but is applied to the ſoft hair of other animals, as of the vicunna, commonly called Vigonia wool, that of the yak of Tartary, &c.; and alſo to fine vegetable fibres, as cotton. The Romans applied the term extenſively to the ſoft hair or down of all quadrupeds, and even to that of birds, as lana anſerina, the wool or down of the gooſe; lana caprina, goat's-wool.

They alſo applied the term to vegetable ſubſtances:

——" Nemora Æthiopium molli canentia lana."
Virg. Georg. ii. 120.

" The trees of Ethiopia, white with ſoft wool, or cotton."

The diſtinction between wool and hair is rather arbitrary than natural, conſiſting in the greater or leſſer degrees of fineneſs, ſoftneſs, and pliability of the fibres. When they poſſeſs theſe properties ſo far as to admit of their being ſpun and woven into a texture ſufficiently pliable to be uſed as an article of dreſs, they are called wool. The gradations between wool and hair on the ſkins of ſome animals are often too minute to admit of accurate diſtinction. The fleeces of many ſheep contain fibres ſo hard and coarſe, that they may moſt properly be called hair; and ſome hairy animals produce on part of their ſkins fibres poſſeſſing all the properties of wool; even in fleeces from the ſheep, we may ſometimes obſerve the very ſame fibre to be a coarſe hair at one end, and at the other end a comparatively ſoft wool. The power of words, when inaccurately applied in retarding the progreſs of improvement, may frequently be traced in the moſt common occurrences of life, and we are perſuaded it has had no inconſiderable effect in this inſtance, in preventing the cultivation of wool, in Europe, on the ſkins of other animals beſides ſheep. No one will deny that it is impoſſible to produce wool on the backs of the ox or the aſs, if we reſtrict the term wool to the fleece of the ſheep; but if by wool we mean a ſoft fine hair, poſſeſſing all the properties which render it ſuitable to be ſpun, woven, and fulled, to make cloth, the oxen of Thibet and the aſſes of Chili do produce and have for centuries produced ſuch wool. Many of the aſſes and oxen even in this kingdom have ſoft woolly tufts of hair on ſome parts of their ſkins, and if ſuch cattle were ſelected, and the breed cultivated, it is probable we might obtain from them a valuable addition to the materials on which national induſtry might be profitably employed.

Sheep's-wool appears to be the product of cultivation; we know of no wild animal which reſembles the wool-bearing ſheep. The argali, from which all the varieties of ſheep are ſuppoſed to be derived, is covered with ſhort hair, at the bottom of which, cloſe to the ſkin, there is a ſofter hair, or down. (See ARGALI and SHEEP.) This is not peculiar to the argali; almoſt all quadrupeds inhabiting cold climates are covered in the ſame manner with a ſoft hair or down, which is protected by a coat of longer and coarſer hair. By removal to a temperate climate, or when placed under the foſtering care of man, and protected from the inclemencies of the weather, and ſupplied regularly with food, the coarſe long hair falls off, and the animal retains only the ſofter and ſhorter hair, or wool. It is alſo obſerved that European ſheep, removed to tropical climates and much expoſed, ſoon become languid and ſickly, and loſe their fleece, which is ſucceeded by a covering of ſhort coarſe hair. Sheep in expoſed ſituations in Europe often produce ſhort coarſe white hairs called kemps, intermixed with the finer wool; on removal to a warmer ſituation, and to a richer paſture, the coarſe hairs fall off, and do not grow again. Theſe facts are ſufficient to prove the effect of cultivation on the fleece; and it muſt be obſerved that ſheep's-wool of a good quality is never found but in thoſe countries which have been the ſeats of the arts, and where a conſiderable degree of luxury or refinement exiſts, or has once prevailed. This is a ſtrong preſumptive proof that ſuch wool has been originally obtained by a careful and long-continued attention to the ſelection of thoſe ſheep which produced the fineſt and moſt valued fleeces.

Angora, the ancient Ancyra, the former ſeat of arts and manufactures, ſtill retains its breed of fine-woolled animals, among which the goat at the preſent time produces a fleece nearly equal to ſilk in luſtre and fineneſs; and the cat and the rabbit of that diſtrict yet produce fine long wool. Damaſcus, and the other ancient cities of Aſia Minor, preſerve in in their vicinity the traces of the former cultivation of fine-woolled animals. The Tarentine fine-woolled fheep, fo much valued by the Greeks and Romans, were obtained from Afia Minor, and were on that account fometimes called Afianæ. It is highly probable that thefe fheep came originally from the more eaftern feats of luxury, where the foft fleeces are now grown, of which the fhawls and cloths of India are fabricated.

In countries where manufactures have once flourifhed, their effects continue for a long time vifible in the race of fheep which ftill remain there. Even in the prefent condition of the fleeces from Barbary and the adjoining ftates, the experienced eye may perceive the veftiges of a fine-woolled race of fheep, degenerated by utter neglect, in a climate naturally unfavourable to the production of fine wool. In Sicily and the fouthern parts of Italy, the remains of the ancient Tarentine breed preferve to the prefent day a race of fine-woolled fheep, but greatly degenerated by neglect. In Portugal the fine-woolled fheep retain more of their original purity, but are ftill much neglected. In Spain attention to the growth of fine wool appears never to have been entirely loft fight of, and it is here that the race of fine-woolled fheep exift in the higheft degree of perfection, though, as we fhall afterwards ftate, probably inferior in fome important qualities to the original Tarentine race. Some writers have afferted that fine wool is the refult of climate and food; but this is not the fact, though we admit that both have fome influence on the quality of wool. It is the breed alone that primarily determines the finenefs of the fleece; this has been ably demonftrated by the experiments of lord Sommerville, Dr. Parry of Bath, and others in this country, and by experiments on a larger fcale in Sweden, Denmark, Saxony, and France.

It has been afcertained by Mr. Bakewell of Difhley, in Leicefterfhire, that the form of animals might be changed by felecting fuch as had any remarkable peculiarities, and continuing to breed from them for a few generations, when a new race is eftablifhed, in which thefe peculiarities continue permanent. It has been afcertained by careful obfervations, both of cattle-breeders and phyfiologifts, that in producing a new breed from two varieties of the fame fpecies, the female has more influence over the form of the progeny than the male; but with refpect to wool the cafe is reverfed, the quality of the fleece depending more on the fire than the dam. Beginning to breed from a coarfe-woolled ewe and a pure fine-woolled ram, the produce of the firft crofs will have a fleece approaching one-half to the finenefs of that of the ram; and continuing to crofs this progeny with a fine-woolled ram, equal to the firft in quality, the fleece of the fcore and crofs will approach three-fourths to the finenefs of the firft, and in a few croffes more will be brought to an equal quality. If we ftate it numerically, and fuppofe the wool of the ewe to be twice as coarfe as that of the ram, or as 320 to 160, the firft crofs will have the fibre reduced to 240, the fecond to 200, the third to 180, the fourth to 170, the fifth to 165, the fixth to $162\frac{1}{2}$, which to all practical purpofes may be regarded as equal to the firft number. This ratio of approximation may be ftated as correct on a large fcale of experiment. If we breed with a fine-woolled ewe and a coarfe-woolled ram, the feries would be reverfed, and in a few generations all veftiges of the fine-woolled race would be nearly, if not entirely, extinct. The ancient Romans, in the time of Columella, feem to have been fully aware of the effects of breed on the finenefs of the wool, and as much as 200*l.* fterling was paid for a fine-woolled ram.

When a flock of fine-woolled fheep are once formed, they can only be kept pure by felecting and preferving the fineft-woolled rams, and moft carefully avoiding all intermixture with fheep from coarfer-woolled flocks that may exift in the country. Where this is neglected, the quality of the wool will foon be debafed.

But fuppofing all the flocks in a country were of the fine-woolled race, accidental varieties of coarfe-woolled fheep will occur among them, or of fheep having fleeces intermixed with coarfe hair. If thefe be not carefully examined and removed, the wool will deteriorate, and more fo where the climate is variable, and the fheep are expofed to great and fudden viciffitudes of temperature.

What has been ftated may fuffice to explain the circumftance of fine-woolled breeds of fheep being only found in the vicinity of prefent or ancient manufactures, or where they have been tranfported from fuch diftricts. Wherever fine-woolled fheep are neglected by man, the wool becomes either coarfe, or intermixed with coarfe hairs; the latter is the cafe in the Shetland ifles, and in all countries where the arts and manufactures have been entirely deftroyed, and ignorant barbarians have fucceeded as the poffeffors of the foil.

Moft ancient writers on wool, and even many moderns, feem not to be aware of any difference in wools, except the finenefs or coarfenefs of the fibre; but the length of the fibre conftitutes a far more important diftinctive character. Long wool, or what is called combing-wool, differs more from fhort or clothing wool, in the ufes to which it is applied, and the mode of manufacture, than flax from cotton.

Sheep's-wool may, therefore, be divided into two kinds. Short wool, or clothing-wool, and long or combing wool: each of thefe kinds may be fubdivided into a variety of forts, according to their degrees of finenefs. This procefs is the proper labour of the wool-forter.

Short wool, or clothing-wool, may vary in length from one to three or four inches; if it be longer it requires to be cut or broken, to prepare it for the further proceffes of the cloth manufacture. Short or clothing wool is always carded or broken upon an inftrument with fine fhort teeth, by which the fibres are opened and fpread in every direction, and the fabrics made from it are fubjected to the procefs of felting, which we fhall afterwards defcribe. By this procefs, the fibres become matted together, and the texture rendered more compact.

Long or combing wool may vary in length from three to eight or ten inches: it is prepared on a comb or inftrument, with rows of long fteel teeth, which open the fibres, and arrange them longitudinally: in the thread fpun from combed wool, the fibres or filaments of the wool are arranged in the fame manner, or fimilar to thofe of flax, and the pieces when woven are not fubjected to the procefs of felting.

The fhorter combing-wools are principally ufed for hofe, and are fpun fofter than the longer combing-wools, the former being made into what is called hard worfted yarn, and the latter into foft worfted yarn.

Short Clothing-Wool.—The principal qualities deferving attention in clothing-wools are the regular finenefs of the hair or pile, its foftnefs and tendency to felt, the length and foundnefs of the ftaple, and the colour. The wool-buyer alfo regards as important the clean ftate of the fleece, and to the grower its weight is particularly deferving attention; for in fleeces equally fine, from fheep of the fame fize, fome may be much heavier than others, the fibres of wool being grown clofer to each other on the fkin.

The finenefs of the hair or fibre can only be eftimated to any ufeful purpofe, in the woollen manufacture, by the wool-forter or wool dealer, accuftomed by long habit to difcern

difcern a minute difference, which is quite imperceptible to common obfervers, and fcarcely appreciable by the moft powerful microfcopes. Of the various attempts that have been made to reduce the finenefs of wool to a certain ftandard, by admeafurement with a micrometer, we fhall afterwards fpeak. From fome experiments we have made, as well as from thofe made by Mr. Luccock, Dr. Parry, and others, we may eftimate the thicknefs of the hair of the fineft Spanifh and Saxony wool to be not more than the fifteen-hundredth part of an inch, and that of the fineft native Englifh to be from twelve to thirteen-hundredth parts, whilft the inferior forts gradually increafe to the fix-hundreth part of an inch and more. A difference in the fize of thefe fibres, too minute to be noticed by the common obferver, may occafion a difference of 40 *per cent.* or more in the value of the wool. The finenefs of the hair has been ever confidered as an important quality fince the clothing manufacture emerged from its rudeft ftate. Fine wool was formerly valued becaufe a finer thread could be fpun from it, and a thinner fabric made, than from the coarfer wools; but fince recent mechanical improvements have been introduced into the woollen manufacture, it has been found practicable to fpin coarfe wools to the fame length as the finer wools were formerly fpun to. It is well known, however, to cloth-manufacturers, that whatever be the finenefs of the yarn, unlefs the wool be fine, it is impoffible to make a fine, compact, and even cloth, in which the thread fhall be covered with a thick foft pile; nor would a thin cloth made from coarfe wool have the fame durability or appearance as one from fine wool of equal weight *per* yard. Fine wool will, therefore, always preferve a fuperior value to the coarfe; indeed it was long confidered as the principal and almoft the only quality deferving the attention of the wool-grower, the wool-ftapler, and the clothier.

The regular finenefs of the fibre is alfo an object of confiderable importance; the lower end of the ftaple, or that part of the fleece neareft the fkin, will fometimes be very fine, and the upper part coarfe. In fome fine fleeces there will frequently be an intermixture of long, filvery, coarfe hairs, and in other fine fleeces an intermixture of fhort, thick, opaque hairs, called kemps. When the wool is thus irregularly fine or intermixed, it is technically called not being *true grown.* The fine fleeces of Spain and Portugal, particularly of the latter country, are many of them injured by the intermixture of the long filvery hairs before-mentioned: whether this be owing to the original Tarentine breed having been croffed with the coarfe-woolled native fheep of Spain, (fee the article SHEEP,) and ftill preferving a tendency to revert to their firft condition, or whether it be the effect of heat on the fkin, is uncertain. The Saxony fleeces, from the fame breed, removed to colder climates, are generally free from this defect. The coarfe fhort hairs, or kemps, are not uncommon in fome of the fine-woolled flocks of England and Wales, particularly thofe which are more expofed to the inclemencies of the weather, and have a fcanty or irregular fupply of food. It has been obferved, in the firft part of the article SHEEP, that in fome flocks the proportion of fine wool in each fleece is much greater than in others, for in few or none is the wool grown uniformly fine over the whole body.

On the Merino fheep the fleece is more regular, whatever be the degree of finenefs, than on any of our native Englifh fine-woolled breeds. The Merino fleece admits of a divifion into four forts, the *refina*, the *fina*, and the *tercera*, with a very minute portion of coarfe from the fhanks and head, which is not fent to market. The three forts are diftinguifhed in commerce by the marks R, F, and T. On the average, there will be in each fleece nearly three-fourths of the beft or R wool. The fecond and third forts, or the F and T, will alfo contain a confiderable portion as fine as the beft; but being fhorter and difcoloured, or intermixed with coarfe hairs, which require their locks to be feparated from the beft fort, or the refina.

In the native Englifh fleeces, however fine fome part may be, the proportion of the beft fort rarely exceeds one-third part, and is frequently not more than one-fixth part of the whole fleece.

The value of the beft part of a Spanifh fleece, or the R wool, varies greatly in different flocks. When this fort, from the moft efteemed flocks, may be worth fix fhillings and fixpence *per* pound in the Englifh market, the R wool from another flock may not be worth more than three fhillings and fixpence. The F and T wools are from 25 to 50 *per cent.* lower than the firft fort: thus, the inferior forts from the fineft piles may be of greater value than the beft fort or R wool of other piles; but they are never intermixed by the dealers, as they are applicable to different fabrics. In the Englifh mode of wool-forting, there will frequently be eight or ten forts in a fingle fleece; and if the beft wool of one fleece be not equal to the fineft fort, it is thrown to a fecond, third, or fourth, or a ftill lower fort, which is of an equal degree of finenefs with it. The beft Englifh fhort native fleeces, fuch as the fine Norfolk and South Down, are generally divided by the wool-forter into the following forts, varying in degree of finenefs from each other, which are called,

Prime,
Choice,
Super,
Head,
Downrights,
Seconds,
Fine abb,
Coarfe abb,
Livery,
Short coarfe or breech wool.

Befides thefe forts of white clothing wool, two and generally three forts of grey wool are made, confifting of locks which may be black, or intermixed with grey hairs. Some wool-forters alfo throw out any remarkably fine locks in the prime, and make a fmall quantity of a fuperior fort, which they call picklock. The origin of fome of the above names is obfcure, but the names of the finer forts appear to indicate either a progreffive improvement in the quality of the wool, or in the art of wool-forting. The relative value of each fort varies confiderably, according to the greater demand for coarfe, fine, or middle cloths; and the variation during and fince the late war in the Spanifh peninfula has been much increafed by temporary caufes. Before that period, when the R wool of good Spanifh piles fold at from five fhillings and fixpence to fix fhillings *per* pound, the prime from Herefordfhire fleeces was fold at about three fhillings and fixpence, and that from the Norfolk and South Down from three fhillings to three fhillings and twopence *per* pound. The higher price of the Herefordfhire was in part owing to its being in a cleaner ftate. The Spanifh wool is alfo cleaner than any of the Englifh wools, being fcoured after it is fhorn; but the latter is only imperfectly wafhed on the fheep, previoufly to its being fhorn. A pack of Englifh clothing wool of 240 pounds weight, in its marketable ftate, will wafte about 70 pounds in the procefs of the manufacture: the fame quantity of Spanifh wool, as fent to market, will not wafte more than 48 pounds on on the average. This contributes to enhance the difference between the prices of each, as well as the ſuperior fineneſs of the latter.

Different wool-ſorters make a conſiderable variation in their modes of ſorting the ſame kind of fleeces: ſome divide them into more ſorts than others; but the following table will ſhew what may be taken as the average relative value of each ſort, when the prime is worth about three ſhillings and two-pence *per* pound, and may ſerve to ſhew the ſkill required to eſtimate the value of fine Engliſh wool in the fleece.

	s.	*d.*		*s.*	*d.*
Prime - -	3	0	to	3	4
Choice - -	2	4	to	2	8
Super - -	2	0	to	2	2
Head - -	1	8	to	1	10
Downrights -	1	5	to	1	6
Seconds - -	1	3	to	1	4
Fine abb -	1	0	to	1	1
Coarſe ditto -	0	9	to	0	10
Livery - -	0	8	to	0	10
Short coarſe -	0	7	to	0	8

The demand for coarſe woollen goods having greatly increaſed of late, the prices of the lower ſorts are conſiderably advanced from the above-ſtated prices, and are at preſent as under:

	s.	*d.*	
Short coarſe -	1	4	*per* pound in London.
Livery - -	1	5	
Fine abb -	1	6	
Seconds - -	1	7	
Downrights -	1	8	
Head - -	1	10	
Super - -	2	0	
Choice - -	2	2	
Prime - -	2	6	
Picklock -	3	0	

The Softneſs of fine clothing Wool is next in importance to the fineneſs of the fibre, though it has been too little attended to in the culture of Engliſh wool. This quality is not dependent on the fineneſs of the fibre; it conſiſts in the peculiar feel which approaches to that of ſilk or down, but in which the wool of all European ſheep is inferior to that of Eaſtern Aſia, or to the wool of the vicunna, or lama of Peru and Chili. In foreign European wools there are different degrees of this property, where the fibre is equally fine. In our native Engliſh wools, the like difference exiſts between the ſoftneſs of wool poſſeſſing the ſame degree of fineneſs, but grown in different diſtricts. In the harder wool, the fibre is elaſtic and hard to the touch, and cloth made from it has the ſame harſh feel; it is alſo more looſe in its texture, and the ſurface of the thread is generally more bare. The difference in the value of cloth from two kinds of wool, equally fine, but one diſtinguiſhed for its ſoftneſs, and the other for the contrary quality, is ſuch, that with the ſame proceſs and expence of manufacture, the one will make a cloth more valuable than the other from twenty to twenty-five *per cent.*

Though the Engliſh woollen manufactures had been carried on for ſo long a period, the cauſe of this difference in cloths made from wool equally fine was but very imperfectly known till the preſent century. Mr. Robert Bakewell, then of Wakefield in Yorkſhire, firſt directed the attention of wool-growers and manufacturers to this ſubject, in a work, entitled "Obſervations on the Influence of Soil and Climate on Wool." The reaſon why the manufacturers remained ſo long ignorant reſpecting it aroſe, he obſerved, from the manner in which the woollen-trade had been carried on in Yorkſhire, the great ſeat of the manufacture of Engliſh clothing-wool, the diviſion of employment there not permitting the wool-dealer, or even the clothier, to witneſs the final reſult of the proceſs. The wool-buyer in the diſtant counties, and the wool-ſorter, who divided the fleece, were equally unacquainted with the cloth manufacture. The Yorkſhire clothier ſold his goods in an undreſſed, and often in an undyed ſtate; they were bought and finiſhed by the cloth merchant, who was formerly unacquainted with the previous proceſſes of the manufacture, or the qualities of wool. In a promiſcuous lot of undreſſed cloth bought at the ſame price, and apparently of the ſame quality in the rough ſtate, if ſome pieces were finiſhed much better and ſofter than others, it was attributed to lucky chance, the patron divinity of the ignorant. Mr. Bakewell proved that the hardneſs of Engliſh wools does not depend on the nature of the food, or even entirely on the breed; it is the effect of the ſoil acting on the ſurface of the fleece. The wools from chalk diſtricts, or light dry calcareous ſoils, have the natural yolk or moiſture abſorbed by the particles of calcareous earth that penetrate the fleece, and the wool is thereby rendered hard. The ſame effect is produced on a ſkin where lime is uſed; it may alſo be produced by keeping wool for a longer or ſhorter time in a dry hot temperature; and when wool has been ſo dried, no proceſs will reſtore to it its priſtine ſoftneſs. On the contrary, wools grown on rich loamy argillaceous ſoils are always diſtinguiſhed for their ſoftneſs. The quantity of greaſe or yolk in the fleece has a conſiderable degree of influence on the ſoftneſs of Merino wool, the pile being ſo cloſe as in a conſiderable degree to prevent the earthy particles from penetrating the fleece; but in all Engliſh fleeces the wool is grown thinner on the ſkin, and admits the more eaſy acceſs of the abſorbent particles. Expoſure to the direct rays of a ſummer ſun has alſo a tendency to injure the ſoft quality of the wool. We ſhall have occaſion to refer to the methods recommended by Mr. Bakewell to improve the ſoftneſs of wool on ſoils naturally unfavourable to its growth.

Of fine European wools, the Saxony generally poſſeſſes a greater degree of ſoftneſs than the Spaniſh, which we believe to be owing to the ſheep being leſs expoſed to the action of light and heat. The native fine Italian wool, before the introduction of the Merino race, poſſeſſed a conſiderable degree of ſoftneſs, judging from wools which we have ſeen from thence, but they were deficient in ſoundneſs, and not *true grown.* The wools on the chalk ſoils in the ſouthern and eaſtern ſide of England are generally hard, except, as in Kent, where the chalk is covered by thick argillaceous beds. Nottingham foreſt, Chamwood foreſt in Leiceſterſhire, and ſome parts of Shropſhire, produced not the fineſt, but ſome of the ſofteſt wools in England before the late incloſures. The Cheviot hills in Cumberland are not paſtured by the fineſt-woolled Engliſh ſheep, but their fleeces poſſeſs a degree of ſoftneſs exceeding any from the other diſtricts of England, and they are rendered ſoft by artificial means, which we ſhall deſcribe. It is ſtill ſomewhat uncertain, whether there are two diſtinct breeds of ſheep, from which the fine ſhawl wool of India are grown; or whether one ſpecies of the animal which yields it is not to be claſſed with the goat. The fleeces from India, which we have ſeen, are grown on a very ſmall ſheep; cloſe to the ſkin, there is a wool as ſoft as the ſofteſt fur; this is covered by long coarſe hairs growing through it. When the wool is once ſhorn, the ſeparation of theſe hairs from the ſoft wool

wool is a work of extreme difficulty; but on the back of the sheep we believe the separation can be made with great ease. The softness of the Indian wool is not even distantly approached in the very softest Merino fleeces from Saxony and Spain; this may be proved by comparing the finest cassimere cloth from Saxony wool, with the shawls or shawl-cloth of India. The ancient Tarentine sheep, called by way of excellence 'molles oves,' were treated with peculiar care by the Romans, and clothed in skins, which we believe was intended to preserve the softness of the wool, as it is still practised in some parts of Asia for that purpose. In Europe no experiments have been made directly to improve the softness of wool, though wool approaching in softness to that of India would be a most valuable acquisition to our manufactures. To be convinced of this, it need only be stated, that the yarn from Indian wool has been sold here at three guineas *per* pound, not on account of the superior fineness of the spinning, but for the softness of the wool. For coarse goods, indeed, such as blankets, carpets, and cloths called duffields, raised with a hairy pile, a considerable degree of hardness or elasticity of the fibre is an advantage; but in all the finer articles of the woollen or worsted manufacture, the opposite quality is of great value.

The felting property of wool is intimately connected with its softness, the softest wools having the greatest tendency to felt, and the hard wools are all defective in this respect. The felting property appears to depend on a peculiar structure of the surface of the fibres, by which they are disposed to move in one direction more easily than another. This is perceptible in drawing a hair through the fingers, first from the end to the point, and again from the point to the end; in one direction the hair feels perfectly smooth, in the other direction a peculiar roughness is felt. The cause of this is supposed to be owing to the surface of the fibres having laminæ, like the scales of fishes, with the edges laid over each other. Indeed in the furs of some animals we have observed with a powerful microscope, that the surface is composed of laminæ laid over each other, resembling the arrangement of the leaves of the artichoke. On this property the process of hat-making depends; the short fibres of the fur being repeatedly compressed, move and interlock with each other, so as to form a compact substance; this motion is further aided by heat and moisture. A similar process takes place to a certain degree in cloth subjected to the strokes of a fulling-mill; the fibres cohere, and the piece contracts in length and breadth, and its texture is rendered more compact and uniform. This process is essential to the beauty and strength of woollen cloth; and it is observed, that the softer wools felt in much less time than the harder, and form a closer pile on the surface of the cloth, on which account it is a common practice to mix a certain quantity of soft wool with the hard, to enable the former to felt with more facility.

The length and soundness of the staple of clothing wool is the quality next to be considered. By the staple of wool is meant the separate locks into which the fleece naturally divides in the skin, each lock consisting of a certain number of fibres, which collectively are called the staple.

The best length of staple for fine clothing-wool, if found, is from two to three inches. If it be longer it requires breaking down to prepare it for the process of carding. Saxony wool, being generally more tender than the Spanish, and more easily broken down, is sometimes four or five inches long; but as it works down easily, it is preferred, on account of the length of its staple, for such goods which require fine spinning, as cassimeres, pelisse cloth, and shawls. Much of the English clothing-wool of a middle quality is grown longer than is desirable for the purpose of the clothier, and when found is thrown out for the hosiery trade, if the demand for the latter be great. As the grower could not shorten the length of the staple without diminishing the weight of the fleece, he has no motive to induce him to grow shorter wool; but the object might be obtained with much benefit to himself by shearing twice in the year, once the latter end of April, and again the latter end of August; the wool would then be grown of a suitable length for the card, and from experiments that have been made we believe the weight would exceed what can be obtained from one clip: the increase would not be less than fifteen *per cent.*, and the condition of the sheep thereby improved.

The soundness of the staple in clothing-wools is not so important as in combing-wools; but for some kinds of colours which injure the wool, it is particularly desirable that the fibre should be sound and strong; this is judged of by drawing out the staple and pulling it by both ends. The soundness and strength of the staple depend primarily on the healthy state of the animal, and on a sufficient supply of food. The staple on some parts of the fleece will always be more tender than on other parts, but by mixture they tend to form a dense pile on the surface of the cloth.

The colour of the fleece should always approach as much as possible to the purest white, because such wool is not only necessary for cloths dressed white, but for all cloths to be dyed bright colours, for which a clear white ground is required, to give a due degree of richness and lustre. It is probable that all sheep's-wool was first of a black or reddish colour: the latter is often referred to by the ancients. Before the invention of dyeing, coloured wool must have had a preference to white; but after the act of communicating beautiful colours to the fleece, white wool would be in the greatest demand, and those sheep which had white fleeces would be selected to breed from. The most ancient flocks of sheep which we have any record of are those of Laban and Jacob, described in the book of Genesis. The fleeces appear to have been principally brown, or spotted and striped, which was in all probability the general colour of the flocks throughout that part of Asia. We learn that in the course of twenty years a great change was effected in the colour of a large portion of the sheep of Laban: though Jacob appears to have concealed from his father-in-law the method by which this change was effected, we are expressly told in the sequel that it was by crossing with rams which had fleeces of the colours required.

Dark-brown or black woolled sheep are not uncommon in many parts of the European flocks, but such wool being of less value than the white, these sheep ought always to be expelled. Some of the English fine-woolled sheep, as the Norfolk and South-Down, have black or grey faces and legs. In all such sheep there is a tendency to grow grey wool on some part of the body, or to produce some grey fibres intermixed with the fleece, which renders the wool unfit for many kinds of white goods; for though the black hairs may be too few or minute to be detected by the wool-sorter, yet when the cloth is stoved they will become visible, forming reddish spots, by which its appearance is much injured. The Herefordshire sheep, which have white faces, are entirely free from this defect, and yield a fleece without any admixture of grey hairs. We have no doubt that by carefully rejecting those sheep from the South-Down flocks, in which the grey is most apparent, this defect might be gradually removed. It is particularly desirable with respect to to thefe fheep, as the wool grown on chalk foils, though lefs foft than on other foils, is generally whiter, and better fuited to fuch goods which require the procefs of bleaching or ftoving, and do not require to be fo much fulled as many other cloths.

The ancients were fo well aware of the neceffity of expelling dark-coloured wool from their flocks, that in felecting the fheep to breed from, they did not truft to the colour of the fleece alone, but carefully examined the mouth and tongue of the ram, and if the leaft blacknefs or fwarthinefs appeared he was immediately rejected; and though fome moderns have doubted the ufe of this precaution, we believe it was well founded.

> "Illum autem, quamvis aries fit candidus ipfe,
> Nigra fubeft udo tantum cui lingua palato,
> Rejice, ne maculis infufcet vellera pullis
> Nafcentem." Vir. Georg. iii.

Pliny alfo ftates, that particular attention was on this account had to the colour of the mouth. "Arietum maxime fpectantur ora." We are informed that this kind of infpection takes place in the Spanifh flocks at prefent, a practice in all probability derived from the Roman fhepherds, as we believe the flock to have been from thofe of Italy, or the Tarentine breed. The colour of the foil on which fheep graze, if very dark or red, communicates to the wool a tint more or lefs ftrong, which is indelible, and renders fuch wool lefs proper for cloths or hofiery goods that are to be finifhed white; for though the colour may be improved by ftoving, yet on wafhing the cloths, they foon return to a brownifh or yellowifh tint. The tint from the foil is, however, rarely of fufficient ftrength to be regarded for dyed goods, excepting for exceedingly light colours.

The cleannefs of wool is principally regarded by the purchafer, as it affects the weight. To the grower thofe fleeces are generally the moft profitable that are well filled with the greafe, or yolk as it is called, becaufe it keeps the wool in a found ftate, and improves its foftnefs. It ought, however, to be wafhed out as much as poffible before it is expofed to fale. The fleeces of the Merino fheep are more plentifully fupplied with yolk than thofe of any of our native fine-woolled breeds; indeed it is fo abundant, that the Englifh mode of wafhing on the back of the fheep will fcarcely produce any effect upon the fleece. The yolk or greafe in the fleece appears, from the experiments made upon it by M. Vauquelin, to be a native foap, confifting principally of animal oil combined with potafh. It is moft copioufly produced in thofe breeds which grow the fineft and fofteft wool, and is always moft abundant on thofe parts of the animal which yield the fineft parts of the fleece. To this fubject we fhall again refer in treating of the improvement of wool. This yolk, though fo beneficial to the wool in a growing ftate, becomes injurious to it when fhorn; for if the fleeces remain piled in an unwafhed ftate, a fermentation takes place, the yolk becomes hard, and the fibre is rendered hard and brittle. This effect takes place more rapidly in hot weather. The Spaniards remove this yolk in a great meafure by wafhing the wool after it is fhorn and forted. In Saxony fine-woolled fheep of the fame race are wafhed in tubs with warm water, foap-lees, and urine, and afterwards in clean water.

In England the wool is wafhed on the back of the fheep by immerging the animal in water, and fqueezing the fleece with the hand. From thefe different modes of wafhing, the wool is left more or lefs pure. Mr. Bakewell, in his Obfervations on the Influence of Soil and Climate on Wool, has given the following table, containing a ftatement of the quantity of neat wool in every hundred pounds, taken on an average of each fort, and fuppofing each to be free from lumps of pitch employed in marking the wool, and cleared from what are called the *dog-locks*. The firft column reprefents the average weight after the wool has been fcoured perfectly clean with foap and water, and dried; the fecond the amount of wafte.

	Pure Wool.	Wafte.
100 lbs. of Englifh wool wafhed on the fheep's back - - - -	75	25
Ditto Saxony fleece-wool - -	80	20
Ditto Spanifh R, or refine - -	88	12
Ditto Spanifh and Portugal unwafhed -	75	55
Ditto Englifh fleeces unwafhed - -	60	40
Ditto lightly greafed wools of Northumberland wafhed on the fheep's back	65	35

Hence it is obvious, that the ftate of the fleece with refpect to cleannefs is an object of great importance to the wool-buyer. The Englifh Merino fheep, from the difficulty of wafhing the wool on the fheep's back, have generally been fhorn in an unwafhed ftate, and the wool offered for fale in this ftate. The purchafers were frequently unacquainted with the great amount of the lofs it would fuffer by wafhing, and were much difappointed at the refult. This circumftance, we conceive, more than any other, tended to prejudice the manufacturer againft the Anglo-Merino wool. The wool is alfo injured by remaining in the greafe, as we have before ftated, and though this has been contradicted, we have no hefitation in afferting the fact from our own experience. Indeed the French manufacturers of fine cloth affert, that the beft wools from Spain, though cleared in a great meafure from the yolk, yet ftill retain fufficient to injure the wool if it be fuffered to grow old when it is packed, the yolk becoming rancid and hard, and communicating the latter property to the wool. We have frequently obferved this effect in the wools from Portugal, that retain a greater portion of the yolk than thofe from Spain.

After wool has been wafhed in the ufual manner practifed in England, and piled or packed, a certain procefs takes place in eight or nine weeks, called *fweating*. This is well known to wool-dealers and manufacturers, but has not been before noticed by any writer that we are acquainted with. It is evidently an incipient fermentation of the remaining yolk; and the inner part of the pack or pile becomes fenfibly warm. This procefs produces a certain change in the wool, whereby it becomes in a better condition for manufacturing, being what is called in the north of England lefs *fuzzy*. This effect refults from a diminution of the natural elafticity of the fibre.

When this fermentation takes place in unwafhed wool, it proceeds farther, and injures the colour and foundnefs of the ftaple or fibre. A fimilar effect is produced in wool or cloth which has been oiled, and remains fome time in an unfcoured ftate. Inftances of fpontaneous combuftion from heaps of refufe wool remaining in a greafy ftate have been known to occur, and occafion the moft ferious accidents in woollen factories.

The weight of the fleece is an object of great importance to the grower. It is generally fuppofed by the Englifh wool-dealers, that an increafe of weight implied an increafe of coarfenefs; indeed the words coarfe and heavy are confidered by them as fynonymous, but this is not abfolutely

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the cafe ; a fleece grown upon the fame animal may be increafed in weight either by the fibres becoming coarfer, or by their being grown longer, or by a greater number of fibres being grown in the fame fkin. To the wool-grower it can never anfwer to increafe the weight of the fleece on fmall fine-woolled fheep, by growing the wool coarfer ; if this be his object, the long-woolled breeds of fheep are to be preferred. He may produce wool fomewhat longer by increafing the quantity of food ; but it generally lofes fomething of its finenefs, and is lefs fuitable for the cloth trade. He may, however, increafe the weight confiderably by felecting fuch breeds as grow the wool clofe upon the fkin, and are thickly covered with wool over every part of the body. In this refpect, the Merino fheep have greatly the advantage over any of the native breeds of Englifh fheep ; many of them yielding from three to four pounds of pure wool, whilft the fineft Englifh fleeces rarely exceed two pounds, and would lofe one-fourth of this weight when brought to a pure ftate by fcouring. It has been doubted whether all fheep's-wool, when clean, poffeffes the fame fpecific gravity ; but admitting there may be fome variation in the wool from different piles, we conceive that it is too minute to deferve the attention of the wool-grower or manufacturer.

The filaments of fine wool being fo minute, it requires an eye habituated by long experience to appreciate the relative finenefs of two piles, which may differ in value as much as twenty-five *per cent.* Even thofe who have been long practifed in fuch examinations find it difficult to form immediately a correct opinion of the finenefs, if they are removed for a few weeks from all opportunity of viewing wool. It is not furprifing then that the wool-grower, who only directs his attention to the fubject during one part of the year, fhould often be unable to judge whether his wool has improved or not fince the preceding fummer. On this account it would be highly defirable that fome eafy and correct method of admeafurement by the micrometer could be invented, which might enable the obferver to decide this with certainty. Mr. Daubenton employed a graduated fcale, adapting it to the eye-piece of a compound microfcope ; but his method does not admit of accuracy. Mr. Luccock made ufe of a more fimple inftrument, which we have feen ; it confifted of a lens about half an inch in focal length, adjufted to a graduated fcale. On this fcale a number of fibres were ftretched and compreffed by a flider and fcrew into a given fpace ; the filaments covering this fpace were then counted by the aid of the lens, and a number of admeafurements being taken of the fame fort, the mean of the whole was fuppofed to give the correct diameter of the filament. In this method, however, fome of the filaments muft unavoidably overlap part of the others, on which account a greater number will be feen in a given fpace than there would be were the whole diameter of each fibre vifible. The error refulting from this may be ftated at one-fifth. Thus Mr. Luccock makes the beft Englifh wool to meafure the fourteen-hundredth part of an inch, which is finer than the beft Spanifh, as meafured by Dr. Parry, by a more accurate but more laborious method. According to Mr. Luccock, a fample of moderately fine Spanifh wool reached to the fixteen-hundredth part of an inch ; according to Dr. Parry, the very beft Spanifh is not fmaller than the fourteen-hundredth part of an inch.

With the above deduction of one-fifth, which we believe to be a near approximation to correctnefs, the diameter of the fibres of the beft Englifh wool, as forted in the ufual method, will be nearly as follows :

	Parts of an Inch.
Prime - - -	$\frac{1}{1120}$
Choice - - -	$\frac{1}{1024}$
Super - - -	$\frac{1}{928}$
Head - - -	$\frac{1}{800}$
Downrights - -	$\frac{1}{710}$
Seconds - - -	$\frac{1}{640}$
Abb - - - -	$\frac{1}{580}$
Fine livery (variable) -	$\frac{1}{480}$

The method of meafurement adopted by Mr. Luccock might be fufficiently correct with the deduction of one-fifth, were the inftrument always ufed by the fame perfon, and a fimilar degree of preffure given in each experiment ; but as this is required, it becomes uncertain in its refults, and inadequate to practical purpofes.

Dr. Parry's method of meafurement is effected with an inftrument fimilar in principle to the lamp micrometer of Dr. Herfchel, of which an account is publifhed in the Philofophical Tranfactions for 1782. (See MICROMETER.) An object of a known diameter being placed in the focus of a compound microfcope, and ftrongly illuminated, a piece of white paper is placed horizontally at fome diftance beneath it ; then looking through the microfcope with one eye, and keeping the other fteadily open, you will fee the object apparently projected on the paper, which is to be meafured, whilft viewing it, with a pair of compaffes. Divide the length of the image fo meafured with the known diameter of the object, which will give the magnifying power of the microfcope. This being found, place the object you wifh to meafure in the focus, and projecting its image on the paper as before, meafure it with the compaffes, and divide the refult by the magnifying power, which will be the real magnitude of the object required.

The light of a lamp is to be preferred to day-light, and the fibres to be meafured are to be *ftretched* on a glafs, and waxed down at both ends. The under fide of the glafs fhould be blackened with Indian ink, except in three parts, the middle, and near the two ends. The unblackened fpaces being placed in the focus of the microfcope, ten or more filaments may be examined and meafured fucceffively, both in the middle part of the glafs, and near the ends, which will give the diameter of the filament at the upper and lower end of the ftaple, and in the middle. Each lock of ten filaments being thus examined in three different parts, the mean of the three meafurements muft be taken for the mean diameter of each filament, and the mean diameter of the ten filaments may be taken for the finenefs of the whole lock.

In place of the blackened glafs, we would recommend a thin flide of ivory or brafs, about five inches in length, and half an inch in breadth, with three tranfverfe flits or openings, one in the middle, and the two others about three-fourths of an inch from each end. On this flide the filaments may be ftretched, it will not be liable to break, and the edges of the filaments will be more correctly defined than when a plate of glafs is placed under them.

The farther the paper is removed from the eye, the larger will be the apparent fpace covered by the image of the object, but it muft not be too far for the hand to meafure it with compaffes. But if in place of the compaffes we have a fheet of pafteboard graduated into minute divifions from a black line upwards, and a fliding index be adjufted, the pafteboard may be placed at a much greater diftance, the obferver adjufting the flide, until the edge of it and the black line coincide with both edges of the filament. An

 horizontal

horizontal pofition for the microfcope will be the moft convenient, illuminating the object with a lamp and lens. In this way, the apparent diameter may be greatly increafed, and we think the obfervations might be made with greater eafe and accuracy.

By the above method the diameter of very minute filaments may be afcertained, and minute differences detected, which the unaffifted eye is unable to detect. We are aware, however, that it requires fome addrefs and time to enable the obferver to manage the inftrument, on which account it cannot, we fear, be made generally ufeful.

The following admeafurements of different fine wools were taken with Dr. Parry's inftrument; the firft column reprefents the outward end of the filament, the fecond the middle, and the third the bottom, in fractional parts of an inch; the latter column the mean of ten filaments of the fame wool.

TABLE of comparative Diameters of the Filaments of various Clothing Wools, by Dr. Parry.

-	Outward End.	Middle.	Inner End.	Mean.
Spanifh Ewe - -	$\frac{1}{1237}$	$\frac{1}{1333}$	$\frac{1}{1368}$	$\frac{1}{1370}$
Lafteria Pile - -	$\frac{1}{1146}$	$\frac{1}{1316}$	$\frac{1}{1372}$	$\frac{1}{1364}$
Ewe - - -	$\frac{1}{1038}$	$\frac{1}{1287}$	$\frac{1}{1240}$.	$\frac{1}{1254}$
Coronet Pile - -	$\frac{1}{1231}$	$\frac{1}{1250}$	$\frac{1}{1157}$	$\frac{1}{1239}$
Native Merino Ram -	$\frac{1}{1146}$	$\frac{1}{1234}$	$\frac{1}{1316}$	$\frac{1}{1234}$
Saxon - - -	$\frac{1}{1220}$	$\frac{1}{1191}$	$\frac{1}{1184}$	$\frac{1}{1302}$
Pictet's Merino Ram	$\frac{1}{1183}$	$\frac{1}{1228}$	$\frac{1}{1176}$	$\frac{1}{1195}$
Beft Negrette Pile -	$\frac{1}{1175}$	$\frac{1}{1153}$	$\frac{1}{1299}$	$\frac{1}{1189}$
Alva Pile - -	$\frac{1}{1085}$	$\frac{1}{1334}$	$\frac{1}{1236}$	$\frac{1}{1176}$
Rambouillet Ewe -	$\frac{1}{1067}$	$\frac{1}{1134}$	$\frac{1}{1228}$	$\frac{1}{1139}$
Imperial Pile - -	$\frac{1}{1116}$	$\frac{1}{1047}$	$\frac{1}{1257}$	$\frac{1}{1133}$
Morie - - -	$\frac{1}{1110}$	$\frac{1}{1027}$	$\frac{1}{1350}$	$\frac{1}{1137}$
Ryeland - - -	$\frac{1}{1033}$	$\frac{1}{1186}$	$\frac{1}{1143}$	$\frac{1}{1174}$
South Down - -	$\frac{1}{1076}$	$\frac{1}{1141}$	$\frac{1}{1151}$	$\frac{1}{1110}$
Anglo Negrette Ram	$\frac{1}{1015}$	$\frac{1}{1019}$	$\frac{1}{1144}$	$\frac{1}{1057}$
Negrette Ram, Marquis of Bath - -	$\frac{1}{995}$	$\frac{1}{975}$	$\frac{1}{1117}$	$\frac{1}{1061}$
Charenton Ram -	$\frac{1}{1063}$	$\frac{1}{923}$	$\frac{1}{1090}$	$\frac{1}{1003}$
Ryeland Ram - -	$\frac{1}{944}$	$\frac{1}{930}$	$\frac{1}{1088}$	$\frac{1}{989}$
Cape, 4th Crofs -	$\frac{1}{855}$	$\frac{1}{996}$	$\frac{1}{970}$	$\frac{1}{937}$
Wilts Ewe - -	$\frac{1}{823}$	$\frac{1}{781}$	$\frac{1}{860}$	$\frac{1}{806}$

Long Wool, or *Combing Wool*, being prepared for fpinning by a procefs entirely different from that of fhort or clothing wool, and the pieces made from it being finifhed in a very different manner, the qualities moft required in this kind of wool are length and foundnefs of the ftaple, without which the fleece is unfuited for the comb. The finenefs of the hair is a fecondary quality, required only in certain kinds of goods. The wool-comb is an inftrument of fimple conftruction, confifting of a wooden handle, with a tranfverfe piece or head, in which are inferted three rows of long fteel teeth. The wool, which is to be combed after being clean fcoured, dried, and oiled, is firft drawn upon thefe teeth with the hand, until the comb is fufficiently loaded. It is then placed on the knee of the comber, and another comb of a fimilar kind is drawn through it, and the operation is repeated till all the hairs or fibres are combed fmooth in one direction. This operation requires confiderable ftrength, but the comb being previoufly heated, and the wool thoroughly oiled, facilitates the procefs. When completed the combed wool is drawn off with the fingers, forming what is called a *fliver*; the fhorter part of the wool fticks in the teeth of the comb, and is called the *noyl:* this is fold to the clothiers.

From the above defcription, it is evident that if the ftaple of the wool be not found, the greater part of it will be broken by the procefs of combing, and form noyls. The ftaple muft alfo have a fufficient degree of length for the combs to operate upon it. Length and foundnefs of the ftaple are therefore the moft effential and characteriftic qualities of combing-wools.

Long wools may be claffed into two kinds: firft, thofe fuited for the manufacture of hard yarn for worfted pieces; and fecond, thofe fuited for the manufacture of foft yarn ufed for hofiery. The former require a greater length of ftaple than the latter. The firft may therefore be called long combing-wool, and the latter fhort combing-wool; between thefe there are gradations of wool, which may be applied to either purpofe.

Long combing-wool fhould have the ftaple from fix inches to eight, ten, or even twelve, in length. Before the recent improvements in fpinning by machinery, a very great length of ftaple was confidered as an excellence in long combing-wools; and on this account the hog-wool, or the firft fleeces from fheep which had not been fhorn when lambs, was more valuable than the wether wool from the fame flock, and bore a higher price than the former, by at leaft fifteen *per cent.* Since that time the wether wool has rifen in relative value on account of the evennefs of the ftaple, each lock being nearly equally thick at both ends; but the ftaple of hog-wool is pointed, or what is technically called *fpirey*. Eight inches, if the wool be found, may be regarded as a very proper length for heavy combing-wools. The longer ftapled wool was formerly worked by itfelf, and ufed for the finer fpun yarn, or mixed in fmall quantities with the wether wool, to improve the fpinning. It is found that an equal length of ftaple contributes to the evennefs of the thread when fpun by machinery, and a very great length of ftaple is rather injurious than otherwife in the procefs of machine fpinning. To the wool-grower, however, it muft always be defirable to increafe the length of his heavy combing fleeces, as he thereby materially increafes the weight; and we have not yet learned that the price has ever been reduced on this account, for if the wool be too long for fome branches of the worfted manufacture, there are others in which it may be worked with advantage.

The length of the ftaple may be increafed by a plentiful fupply of nutritious food. The fame effect may alfo be produced by letting the wool remain a longer time on the fheep before it is fhorn. We have feen a ftaple of Lincolnfhire wool which was twenty inches in length: it had grown two years without fhearing. This, however, would be unattended with any advantage to the grower. The more frequently fheep are fhorn, provided the wool is fufficiently long, the greater will be the weight grown in a given time on the fame animal; for, from obfervations which we have made, we are fatisfied that wool is grown more rapidly immediately after the fheep are fhorn than at any other time. Length of ftaple in wool depends primarily on the breed, but may be more affected by culture than many other qualities of the fleece. The foundnefs of the ftaple may be eafily judged of by pulling both ends of it with the fingers with confiderable force. In weak or unfound wool the ftaple eafily breaks in one or more parts, and on obferving it, it will be feen that the fibres are much thinner in the part which breaks. This is occafioned either by a deficient fupply

ply of food, by difeafe, or by inclement feafons, which caufe a ftoppage in the growth of the fleece. This goes on to a greater or lefs degree. In fome inftances, the ftoppage has been fo entire that the upper part of the ftaple is nearly feparated from the lower, and is only connected with it by a few filaments: in fuch cafes, the ftoppage has continued for a confiderable time, and the bottom part of the ftaple may be confidered as a new fleece, protruding the old one from the fkin. Connected with the foundnefs of wool, there is another property required; this is, that the ftaple be free and open, or that the fibres fhall not be matted or felted together; an effect which takes place frequently when the wool is unfound. It is in fact a natural felting of the wool on the back of the animal, when by any caufe it has ceafed to grow. Sometimes the lower part of the fleece next the fkin will be fo completely matted as to form a fubftance nearly as hard as a hat, and will hold to the fkin by a few hairs only. Thefe are called cotted fleeces; all approach to this ftate is peculiarly injurious to combing-wools. The wool-buyers generally throw out the cotted and unfound fleeces when they pack the wool from the grower, and buy them at a very reduced price. The foftnefs of combing-wool, though of lefs importance than in clothing-wool, yet enhances its value, as it is found that fuch wool makes a clofer and fofter thread, and in every procefs of the manufacture finifhes more *kindly*. Combing-wools grown on light calcareous foils are deficient in this refpect; fuch are the combing-wools of Oxfordfhire and the Cotfwold hills, which are formed of that fpecies of lime-ftone called oolite, or roe-ftone. A copious fupply of the yolk is neceffary to the healthy condition of the fleece, and as this in many flocks is nearly equal in weight to the wool, the fleeces contain from fix to eight pounds or more of it before they are wafhed, for in the unwafhed ftate they often weigh eighteen pounds in many of the long-woolled flocks in England.

The whitenefs of the fleece is lefs important in the long combing than in clothing wool, provided it be free from grey hairs. The latter circumftance does not frequently occur in combing-wools. There is, however, a peculiar colour communicated by the foil, which is fometimes fo deep as to injure the wool for particular ufes, and what is of more importance, there is a dingy-brown colour given to the fleece by impoverifhed keeping or difeafe, which is called a *winter ftain*; it is a fure indication that the wool is not in a thoroughly found ftate, and fuch fleeces are carefully thrown out by the wool-forter, being only fuited for thofe goods which are to be dyed dark colours.

The finenefs of heavy combing-wool is of lefs importance than the other qualities. In every fleece of this kind there will be a certain fmall portion of fhort clothing-wool on the fhanks, the belly, the throat, and the buttocks. The clothing-wool from fuch fleeces is not often divided into more than two or three low forts, and the combing-wool is feldom thrown into more than four forts, that is, two forts of the hog-wool, and two forts of the wether-wool, of which three-fourths, if the fleece be good, will form the beft fort in each.

There is, however, a fine long combing-wool which is required for bombazines and the finer kinds of worfted goods; this is moft frequently felected from the longer parts of clothing fleeces, and admits a divifion into four or five forts, the fineft being equal in hair to that of the head or fuper in clothing-wool; whereas the beft fort of the common heavy combing-wools feldom ranges higher in point of finenefs than the coarfeft fort of clothing-wool above the breech locks; *viz.* the low abb and the livery.

Short combing or hofiery wool requires a different length of ftaple, according to its finenefs: for the better forts, the ftaple fhould not be fhorter than four or five inches; the lower forts may range as high as eight inches. A greater length than this is not defirable for any kind of foft worfted. What has been faid of the foundnefs and finenefs of ftaple required for long combing-wool, applies equally to the hofiery wool, but in this the finenefs of the hair and foftnefs are of more importance. Moft of the fleeces which yield fine combing-wool produce nearly an equal quantity of fhort wool, which is thrown in the fame manner as the regular clothing forts. The combing forts for the hofiery are generally called,

Super matching,
Fine matching,
Fine drawing,
Altered drawing,
Brown drawing,
Saycaft.

The names of thefe forts derive their origin from ancient proceffes of the manufacture, with which we are unacquainted at prefent. The lower fort, or faycaft, was probably at firft the long coarfe combing-wool, thrown out for the manufacture of fays, of which we have frequent mention in the earlieft hiftory of the woollen trade in England. The relative value of thefe forts, compared with each other, varies according to the demand for the finer or coarfer kinds of hofiery, and is alfo affected by the clothing trade. When any clothing fort which ranges in finenefs with one of the combing forts is in great demand, the wool-forter will break down the fhorter combing-wool of this fort, and throw it to the clothing-wool, which enhances the price of the former by making it fcarce. The finenefs of thefe forts out of the beft combing-wools, ftated numerically, as compared with clothing forts, will be nearly as under, in the fractional parts of an inch.

Super matching	-	-	$\frac{1}{860}$
Fine matching	-	-	$\frac{1}{780}$
Fine drawing	-	-	$\frac{1}{700}$
Altered drawing	-	-	$\frac{1}{600}$
Brown drawing	-	-	$\frac{1}{520}$
Saycaft	-		$\frac{1}{350}$

Moft of the beft forters throw out the hog combing-wool from the beft forts, making a fuperfine hog for the bombazine trade, hog-wool being lefs fuitable for the hofiery, which does not require yarn fo finely fpun as for hard yarn.

As all the different forts of fhort combing-wool, together with feveral forts of clothing-wool, will frequently occur in one Englifh fleece, it is obvioufly the intereft of the grower that his fleece fhould produce as great a proportion of the beft forts as can be done without materially diminifhing the weight.

Skin Wool, or *Pelt Wool*, is the wool feparated from the fkins of flaughtered fheep by the fellmonger. The quantity of this wool, in a country like England, where fo much animal food is confumed, is very confiderable, and has been eftimated at near 50,000 packs of 240lbs. *per annum*, for England and Wales. Soon after fhearing, the fkin-wool is too fhort to be worked by itfelf, and is generally kept and mixed in with the longer wools. The procefs by which wool is feparated from the fkins has a tendency to make it hard, and deftroy or injure its felting or milling property, on which account fhort-fkin wools are feldom ufed for the manufacture of cloth, but more generally for flannels, ferges, and thofe kinds of goods which require little or no milling;

 the

the fineſt kinds are much uſed for ſtockings made of yarn from carded wool. In the ſpring, when the wool on the ſkins has acquired a conſiderable length, it is thrown into combing ſorts; the finer kinds are uſed for knitting hoſiery yarn, and the coarſer for hard yarn for the warps of ſerges and other goods, having a warp of combed and a weft of carded wool. The value of ſkin-wool is ſeldom equal to that of fleece-wool of the ſame degree of length and fineneſs, owing to the felting property being injured, which renders it more unfit for the manufacture of woollen cloth.

Lamb's Wool.—The wool of the lamb is, with certain exceptions, ſofter than that of ſheep's-wool, from the ſame flocks. It poſſeſſes the property of felting in a remarkable degree, and on this account is principally manufactured into hats, except ſkin lamb's-wool, which loſing its felting property in a great degree, is employed in the manufacture of flannels and woollen yarn for lamb's-wool hoſiery. In the northern parts of Europe, the lambs of ſome of the breeds of ſheep poſſeſs a fleece ſo delicately ſoft, that it conſtitutes a moſt valuable fur, being dreſſed on the ſkin, and uſed as a coſtly article of attire. According to Pallas, the inhabitants of the Ukrain and Podoli, as ſoon as the lamb is dropped, (which comes into the world with a pretty wavy ſkin, even without the aſſiſtance of art,) to augment its beauty, and make it bring a higher price, ſew it up in a ſort of coarſe linen ſhirt, ſo as to keep up a conſtant gentle preſſure on the wool, pouring warm water over it every day to make it ſoft and ſleek; only letting out the bandage a little from time to time as the animal increaſes in ſize, but ſtill keeping it tight enough to effect their purpoſe, which is to lay the *wool* in beautiful gloſſy ringlets, and thereby produce a delicate ſpecies of fur in great requeſt for lining clothes and morning-gowns. By this treatment, the ſtaple of the fine ſoft wool which riſes in the infancy of the lamb takes a handſome arrangement; and the animal is killed younger or older according to the ſpecies of fur intended to be produced; from a ſhort gloſſy nap, like ſatin, only fit from its thinneſs for the purpoſe mentioned above, to a warm thick fur for a winter great-coat. The firſt of theſe furs in eſtimation and price is a fine black, that looks like ſilk damaſk; an inferior black fur comes next, much thicker, uſed for *peliſſes*, or *ſhubes*, as the upper winter garb worn out of doors is called; and the leaſt in eſtimation is the whiteſt, except it be of a very pure colour and ſilky appearance, where it is a rival to the firſt; eſpecially for night-gowns, a very common dreſs both morning and evening amongſt the Ruſſians; particularly in the interior parts of the empire.

The Boucharian ſheep, as deſcribed by Pallas, grows a compact, ſoft, and elaſtic wool, which is elegantly formed into frizzled ringlets. In the lamb, the wool is formed into delicate little circular waves, as if preſſed cloſe to the ſkin by art; but when taken from the mother, or killed immediately after birth, they are ſtill more beautiful, and often elegantly marbled with feathered waves, like ſilk damaſk. Theſe three furs are the fineſt and moſt precious of the kind known to Europe and the Eaſt; they are brought to us by the Boucharian Tartars and Perſians, who ſell them dear. The moſt prized are, the *blue*, the black, and the ſilver grey; but of the *unborn lamb-ſkins*, as the fine gloſſy thin furs are called, which ſo much reſemble ſilk damaſk, the fine black is deareſt and moſt eſteemed. To obtain theſe valuable furs, the Boucharian Tartars purchaſe whole flocks of male lambs juſt dropped from their mothers: as to kill a female till paſt the age of breeding is held as a kind of crime by all Tartar hordes; ſuch is their reverence for an animal which conſtitutes their greateſt riches, and the propagation and care of which are the great buſineſs of their lives; ſo that all the fur we ſee of this ſpecies ſold by the Tartars are from young rams. The Boucharians are of opinion, that art is neceſſary to preſerve theſe furs in their greateſt beauty; and under that idea, keep the lambs under ſhades, &c. during the meridian ardour of the ſun; but Dr. Pallas has reaſon to think, that theſe precautions are uſeleſs, as he obſerved that the ſame variety of ſheep produced the ſame fine hues equal in every reſpect, without any ſort of care, in the hands of the Kirguite Tartars.

It is very remarkable that the lamb's-wool, in many of the Merino flocks, is coarſer than the ſheep's-wool. In ſome of the flocks, the lambs are at firſt covered with coarſe hair, which falls off afterwards, and they produce the fineſt wool.

Wool from other animals beſides the ſheep is employed in manufactures, and ſpun and woven into fabrics of different kinds, either unmixed or mixed with ſheep's-wool. The goats of Thibet, which grow the fine ſhawl wool, produce it as a fine down at the bottom of the long coarſe hair, with which the animals are covered. Many of the common goats in Europe grow a ſimilar down, which, by cultivation, might become a valuable article of commerce. It is not, however, yet clearly aſcertained, whether the ſhawls and ſhawl cloth of India are all manufactured from goat's-wool; part of it appears to be made from ſheep's-wool peculiarly ſoft and fine. The Angora goat grows a hair extremely fine and ſilky, which is much uſed in ſome of the French worſted goods mixed with ſilk. This goat is properly a long-woolled animal. Dr. Anderſon ſays, that the Angora goat will proſper and preſerve its peculiarities in France and Sweden. The wool of the vicunna, called Vigonia wool, is generally of a reddiſh-fawn colour; it is peculiarly ſoft and ſilky, but intermixed with long coarſe hairs, which are very difficult to ſeparate. (See VICUNNA.) From the lama and pacos of Peru a ſtronger and longer ſtapled wool is obtained, which is ſometimes white. Under a liberal government which protected and encouraged commerce, we have no doubt the fleeces of theſe animals might be greatly improved, and would become an article of great value. The wool from the yak of Tartary, and the muſk ox of Hudſon's bay, has yet received little attention. We have ſeen ſtockings made of the latter, and which are worn in that country; the wool was ſoft but not fine, and much intermixed with long coarſe hairs.

The quantity of ſheep's-wool annually grown in England and Wales was eſtimated, by perſons in the wool trade examined before the houſe of commons in the year 1800, at ſix hundred thouſand packs. Mr. Luccock, in his Treatiſe on Wool, ſeems to conſider this eſtimate as greatly exceeding the real amount, and has given an eſtimate founded on the ſuppoſed extent of ſurface paſtured by ſheep, and the quantity of ſheep *per* acre in each county. This table we ſubjoin, as the only attempt that we know of to determine the queſtion on certain data; though we conſider it only as an approximation to truth, and are inclined to believe that the quantity is under the real amount. Such is alſo the opinion of the moſt intelligent perſons in the wool trade, whom we have had an opportunity of conſulting.

From this table, it will appear that the total amount, including ſkin-wool and lamb's-wool, is ſomewhat ſhort of four hundred thouſand packs, which is probably one-fourth below the true quantity, could it be aſcertained. Mr. Luccock is inclined to believe that the flocks of ſheep in England and Wales are not ſo numerous as formerly, but he ſays thoſe of Ireland and Scotland are rapidly increaſing. Even in England and Wales, he ſays, we have more than three millions of acres capable of being improved, and carrying a more numerous ſtock. We have two millions of ſheep whoſe fleeces are ſcarcely wool, and which might be brought to contribute their ſhare to ſupport the woollen manufacture, and to increaſe the wealth of the country.

It may be proper to remark, that the quantity of wool grown annually in England is more variable than is generally ſuppoſed, owing to the variable temperature of our climate. In long-continued and ſevere winters, the ſheep not obtaining the ſame quantity of food, and being alſo rendered leſs vigorous by the cold, do not grow ſo much wool as in milder ſeaſons. The difference between the weight of the fleeces grown in ſevere and in very mild ſeaſons, may be ſtated at one-fifth of the whole annual clip: indeed we believe it exceeds that proportion. About the year 1700, the annual value of Engliſh wool was eſtimated at two millions ſterling. If we ſuppoſe the average price at that time to have been eight-pence *per* pound, or eight pounds *per* pack, this will make the total weight of wool two hundred and fifty thouſand packs. Indeed when we conſider the improved ſtate of our agriculture, the great increaſe of our population, and of our woollen exports, we may fairly ſtate the preſent weight of wool grown to be double the amount of what it was at the period referred to. In a ſubſequent part of this article, it will be ſeen that the cloth manufactures of Yorkſhire, principally from Engliſh wools, have increaſed eight-fold in the laſt eighty years; and though the woollen manufactures have removed from ſome other ſituations, yet the great increaſe on the whole in England cannot be doubted. Since the date of Mr. Luccock's table in 1805, in conſequence of the high price of long combing-wool, the growers have paid more attention to the weight of their fleeces; and many who had rendered their fleeces lighter by exchanging the Lincolnſhire for the Leiceſter breeds of ſheep, have ſince been reverting to the former breed, or rather to a mixed breed, endeavouring to combine the improved form of the Leiceſter ſheep with the heavy fleece of the Lincoln. The quantity of long combing-wool grown annually is greater than it was even ten years ſince; the high and increaſing price and demand operating naturally as a premium for its cultivation.

TABLE I.—Shewing the Produce of Engliſh Long Wool.

Diſtrict.	County.	No. of Acres.	No. of Sheep.	Weight of Fleece.	No. of Packs.
Teeſwater -	Durham - - - - - -	100800	67200	9	2520
	Yorkſhire - - - - - -	61250	14310	8	477
Lincoln -	Holderneſs - - - - -	127680	84000	8	2800
	Lincoln rich land - - -	413875	1241625	9	46561
	marſhes - - - - -	175000	87500	8	2916
	miſcellaneous land - -	758485	505657	8	16855
	Norfolk - - - - - -	55428	38500	7	1223
	Cambridge - - - - - -	187600	41688	8	1390
	Huntingdon - - - - -	87500	87500	7	2552
Leiceſter -	Leiceſter - - - - - -	398650	380528	7	11100
	Northampton - - - - -	560000	640000	6	16000
	Rutland - - - - - -	117000	114000	5	2370
	Warwick - - - - - -	182875	160000	5	3333
	Stafford - - - - - -	14000	3720	7	113
Kent - -	Romney Marſh - - - - -	46920	185000	7	5400
	Other Marſhes - - - - -	65000	108330	7	3160
Devonſhire -	South Hams - - - - -	387500	193750	8	6458
Cotſwold -	Glouceſter - - - - - -	200000	200000	8	6666
		3939563	4153308		131794
	Slaughtered	1176770 Sheep			
		196128 Producing long-ſkin wool 5720 Packs.			
		Carrion wool 286			
					5434
			Neat Total -		137228

TABLE II.—Englifh Short Wool.

Diftrict.	County.	No. of Acres.	No. of Sheep.	Weight of Fleece.	No. of Packs.
Norfolk	Norfolk	1260572	683704	2	5697
	Suffolk	817000	497000	$2\frac{1}{2}$	5176
	Cambridge	817600	67744	4	1128
	Huntingdon	144000	108000	$4\frac{1}{2}$	2000
	Bedford	268800	204000	5	4250
	Effex	778400	519000	3	6486
	Suffex Downs	211200	316800	2	2640
	Low Land	623840	547000	3	6837
	Kent	728000	524475	$3\frac{1}{4}$	7000
	Hampfhire	774900	516600	3	6457
	Ifle of Wight	87500	61000	$3\frac{1}{4}$	800
	Surrey	327600	283000	3	3540
Wiltfhire	Wiltfhire Downs	437000	583500	$2\frac{3}{4}$	6684
	Pafture	235000	117500	3	1460
	Berkfhire	408800	306600	$3\frac{1}{4}$	4151
	Oxford	380730	304584	Various.	5303
	Bucks	408800	222968	3	2787
	Herts	369600	277000	$4\frac{1}{2}$	5297
	Middlefex	76000	45000	4	750
Weftern	Dorfet	700000	632240	$3\frac{3}{4}$	9880
	Devon	873700	436850	4	7280
	Cornwall	812000	203000	4	3382
	Somerfet	851200	500700	$4\frac{1}{2}$	9338
	Gloucefter	528000	355000	Various.	5400
Hereford	Hereford	672000	500000	2	4200
	Monmouth	322625	177619	Various.	1431
	Worcefter	369600	330504	$3\frac{1}{2}$	4820
	Shropfhire	739200	422034	$2\frac{1}{2}$	4397
	Stafford	549360	183120	2	1526
	Warwick	365925	182962	3	2287
	Leicefter	50000	20000	$3\frac{1}{2}$	291
	Lincoln	309120	123648	$5\frac{1}{2}$	2833
	Nottingham	435680	255147	Various.	4112
	Derby	553280	362400	3	4530
Heath	Chefter	588000	65000	Various.	926
	Lancafter	952000	310000	$3\frac{1}{2}$	4522
	York Weft Riding	1429250	383122	Various.	6678
	Eaft Riding	454720	306240	5	6380
	North Riding	1200000	365326	Various.	5939
	Weftmoreland	431200	378400	$3\frac{1}{2}$	3262
	Cumberland	856800	378400	$3\frac{3}{4}$	5915
	Durham	414400	159385	5	3320
	Northumberland	1108800	538162	$5\frac{1}{2}$	12333
Welfh	North Wales	2035200	683040	2	5692
	South Wales	2284800	571200	$1\frac{1}{2}$	3570
	Ifle of Man				
		28412202	14854299		202737

			Packs Skin Wool.	
Slaughtered	4221748 fheep	$\frac{3.25}{2}$	28580	
Carrion	211087		1429	
Slaughter of long-wool fheep	980642	3	12258	
Carrion of ditto brought forward			286	
				42553
Total of fhort wool				245290
Ditto long ditto				137228
Wool from lambs flaughtered			2918	
Ditto fhorn			7800	
				10718
Grand total				393236

	lbs.	oz.
N.B.—The average fleece of England, nearly - - - - - -	4	8
Do. ——————— short wool	3	4
Do. ——————— long wool	7	10
Do. ——— stock *per* acre in England - - - -		$\frac{10}{32}$ sh.
Do. ——— do. long wool -		$\frac{20}{13}$ sh.
Do. ——— do. short wool -		$\frac{9}{22}$
Do. ——— produce *per* acre long fleece wool - - -	8	0
Do. ——— do. short do. -	1	5
Do. ——— do. long skin wool	0	5
Do. ——— do. short do. -	0	4
Do. ——— do. skin wool of the kingdom, nearly - -	0	5

The wool of Scotland may, perhaps, be estimated at 70,000 packs, of which the greater part, particularly that grown in the Highlands, is of the very coarsest kind. Of the quantity of wool grown in Ireland, we can form no correct estimate, but it cannot be great. From the returns at the Custom-house, it appears that the quantity of wool imported from Ireland and the Isle of Man in 1816 amounted to about 2600 packs; whilst the value of woollens imported from England was upwards of 500,000*l.* sterling. The woollen and worsted manufactures in Ireland are no where on an extensive scale; perhaps 60,000 packs are the full amount of the wool annually shorn in Ireland: this was the amount stated about a century since.

The quantity of wool imported into England may be seen from the following return at the Custom-house for the year 1817, amounting to about thirty thousand packs. The qualities we have annexed in the last column.

An Account of the Quantity of Sheep and Lamb's Wool imported into Great Britain, in the Year ending 5th January 1817; distinguishing the Countries from whence imported.

Countries from whence imported.	Year ending 5th Jan. 1817.	Quality.
	lbs.	
Russia - - -	228,673	Coarse.
Denmark - -	80,646	Principally coarse.
Iceland and Feröe -	33,395	Coarse.
Prussia - - -	16,712	Fine clothing-wool.
Germany - -	2,816,655	Principally ditto.
Holland - - -	143,390	Ditto.
Flanders - - -	77,625	Ditto.
France - - -	221,595	Ditto.
Portugal, &c. - -	493,277	Ditto.
Spain - - -	2,958,607	Ditto.
Gibraltar - - -	25,692	Coarse.
Italy - - -	108,234	Principally fine.
Turkey - - -	26,821	Fine.
Ireland and Isle of Man (produce)	600,377	Various, none very fine.
——— (foreign) -	1,171	
New Holland - -	13,611	Fine Merino.
Cape of Good Hope	9,623	Ditto.
United States of America - - -	43,465	Various.
Spanish colonies in South America -	206,454	Ditto.
Brasils - - -	5,512	Ditto.
British West Indies -	6,329	Ditto.
Total - -	8,117,864	

The whole of the imported wool, with scarcely an exception, is worked on the card, none of it being suited for the comb. The coarser kinds are principally employed for carpets, &c.; and the fine from Spain, Germany, Portugal, and France, supply our manufactures of superfine broad cloths, cassimeres, &c. So large a portion being of the finer kinds, the total value cannot be less than one million and a half pounds sterling.

Wool of New Holland.—The annual value and amount of the fine wool imported into England for our own manufactures being so great, we must surely applaud the meritorious exertions of those who attempt to supply the demand with the produce of our own country, or of our dependent colonies, and more particularly if they can raise this supply from parts where no wool was before grown. In this view, it cannot fail to be highly interesting to learn, that the exertions of one enlightened agriculturist have been eminently successful in spreading over an immense region dependent on England the very finest-woolled sheep, where the soil had never before yielded any produce serviceable to civilized man.

John Macarthur, esq. descended from an ancient family in Argyleshire, captain in a regiment then commanded by general Grose, went to New Holland in 1789. Fortunately for the future prosperity of the colony, his active spirit of inquiry and enterprise led him to direct his attention to the natural advantages which the soil and climate presented to the agriculturist, and having by purchase and grants obtained a considerable tract of country, he quitted the service in 1793, and commenced his farming operations. His stock at first consisted only of a few oxen and thirty Bengal ewes, growing a coarse kind of wool or hair. About the year 1795, he obtained from captain Kent, of the Royal Navy, one Merino ram and two ewes, purchased from the Dutch governor of the Cape of Good Hope. With these he began to cross his coarse-haired sheep, and to select the finest-woolled progeny to breed from. Having occasion to return to England in 1802, be brought over specimens of his wool, which were shewn to a body of the clothiers from the west of England, then in London on public business, who were so sensible of the advantages which might result from encouraging the growth of fine wool in the colony, that they presented a petition to the privy council, by whom Mr. Macarthur was examined. His plans being approved, the privy council recommended the secretary of state for the colonies to give him an additional grant of land, in a tract of country, from its fertility, called the cow-pastures, forming part of Camden county. On his return he took with him three Merino rams and two ewes, purchased from his majesty's flocks; and thus encouraged, he proceeded with rapid steps in the increase and improvement of his flocks, the climate being every way suited to secure the healthy condition of the sheep, and preserve the fineness of the wool.

The numbers increase four-fold every five years, so that his flocks already amounted to about four thousand sheep and lambs, including the fine and mixed breeds, when the unfortunate disputes with governor Blight, and the subsequent arrest of the latter, obliged Mr. Macarthur once more to return to England, and in some degree interrupted the progress of improvement. In 1817 his flocks had increased to about seven thousand, and the wool which has been sent to this country at different times, is become an important source of profit, the better sort being equal to the best Merino piles from Spain or Saxony. What we have seen more nearly resembles the latter, and were they both in the same state of cleanness, the most experienced eye could not discern any difference between them in fineness of the hair, length of staple, soundness, colour, or other properties.

The

The wool has been hitherto washed on the sheep's back in the English method, by which it is not rendered so clean as by the Spanish or German mode; but making allowance for the additional waste, its value is equal to that of the very best Merino wool imported from any part of Europe.

The quantity imported this year is about eighteen thousand pounds weight, and a farther arrival is expected. The laudable example of Mr. Macarthur has been followed by other persons in the colony, and the total amount of wool sent from thence this year is about fifty thousand pounds weight; and such is the spirit of agricultural improvement, that at the annual sales of sheep established by Mr. Macarthur, rams and ewes have been sold at from ten to thirty guineas each. Though the absence of Mr. Macarthur impeded the progress of improvement, yet this will be more than compensated by the valuable information he has obtained with respect to the management and improvement of his flocks, from observations made on the continent; and he has further benefited the colony by taking back with him a selection of olive-trees, vines, and oranges. The dryness and mildness of the climate of New Holland, and the almost total absence of briars and underwood, are extremely favourable to sheep. His stock is divided into flocks of about four hundred, with shepherds and Spanish dogs to each. Under these propitious circumstances, and as the flocks double in number every thirty months, we may anticipate, that in the course of twenty or twenty-five years, the importation of fine wool from this colony will be fully equal to the total amount at present imported into England from all the different countries of Europe. It might repay the exertions of this enlightened agriculturist, and of the British government, could they procure from India the animals, whether sheep or goats, which yield the peculiarly soft wool for shawls. This would be a most valuable article, and is much wanted by our manufacturers.

There can scarcely be a doubt, that under the favourable climate of the British settlements in New Holland, all the Asiatic wool-bearing animals, particularly those of Cashmere and Thibet, might be introduced with every prospect of success. The coarse wool grown in the colony is chiefly manufactured in the country for domestic use. It is estimated that there are at present sixty thousand sheep in the colony, and a little perseverance and attention would suffice to change the coarse-woolled breeds into finer ones; a change which is at present rapidly taking place, and deserves the greatest encouragement, as wool is the only article of produce which the colonists have at present to export in exchange for British manufactured goods.

The Improvement of Wool depends primarily on attention to the breed of sheep, but there are various circumstances of soil, climate, and food, which are important to be regarded. The experiments that have been made in various parts of Europe within the last half century, have sufficiently removed the prejudice that long prevailed, respecting the impossibility of growing the finest clothing-wool in almost every part of the globe where sheep will subsist and thrive. It is different with the long combing-wools, to grow which in perfection, luxuriant pastures seem absolutely requisite, and these cannot be obtained under a parching sun, nor could the animal subsist in tropical climates, covered with such a load of wool as is grown on our sheep in Lincolnshire. Under such circumstances, an entire change seems to take place in the animal system; the long-woolled sheep become diseased and feverish, and only recover by casting the fleece, which is replaced by a coat of short hair. The rich pasture in England, and the opposite coasts of Flanders, seem more favourable to the growth of heavy combing fleeces, than any other country in the known world; and the Leicestershire and Lincolnshire sheep seem every way well suited to these pastures, and the prices of the wool obtained at present are sufficient to secure attention to its cultivation. At one period, indeed, during the American revolution, the price of long combing-wool not being more than about three-pence *per* pound, the growers turned their attention principally to the improvement of the carcase, and neglected the weight of the fleece. At present the price is about eighteen-pence, and the average weight being about eight pounds, the wool forms an important object, and the growers are endeavouring to increase the weight of their fleeces. For the common purposes of the worsted manufactures, this wool is so well suited as to leave nothing further to be desired; and it is this kind which foreign manufacturers are so desirous to obtain from us. In many situations, however, where heavy long-woolled sheep are introduced, and where the soil is not sufficiently rich to grow it in perfection, it would be possible to grow a fleece weighing five or six pounds of very fine combing-wool, by crossing the long-woolled ewes with the Anglo-Merino rams. The increasing demand for finer goods, and the great improvement made in the spinning of combing-wool by machinery, make such a change desirable where the pastures are not sufficiently rich to bear the heavy long-woolled breeds of Leicester and Lincoln.

In many cold and exposed situations it would be desirable to provide better shelter for the flocks; and the practice of *greasing*, hereafter described, might be introduced with great advantage, and would tend to preserve the sheep and improve the quality of the wool.

The experiments made on the fine-woolled sheep on a large scale in different parts of Europe, prove that the peculiarities of food and climate have comparatively small influence on the quality of clothing-wool, and that it may be grown equally fine in situations where the sheep are confined and kept on dry meat a great part of the year, as in Saxony, Sweden, and Denmark. It may also be grown in the richest pastures, provided the pastures be over-stocked, to keep the herbage bare. There cannot, however, be a doubt, that a dry light soil, particularly in the moist climate of England, is most favourable to the health of the sheep, and to the quality of the wool.

The experiments that have been made in England on the Merino sheep have not been so successful as in other countries, principally arising from two causes.

In the first place, the demand for meat in England will always make the wool but a secondary object with the grazier, and no cross of the Merino sheep with the English has yet produced a race that equal in symmetry of form the South Down sheep, or that will produce the same quantity of meat to the butcher in the same space of time, and with the same food. In the second place, the mode of washing the Merino and Anglo-Merino wool in England will, so long as it is practised, prevent the wool from obtaining its proper value in the market. From the great quantity of natural yolk or grease in the Merino fleece, it is impossible to wash the wool on the sheep's back by mere immersion in water. In Spain no attempts are made to wash the wool upon the sheep's back, but all the fleeces of a pile are regularly sorted, and the different sorts scoured and dried before the wool is packed. But where the quantity of wool which any one grower possesses is small, as in England, it would not answer to send for wool-sorters from a distance; and to wash the wool before it is sorted, would so intermingle the fine with the coarse locks, as to render the regular sorting extremely difficult and expensive. In

Saxony

Saxony and Sweden the wool is washed on the sheep's backs. The following account of the process is thus described by baron Schulz. The sheep are first washed with one part clear ley, and two parts lukewarm water, and then in another tub with less ley in the water; after which the sheep are washed, laying them always on their backs, with their heads up, in a tub with clean water; and lastly, there is poured on the sheep, when standing on the ground, a sufficient quantity of water, which is as much as possible squeezed out of the wool. The sheep are afterwards driven into an unpastured meadow adjoining, and remain there, to prevent their soiling themselves in the sheep-house. They remain there a day and a night, or longer, till the wool be dry, which in fine weather will be in three days. Some persons wash their sheep twice, but the wool becomes harder in consequence of it, and has a greyer appearance.

The great quantity of grease which the finest Spanish wool contains at the first washing mixes with the ley-water, and makes it quite soapy; but this grease is wanting in the second washing, so that the water is not in the least softened. Some mode of washing like the above must be introduced in England, before the manufacturer will encourage the Anglo-Merino wool; for after his purchase, when he thinks he has obtained sufficient allowance in the price to cover the waste, he is generally much disappointed in finding the loss in the manufacture so greatly to exceed his expectation, and he is deterred from making a second trial.

In the northern counties of England, and in Scotland, a practice has long prevailed of greasing the sheep with a mixture of tar and butter, to preserve the animal from the effects of moisture, and the inclemency of the weather in hilly and exposed situations. This practice seems at present peculiar to Britain, but the ancients evidently made use of mixtures of the dregs of olive wax, tar, wine, and other ingredients, to protect the skin of sheep after shearing, and to soften and improve the wool. Such was the practice of the Italian shepherds, as described by Virgil:

> " Aut tonsum tristi contingunt corpus amurca,
> Et spumas miscent argenti vivaque sulfura,
> Idæasque pices et pingues unguine ceras
> Scyllamque helleborosque graves nigrumque bitumen."
> Georg. lib. iii.

That this practice was extremely beneficial in warm climates, by protecting the skin of the sheep from insects after shearing, and by keeping the wool in a soft state, cannot be doubted.

The practice of greasing the sheep in Scotland, and the northern counties of England, with a mixture of tar and butter, seems to have been introduced merely to preserve the sheep, and was generally supposed to be injurious to the wool. Indeed the great proportion of tar, too frequently employed, gave some ground for entertaining this opinion; and the breed of sheep, on which this mixture was most generally applied, is naturally the worst which exists in Britain for the production of wool, the fleeces more nearly resembling coarse hair than wool; but Mr. Bakewell, in his Treatise on Wool, observes, that "in Northumberland, where the fine-woolled sheep have received the benefit of greasing with a mixture in which the proportion of tar was merely sufficient to give it due tenacity, the wool is greatly improved by the process, but the ignorance or selfishness of the wool-buyers for a long time prevented the acknowledgment of the fact." Many were afraid to purchase the wool on account of its dirty appearance, but its value is now better understood in the Yorkshire markets, and it is purchased by the manufacturers of coloured cloth in preference to the ungreased wool of the same degree of fineness. The same preference is also given to the cloths in the halls, where they are sold in an undressed state. When these cloths are finished, their superiority is more apparent, possessing a degree of softness far beyond the ungreased wool. These wools appear to improve in every process of the manufacture, and yield a cloth of greater value by twenty or thirty *per cent.* than the ungreased hard wools, though the latter may be equally fine.

But even in Northumberland, where the wool is so greatly improved by the practice, its good effects in this respect are not sufficiently known, and the operation is delayed till the approach of winter. By this delay, the upper part of the staple which is first grown, is deprived of the advantage of being kept in a moist soft state during the summer heat. When the operation has taken place, a perceptible improvement may be observed in the wool which is afterwards grown. The line of distinction is clearly marked by the stain which the unguent leaves in the staple, the bottom part of which, where it is applied, is finer and softer than the upper part which was grown before its application. This difference is so great, that a careful examination of the fine-greased wools of Northumberland might alone be sufficient to demonstrate the advantage of the practice, and the inconvenience of delaying the operation to the end of the year. To derive the most advantage from the ointment both to the wool and the sheep, it should be applied immediately after shearing, and again at the approach of winter. By the first greasing, the wool will be kept soft and moist during the sultry heats of July and August, and the top of the staple would not become harsh and discoloured, which is frequently the case with English wool. One acknowledged advantage of greasing immediately after shearing should not be overlooked; it destroys the sheep-tick, and has a tendency to prevent cutaneous distempers, and to protect the skin from the bite of the fly. The manner of preparing the ointment in Northumberland is as follows:—From sixteen to twenty pounds of butter are placed over a gentle fire, and melted; a gallon of tar is then added, and the mixture stirred with a stick until the tar and butter are well combined, and form a soft tenacious ointment. Some skill is required in its application, the want of which has prevented the practice from prevailing more generally. If the ointment be rubbed on the wool, it collects on the top of the staple, where it detains the loose soil, and becomes hard, and is injurious to the wool. The proper method is to divide the staples or locks with one hand, and apply the ointment with the finger immediately upon the skin; it is thus kept constantly soft by the warmth of the animal, and is equally diffused through the fleece. Attention to this circumstance is of the greatest importance to the success of the practice. The quantity laid on each animal varies in different districts. In the lighter mode of greasing, one gallon of tar and twenty pounds of butter will be sufficient for fifty sheep. In Scotland, where greasing is applied merely to preserve the animal against the inclemency of the climate, a much larger portion of tar is used: this would be very injurious to the wool, were it of any other than the very coarsest kind.

Could a cheap substitute for tar be found, which would possess equal tenacity, the ointment might be applied with great advantage to all our native breeds of English sheep, both for the preservation of the animal and the improvement of the wool. Mr. Bakewell states, that long combing-wools, which have been greased in this manner, produce a softer and superior yarn to any ever made from wool of the native English breeds which have not undergone the process.

cefs. On all chalk and light calcareous foils, the wool is always much harfher than wools of the fame degree of finenefs grown on argillaceous or filiceous foils; and this arifes from the calcareous earth penetrating the fleece, and abforbing the natural greafe, and thus rendering the fibres hard and elaftic. Thefe foils cover a large portion of the fouth-eaftern counties of England, and of fome of the midland counties; and it is well known to cloth manufacturers that the wool from thefe diftricts do not work fo well, nor make fo foft a cloth, as wool on filiceous or argillaceous foils. Nor will this wool felt in the fulling-mill like the fofter wools. The practice of greafing would be of undoubted advantage in calcareous diftricts, applying the ointment more fparingly than in the northern counties. Perhaps twenty-five pounds of butter, and one of tar, or two of bees'-wax, might be fufficient for one hundred South-Down fheep; and if the mixture were applied once after fhearing, and again in October, the expence would be abundantly compenfated by the improved condition both of the fheep and wool. The foftnefs of wool appears to be effentially connected with the property of felting, and depends partly on the ftructure of the furface of the fibre, and partly on its poffeffing but a moderate degree of elafticity. The procefs of felting is beft illuftrated in the hat manufacture, where the fibres of wool or fur are brought into contact by preffure and warmth, and form a compact fubftance without the aid of fpinning and weaving. In fome parts of Tartary, coarfe cloth for tents is manufactured by fpreading the wool on the ground, and preffing it in warm water with the feet; this was probably the firft mode of making cloth. All good woollen cloth is ftill woven comparatively loofe, and is made firm and clofe in the fulling-mill. The fibres of wool or fur have a tendency to move more eafily in one direction when preffed, than in the oppofite direction. This motion has been compared to that of an ear of barley placed under the coat-fleeve, with the points of the beards downwards; by the action of the arm the ear is moved in a retrograde direction, until it has advanced from the wrift to the fhoulder. When we draw a hair of wool or fur through the fingers in a direction from the points to the root, we can feel a fenfible degree of roughnefs, which is not felt if the hair be drawn from the root to the point. Hence we may fuppofe, that the furface is covered with a number of points or rings, which are too minute to be obferved by the microfcope, except in fome kinds of fur, as in that from the South-fea feal, in which, with a powerful microfcope, we have feen the furface covered with diftinct leaves or points, fhaped like thofe of the artichoke. We have a ftriking illuftration of this tendency of the fibre to move in one direction in that particular procefs of hat-making, where it is intended to cover the felt or fubftance of the hat with fur of a fuperior kind. The felt on which this fur is to be laid being finifhed, the hair of the beaver is uniformly fpread upon the furface, and being covered with a cloth, it is preffed and agitated by the hand for a certain time. The fibres of beaver-hair introduce themfelves by their roots into the felt, and proceed to a certain depth, and become firmly fixed in it. If the preffure were continued for a longer time, the hairs would pafs entirely through the felt, going out at the under furface, as each hair follows the direction it acquired at the beginning of the procefs.

As the felting property, therefore, feems to depend on the minute ftructure of the furface of the fibre, it is eafy to conceive how this may be injured by a dry calcareous foil, and how this property is beft preferved in thofe furs which are grown under a covering of coarfe hair, and protected from external injury. The procefs of greafing is in fome refpects a fubftitute for fuch a covering, and not only defends the furface, but prevents the fibre from becoming dry, harfh, and elaftic. The ancient Greeks and Romans were in the practice of covering their foft-woolled fheep, called *molles oves*, with fkins: this has been fuppofed to have been intended merely as a protection from briars and underwood; but we have no doubt that wool fo covered would be much fofter than wool expofed to the action of light, and of the foil. That the rays of the fummer fun have a tendency to make wool both coarfer and harfher, may be feen in the effect produced on fheep that are expofed to it without fhelter immediately after fhearing. The top point of the ftaple which was grown at that time is almoft always coarfer and harder than the bottom of the ftaple which has been grown under the cover of the upper part of the fleece, and confequently more protected from light. An analogous effect is produced on the fkins of horfes kept in coal-mines, which become fleek and foft. Thefe facts may fuggeft to wool-growers defirous of improving their wool, the advantage of providing fhade for their flocks during the fultry heats of fummer. The natural inftincts of fheep might teach them the impropriety, not to fpeak of the cruelty, of keeping their fheep in fummer inclofed in pens, and unfheltered, upon a dry foil, where the animals are almoft roafted alive; a practice not lefs injurious to the health of fheep than to all the beft qualities of the wool. Next to a regular fupply of food, protection from the effects of heat and wet are objects of the firft importance in the management of fheep; and it may be ftated as an undoubted truth, that whatever contributes to the comfort of the animal, will enable it to fatten with a fmaller quantity of food, will tend to preferve it in a healthy ftate, and will alfo increafe the quantity and improve the quality of the wool.

WOOL, *Chemical Examination of.* The chemical properties of wool are very fimilar to thofe of hair, and as we omitted to fpeak of thefe in their proper place, we fhall introduce them here.

From the experiments of Achard and Hatchett, it appears that hair contains gelatine, to which it owes its fupplenefs and toughnefs. When hair is boiled in water, this principle is feparated, and the hair becomes much more brittle than before. Indeed, if the procefs be continued long enough, the hair crumbles to pieces between the fingers. The portion infoluble in water poffeffes, according to Mr. Hatchett, the properties of coagulated albumen.

Mr. Hatchett has concluded, from his experiments, that the hair which lofes its curl in moift weather, and which is fofteft and moft flexible, is that which yields its gelatine moft readily; whereas ftrong and elaftic hair yields it with the greateft difficulty, and in the fmalleft proportion. This conclufion has been confirmed by a very confiderable hair merchant in London, who affured him that the firft kind of hair was much more injured by boiling than the fecond.

Vauquelin has publifhed a curious fet of experiments on human hair of different colours. He found it completely foluble in a Papin's digefter. During this procefs, fulphuretted hydrogen was evolved. The folution thus obtained contains a kind of bituminous oil, which is depofited very flowly. This oil was black when the hair was black, but yellowifh-red when red hair was the fubject of experiment. When this oil was removed, nut-galls and chlorine produced copious precipitates. Silver was blackened, and acetate of lead precipitated brown. When concentrated by evaporation, it did not concrete into a jelly.

Water

Water containing only four *per cent.* of potaſh diſſolves hair, while hydro-ſulphuret of ammonia is evolved. If the hair be black, a thick dark-coloured oil, with ſome ſulphur and iron, remain undiſſolved. If the hair be red, this oil is yellowiſh. Acids throw down from this ſolution a precipitate, ſoluble in exceſs of acid.

Sulphuric and muriatic acids become red when firſt poured on hair, and gradually diſſolve it. Nitric acid turns hair yellow, and diſſolves it, while an oil ſeparates, varying in colour, as before-mentioned, according to the colour of the hair employed. The ſolution contains a great deal of oxalic acid, beſides bitter principle, iron, and ſulphuric acid. Chlorine reduces it to a ſubſtance of the conſiſtence of turpentine, partly ſoluble in alcohol.

Alcohol, digeſted on black hair, extracts from it two kinds of oil. The firſt, which is white, ſubſides in white ſhining ſcales as the liquor cools; the ſecond is obtained by evaporating the alcohol. It has a greyiſh-green colour, and at laſt becomes ſolid. From red hair alcohol alſo extracts two oils, one white, as above, the other red as blood. After this latter has been extracted, the hair becomes cheſnut. Hence its red colour appears to depend upon this oil.

Hair on incineration yields iron and mangane ſe, ſulphate and carbonate of lime, muriate of ſoda, and a conſiderable proportion of ſilica. The aſhes of red hair contain leſs iron and manganeſe. Thoſe of white hair ſtill leſs; but in thoſe we find magneſia, which is wanting in the aſhes of other hair. The aſhes of hair do not exceed .015 of the hair.

Hence, according to this analyſis, hair conſiſts of

1. Animal matters conſtituting the greateſt part.
2. A white ſolid oil, ſmall in quantity.
3. A greyiſh-green oil, more abundant.
4. Iron, ſtate unknown.
5. Oxyd of manganeſe.
6. Phoſphate of lime.
7. Carbonate of lime, very ſcanty.
8. Silica.
9. Sulphur.

Vauquelin infers from theſe experiments, that hair depends for its colour upon a kind of oil, which varies according to the colour of the hair in which it is found. He alſo ſuppoſes, that ſulphuret of iron contributes to the colour of black hair. The ſudden change of colour in hair from grief, he thinks, is owing to the evolution of an acid. Bichat, however, attributes this change, perhaps with greater probability, to the abſorption of the colouring principle. To whatever cauſe it be owing, the fact appears undoubted; and it ſhews a cloſer connection between the living powers and the hair, than many phyſiologiſts are inclined to admit.

Wool appears, according to the experiments of Berthollet, to coincide almoſt exactly in its chemical properties with thoſe of hair above-mentioned. When growing on the back of the animal, it is enveloped in a greaſy matter, called the *yolk*, and which appears to be a kind of ſoap; or, more properly ſpeaking, according to the experiments of Vauquelin, who has examined it, of

1. A ſoap of potaſh.
2. Carbonate of potaſh.
3. A little acetate of potaſh.
4. Lime.
5. A little muriate of potaſh.
6. An animal matter.

This ſubſtance appears to have the property of protecting the animal from inſects to a certain degree, and of preſerving the ſoftneſs of the wool, which are perhaps its chief uſes. It is removed from the wool before it is manufactured, by the proceſs termed *ſcouring*. The affinity of the animal matter of wool for all colouring principles is very great, and in general far exceeds that of the different vegetable fibres, as cotton, flax, &c. for ſuch principles. There is one kind of coarſe wool, however, which, according to Dr. Bancroft, does not poſſeſs this property, and receives colours with great difficulty. See DYEING, and the preceding article.

WOOL, *Laws relating to.* The jealouſy entertained on the ſubject of our wools, may be learnt from the legal reſtriction which has been made in relation thereto; as alſo with the view that as much employment as is poſſible may be found for the labouring claſſes. This is effected by the prohibition of the exportation of wool in an unmanufactured ſtate, as will be ſeen below. It muſt be obvious, however, that it would be to little purpoſe to be thus ſtrict reſpecting the article itſelf, if that which produced it was not equally guarded; therefore as early as 13 & 14 Ch. II. c. 18. it was made felony to export ſheep from England or Ireland, or even to Scotland: now however the penalty is forfeiture of every ram, ſheep, or lamb, and the veſſel in which ſuch is ſhipped with intent to exportation from Great Britain and the iſlands belonging thereto; and offenders are to forfeit 3*l.* for every ſheep, &c. ſo ſhipped, and to ſuffer three months ſolitary impriſonment, and till the forfeiture be paid, but not to exceed twelve months; and for any ſecond offence 5*l.* for each ram, &c. and ſix months impriſonment, and till the fine is paid, but not to exceed two years. 28 Geo. III. c. 38. § 2.

By the 9th and 37th ſections, no wool, woolfells, mortlings, yarn, or worſted made of wool, woolflocks, coverings, cruels, waddings, or other manufactures, or pretended manufactures ſlightly wrought up ſo that it may be reduced to wool again, or mattreſſes, or beds ſtuffed with wool combed or fit for combing or carding, may be ſhipped or exported, or carried or moved for that purpoſe, from Great Britain, or Guernſey, Jerſey, Alderney, Sark, or Man, to any foreign place, on forfeiture of the wool, with the carriage, ſhip, or cattle on which it is laden or removed; but 300 ſheep may be ſent annually from Liverpool or Whitehaven to the Iſle of Man (51 Geo. III. c. 50.); and the perſon offending to forfeit 3*s.* for every pound weight, or 50*l.* in the whole, and to be impriſoned three months, and till the penalty is paid, but not to exceed ſix months; but for a ſecond offence he is to forfeit the like ſums, and to be impriſoned for ſix months, and till ſuch fine be paid, not exceeding two years; but this is not to extend to lambſkins dreſſed for furs and linings.

And perſons qualified by the governors of the following iſlands may export the reſpective qualities ſet againſt them from Southampton to thoſe places in every year:

	Tods.
To Jerſey - -	4000
To Guernſey -	2000
To Alderney -	400
To Sark - -	200

28 Geo. III. c. 38. § 16, 17. And 20,000 pounds weight of worſted and woollen yarn may be exported annually from London to Lower Canada, by permiſſion of his majeſty in council. 47 Geo III. c. 9. 52 Geo. III. c. 55.

By the 48 Geo. III. c. 44. wool may be ſhipped in England for exportation to Ireland, on being duly entered and bond given for its true exportation there; and upon obtaining a licence under the hands of the commiſſioners of the cuſtoms to allow it.

No

No wool ſhipped to be ſent coaſtwiſe from one part of Great Britain to another, until due notice be given and bond entered into, and a licence obtained under the hand of three commiſſioners of the cuſtoms. Penalty, forfeiture. 28 Geo. III. c. 38. § 34. And wool muſt alſo be ſhipped coaſtwiſe in Britiſh ſhip, Britiſh owned and manned, the owner of which does not reſide out of Great Britain. § 19. and 12 Car. II. c. 18. Formerly there were penalties and forfeitures for keeping or removing wool in Kent and Suſſex within certain diſtances of the ſea (ten and fifteen miles), without entry and bond, and procuring certificates or permits, and alſo for removing wool within five miles of the ſea-coaſt of Great Britain before ſun-riſing and after ſun-ſet; but by the 54 Geo. III. c. 78. all the regulations formerly required *antecedent to the removal* of wool on land throughout England are repealed.

Wool to be packed in packs, or truſſes of leather, or canvas, called 'Pack-cloths,' or in linen or woollen, and to be marked '*Wool*,' in letters three inches long, on forfeiture of the wool, and 1*s. per* pound. 28 Geo. III. c. 38. § 28.

Perſons packing wool, &c. into boxes, barrels, caſks, or cheſts, and other than as above, or preſſing or ſteaning the ſame, to forfeit the goods, and 3*s. per* pound. Ibid. § 30, 31.

Inſurances for the conveyance of wool contrary to this act void, and the parties may be puniſhed. § 45, 46, 47, 48.

King's ſhips empowered and required to ſearch ſhips for wool ſhipped without licence. § 49, 50, 51.

No perſon can ſeize wool unlawfully removing but officers of cuſtoms, exciſe, and ſalt-duties, or perſons accompanied by a conſtable (§ 52.); and perſons neglecting their duty to forfeit 20*l.*, and making colluſive ſeizures or agreements to be ſubject to like penalties as exporters. (§ 53. 55.) Hindering, obſtructing, or beating officers, ſubjects offenders to tranſportation; and bribery of them, whether accepted or not, to the penalty of 300*l.* § 56, 57.

If any queſtion ariſes upon the growth of the wool, the *onus probandi* is to lie upon the owners. § 60.

Informations may be laid in any court of record, and penalties, &c. under 200*l.* may be determined before two juſtices of the peace; and juſtices at quarter-ſeſſions may direct ſhips, goods, wool, &c. to be ſold. § 62, 63.

Proſecutions to be commenced within three years. § 77.

Wool the growth of Ireland may be exported to England, and no where elſe. 1 W. & M. c. 32. 7 & 8 W. III. c. 28. 10 & 11 W. III. c. 10. 26 Geo. III. c. 11.

And the Admiralty is to appoint three ſhips of the ſixth rate, and eight or more armed ſloops, to prevent the exportation of wool from Ireland to foreign ports. 5 Geo. II. c. 21.

Wool the produce of any of the colonies, &c. in America, or countries on the continent of America, ſubject to any foreign European ſtates, imported into certain Britiſh Weſt India iſlands, may be imported into Great Britain under the regulations of the 12 Car. II. c. 18.

Thoſe places are, Jamaica, Granada, Dominica, Antigua, Trinidad, Tobago, New Providence, Crooked iſland, St. Vincent, Bermuda, Caicos, Tortola, Curacoa, and the Bahamas. 27 Geo. III. c. 27. 45 Geo. III. c. 57. 47 Geo. III. ſeſſ. 2. c. 34.

Britiſh hare or coney wool may not be exported, (except to Ireland, 39 & 40 Geo. III. c. 67.) on penalty of forfeiture. The owner or ſhipper to pay 100*l.*, and the maſter of the ſhip 40*l.* 24 Geo. III. c. 21.

Wool, *Cheeſe made under*, in *Rural Economy*, a term applied to that ſort of high-taſted ewe cheeſe which is made before the ſheep are ſhorn. See Cheese.

Wool, *Pack of*, a quantity of wool packed up cloſely together in a large bag of the ſack-cloth kind, which in London is conſtituted of two hundred and forty pounds. See Wool.

Wool, *Pocket of*. See Pocket.

Wool, *Sarplar of*. See Sarplar.

Wool-*Stapler*, a perſon who ſtaples and deals in wool. See Wool.

Wool-*Stapling*. See Stapling *of Wool*.

Wool-*Balls*, in *Natural Hiſtory*, maſſes of wool compacted into firm and hard balls, and found in the ſtomachs of ſheep, as the hair-balls are in oxen and other animals.

Theſe are doubtleſs formed in the ſame manner as thoſe hair-balls of the outer covering of the animal; but they are much more uncommon; they are found in numbers, three, four, or five, in the ſtomach of the ſame animal. Their outſide has commonly much the ſame appearance of a puff-ball, and is uſually either in part or wholly covered with a very thin and ſoft blackiſh ſmooth ſkin; the inner ſubſtance is entirely wool, but that wrought together as cloſely as the hatter does his furs in the making of them into hats.

They are uſually ſoft, ſmooth, and ſomewhat elaſtic, of a pale buff-colour, very light, and of irregular figures rather cubic than globular, and ſeldom of any great ſize, an inch in diameter being their common ſtandard. Moreton's Northampt. p. 451. See Balls.

WOOLASSEY, in *Geography*, a town of Bengal; 42 miles N.E. of Calcutta.

WOOLDALE, a townſhip of England, in the Weſt Riding of Yorkſhire, near Wakefield.

WOOLDAW, a town of Bengal; 40 miles W. of Nagore.

WOOLDERS, *Single and Double-Handed*, in *Ship-Building*, are ſticks about three feet long, and four inches in circumference, with ſtraps of rope-yarn made faſt, to fix on the rope in making, and aſſiſt the men at the hooks in cloſing the rope.

WOOLDING, is winding ſeveral cloſe turns of rope in a tight manner round the maſts and yards, that are made of ſeveral united pieces, to ſtrengthen and confine the ſame together. In making new maſts and yards, this method is diſcontinued, and iron hoops uſed in lieu.

Woolding is alſo the rope employed in this ſervice.

WOOL-DRIVERS, are thoſe who buy wool of the ſheep-owners in the country, and carry it on horſeback to the clothiers, or market-towns, to ſell it again.

WOOLER, anciently Willove, in *Geography*, a market-town, and pariſh in the ward of Coquet-dale, and county of Northumberland, England. The former is ſituated near the Cheviot-hills, 17 miles S. from Berwick-upon-Tweed, 46 N. by W. from Newcaſtle, and 320 in the ſame direction from London. In 1811 the houſes in the pariſh were 284, inhabited by 1704 perſons. A market is held on Thurſday, and fairs on the 4th of May and 17th of October. Wooler was a barony, and conſiſted of ſeveral manors in the time of Henry I., who conferred it on Robert de Muſcamp, whoſe ſucceſſor Robert, in the reign of Henry III., was the moſt powerful baron in the north of England: it now belongs to the earl of Tankerville. The church was rebuilt in 1765, and the town contains ſome meeting-houſes for diſſenters. Situated near the confines between the kingdoms

doms of England and Scotland, the environs of Wooler prefent many intrenchments, cairns, and other memorials of the fanguinary conflicts which in former times occurred between the rival nations on the borders. About ten miles N. from the town, on the road to Scotland, is the celebrated Flodden-field, where the Scotch, in 1513, received a fignal defeat, and James IV. was flain.—Beauties of England, Northumberland, by the Rev. J. Hodgfon, 8vo. 1812.

WOOLHASA, a town of Algiers; 6 miles N.W. of Tackumbreet.

WOOLLEN MANUFACTURE, *Progrefs of the.* The origin of the woollen manufacture, like that of many other ufeful arts, is not precifely known. At a very early period, domeftic fheep were extenfively fpread over Weftern Afia. The introduction of fheep into Europe is not recorded by ancient writers, unlefs we fuppofe the expedition of the Argonauts to Colchis refers to this event. Sheep were probably firft domefticated for their milk, and afterwards for their fkins, which muft have been the firft drefs of paftoral nations. Sheep and goats, in the early ages of fociety, were nearly of equal value. The Greeks, who oftentatioufly refer all ufeful difcoveries to their own country, and rank their inventors among the gods, have afcribed to Minerva the invention of fpinning and weaving. Thefe arts appear, however, to have been firft practifed, at a very early period, in Egypt, and applied to the fpinning and weaving of flax. At what time they were firft applied to wool is unknown. Though Pliny informs us, that Nicias of Megara difcovered the art of fulling cloth, the property which wool poffeffed of felting was known in the Eaft at a much earlier period, and probably gave rife to the firft manufacture of woollen goods which were not woven, but felted like the fubftance of hats.

On this fubject, Mr. Luccock, in his Treatife on Wool, judicioufly remarks, "whilft the fkins of fheep dreffed with their wool on ferved as clothing, it is obvious that only one ufeful fleece could be obtained from one animal, and as the fleece is generally caft, or falls off once a year, this produce muft have been wafted. In a very early period, however, the property which wool poffeffes of felting was difcovered, or, in other words, it was found that by preffure and moifture the fibres of wool might be made to adhere together, and produce a compact pliable fubftance, quite as durable and more convenient than the fkins formerly ufed. This appears to have been the firft effort to produce a woollen manufacture." It is probable the felting property was difcovered by accident, as fome fleeces will felt upon the fheep's backs; among farmers, thefe are called cotted fleeces. When the application of this difcovery was firft made, the knowledge of the art was foon widely fpread. The tents of the Arabs and Tartars are, at the prefent day, all made of felt from the wool of fheep, mingled with the hair of goats, camels, and other quadrupeds, and may be confidered as remains of the original art of cloth-making.

The art of fpinning and weaving threads made from wool was, in all probability, derived from the Eaft; they are alluded to by Mofes as exifting nearly fifteen hundred years before the Chriftian era, and it appears that the early patriarchs had numerous flocks of fheep.

The greater part of thefe fheep, we are informed, were, at firft, either dark-coloured or fpotted; hence we may infer that the art of dyeing wool was then unknown. When the felection and cultivation of white wool gave to woollen cloth the property of receiving the tints of the dyer, the value and ufe of wool muft have greatly increafed, owing to the great eftimation in which richly-coloured garments are held by people advancing to a ftate of civilization.

Thus, in addition to the fuperior pliability and comfort of woollen cloth, compared with fkins or felts, the tafte for it muft have been widely fpread by the art of dyeing. It had alfo the great recommendation to its general adoption, that it could be fabricated with eafe in every family. The machinery required for the purpofe was extremely fimple. The diftaff and the loom, fays Mr. Luccock, were little more in the hands of the firft manufacturers, than the fpade in thofe of the hufbandman. Spinning and weaving, as we have already obferved, were in ufe at leaft fifteen hundred years before the Chriftian era; but the manner in which they were performed is not related until about three centuries afterwards. Then the loom confifted of a frame of wood, in fome refpect different from the modern one, but well adapted to the fame purpofes.

The alterations which have been made in it confift, perhaps, more in the pofition of the beam, and the mode of opening the web for the paffage of the fhuttle, than in any other circumftance. Nor was the earlieft mode of fpinning lefs perfect, than that which was practifed in the moft celebrated manufacturing countries for many ages afterwards. It was performed by means of a rod or ftaff, about which the wool to be fpun was carefully wrapt, and held in the left-hand, while a rough kind of fpindle, quickly twirled betwixt the right-hand and the thigh, was fuffered to continue its motion when fufpended by the thread which the artift gradually lengthened with his fingers. This leaft complex of fpinning-machines is not entirely laid afide even now. A few years fince it was not uncommon in the county of Norfolk, and its continuance in ufe through fo many ages is the beft proof of its excellence.

The preparing of wool for fpinning was probably firft effected by the fingers, and afterwards by the fuller's teazle or thiftle, the dipfacus fullorum, which with its rough and hooked points was well adapted to the purpofe, and has continued in ufe to the prefent day. The card afterwards ufed was probably a fubftitute for the carduus, or teazle. The application of the wheel to a fpindle, or the fpinning-wheel, is, we believe, unnoticed in hiftory. Whenever thefe inventions took place, it is probable their firft introduction contributed more to increafe the quantity, than improve the quality of the yarn and cloth. For a confiderable period after the commencement of the woollen manufacture, the improvements made in fpinning or weaving of wool were effected by the improved addrefs and fkill of the manufacturer, rather than by any alteration in his machinery, as we now fee the manufacturing nations of the Eaft execute very elaborate works with inftruments of the moft fimple conftruction. In proportion as luxury and refinement increafed, the demand for fuperior fabrics would induce the growers of wool to pay great attention to the fleece, and to felect and preferve for breeding thofe fheep which produced the fofteft and fineft wool; with the ancients thefe terms were fynonymous. The produce of fine white wool from fheep is entirely the refult of cultivation; it has never been grown except in countries were the woollen manufactures have flourifhed. The race of fine-woolled fheep has, however, been partly preferved in thofe countries after the deftruction of their trade. The grower would alfo foon learn to pay particular attention to the whitenefs of his fleeces, as a clear white ground is neceffary for receiving the moft brilliant dyes. Blue, purple, and fcarlet, were the tints moft admired; and though the ingredients, by means of which they were produced, are in fome meafure unknown, yet we have the moft indubitable teftimonies to their excellency, and the eftimation in which they were held. To produce them in their richeft luftre,

luftre, a felection of the wool moft adapted to receive them muft be made, and this would operate with great precifion upon the wool-forter's attention.

While the manufacture of wool was confined to the houfes of the grower, and the bufinefs of it tranfacted by his domeftics in a fecluded ftate, there was lefs room for the ftimulation and exercife of invention than in after-ages, when it became the appropriate calling of one particular part of the community, and their fuccefs depended upon the opinion which others formed of the fabric. Yet in the fimpleft days of Greece, it was not deemed an employment unfuitable to palaces, nor did a princefs degrade her dignity by fuperintending the labours of the loom, the diftaff, and the dyeing vat.

We have little information refpecting the woollen manufactures of the Greeks and Romans, as diftinct from their domeftic manufactures; but large eftablifhments were neceffary for the clothing of diftant armies, and for foreign commerce. That the Romans had carried the manufacture of fine woollen cloth to a high degree of perfection, is proved by a variety of circumftances, and particularly by the great attention paid to the cultivation of fine-woolled fheep, and by the high prices at which the wool and fheep were fold, as appears from the writings of Pliny, Varro, and Columella. Pliny defcribes two kinds of fheep: the one which grew coarfe long wool, and was on this account called *hirtum* or *hirfutum*, and from its hardinefs and ruder treatment *colonicum* or ruftic; the other breed was called *molle*, from the foftnefs of the wool, and *generofum* or noble, from its excellence; alfo *pellitum*, from its being clothed with fkins to protect the wool. The race is fometimes alfo called Tarentinum, Apulum, Calabrum Atticum, and Græcum, from the neighbourhood or diftrict in which it chiefly lived; but what is of more importance, as fhewing the origin of the fine-woolled fheep of Italy, the race is called Afianum; and, according to Pliny, a fimilar race exifted in his time at Laodicea in Syria. The defcription given of thefe fheep by Pliny agrees with the prefent race of Merino fheep. There is not, fays Dr. Parry, throughout Europe, any breed of fhort-woolled fheep now exifting befides the Merino, of which the males are horned and the females not.

That the Romans imported their Tarentine fheep into their weftern colonies, with the art of manufacturing fine cloth, we learn from Strabo and Pliny. The former writer, who flourifhed in the reign of Auguftus, fays, that in Turdetania in Portugal, then a part of Spain, "they formerly imported many garments, but now their wool was better than that of the Coraxi, and fo beautiful, that a ram for the purpofe of breeding was fold for a talent, and that fabrics of extraordinary thinnefs were made of this wool by the Saltratæ." Probably this was fimilar to the fhawl cloth of India, and woven in the fame manner, as Pliny calls it fcutulatus, a term which he applies alfo to the fpider's-web. The little attic talent of filver is eftimated to equal in value 216*l.* of Englifh money, which fhews the high eftimation in which the beft wool was held even in the colonies of Rome.

All ranks of people of both fexes among the Romans chiefly wore woollen garments. In the reign of Aurelian, 270 years after Chrift, a pound of filk, according to Vopifcus, was equal to a pound of gold. A people fo pre-eminent in wealth, and in all the refinements of art, would naturally be folicitous to attain the higheft degree of excellence in the manufacture of thofe fabrics, which were calculated to gratify their paffion for adorning their perfons, and it was equally as neceffary to confult their eafe as their vanity. The fummer-heat of Italy was fo great, that the affluent could fcarcely have fupported a woollen drefs, had it not been made of the lighteft and thinneft cloth. We find alfo, that during the Auguftan age, and for a confiderable time afterwards, it was the fafhion to wear cloths which, as at prefent, were furnifhed with a raifed nap or pile. Such cloths were called *pexæ*, in contradiftinction to tritæ or thread-bare. Thus Horace:

> " ——— Si forte fubucula pexæ
> Trita fub eft tunicæ —— rides."

> " You laugh if you efpy a thread-bare veft
> Under a well-dreffed tunic."

And alfo Martial:

> " Pexatus pulchre, rides mea, Zoile trita."

The term pexatus, applied to cloth, leads us to fuppofe that the nap or pile was raifed with a comb, having very fine teeth. Pliny informs us, that in his time the price of wool had never exceeded 100 feftertii the libra, or pound; now the Roman feftertius being about 8*d.* of our money, and the libra about 5245 grains, it follows that an avoirdupois pound, or 7008 grains, would have coft about 1*l.* 2*s.* of our money. From the intercourfe with Perfia and the Eaft, the Romans would become acquainted with the fhawl-cloths of India, and would naturally wifh to imitate fo beautiful and delicate a fabric. Thefe are made from very foft fine fhort wool, and not from combed wool, as has been generally fuppofed in this country. The exiftence of that manufacture in Hindooftan for many ages, is a proof of the high degree of perfection to which the fabrication of woollen cloth had been carried in former times. For fhawl-cloth is only woollen cloth, woven with a twill, and unmilled, but it is fpun to a great degree of finenefs, and from wool fo peculiarly foft, that it has never been rivalled by any European nations. The perfection of the colours, and the fkill difplayed in the weaving, we have no reafon to believe are greater now than in the time of Alexander the Great; and if thefe manufactures were fuccefsfully imitated by the Greeks or Romans, or even diftantly approached in the manufacture of their fine cloths, we may form fome idea of the perfection to which they had arrived. When in the decline of the Roman empire, their colonies were overrun by favage barbarians, all their public eftablifhments and manufactures were deftroyed, but the art of producing from the fleece a warm and fubftantial clothing was never entirely loft, even during the darkeft days of ignorance. It began to revive, and became the feparate occupation of one clafs of the community about the middle of the tenth century in the Low Countries, where it remained the glory of the people, and the fource of their opulence, through more than four hundred years. The wool which it confumed for the firft few years was the produce of their own paftures, which had but lately been reclaimed from the foreft; but as the manufacture extended itfelf, the demands became larger, and were fupplied from a greater diftance. The wealth which it diftributed was foon vifible, and people crowded into the country, engaged in its commerce, and pufhed their fpeculations with increafing vigour through a hundred and fifty years, when an inundation of the fea threatened to involve the art, the artift, and the country, in one general deftruction. The difperfion of the people who fled from the calamity which appeared to overwhelm their hopes, inftead of deftroying the infant manufacture, gave it additional vigour, and was the means of eftablifhing a connection be-

tween

tween the Netherlands and foreign countries, which proved of the higheft importance to commerce. It contributed to a much more fpeedy recovery of the arts connected with the woollen manufacture, from the ruin which feemed to threaten them, and gave a ftriking inftance of their partiality for the feats where they have once flourifhed, under the patronage of a government liberal enough to encourage, and fufficiently powerful to protect them, even in fituations attended with natural difadvantages. The influence of thefe manufactures upon the fleeces of the Low Countries muft have been very confiderable; for before the year 960 we have no reafon to fuppofe that their quality was fuperior to that which we find in the neighbouring diftricts; yet it was not very long ere Flanders and Brabant became famous for the manufacture of fine cloths, even at a period when they imported but little foreign wool. Perhaps the fabrics might not be equal to thofe which we now produce from the fleeces of Spain, or even from the improved ones of our own fheep, but they were preferable to thofe of England and the nations of the continent, Italy and Spain excepted. It was about the year 1200 that the merchants began to import the wools of other countries, to extend their connections much more widely, and to grow by this means ftill more rich and powerful. The manufactures required a larger quantity of the raw material than ufual, and the population of the country had reached that extent which does not admit of a great number of fheep being kept, even though the employment of the people depend upon the fleeces, and their fubfiftence upon the food which they furnifh. We fhall obferve inftances of a fimilar kind when we treat more particularly of England. The operation of thefe two caufes was evidently fufficient to induce the manufacturer to go farther from home, and to feek the moft convenient methods of fupplying his looms. It might have been expected that he would have turned his attention to France and to Germany; but independent of the hoftile difpofitions of fome of the neighbouring fovereigns, the raw material was too bulky to be conveyed at an eafy expence through the bad roads of a half cultivated country; and the fhips of Spain and of Britain, who found an intereft in fupplying the wants of the Netherlands, unladed their cargoes almoft at his very door, and folicited in payment but little elfe than the goods which he had manufactured.

Spain was the firft country on the weftern fide of Europe, where the Tarentine breed of fine-woolled fheep were cultivated with fuccefs by the Romans. See SHEEP.

This breed, intermixed with the native flocks, gave rife to the prefent fine-woolled fheep of Spain; and it does not appear that this valuable race was ever greatly neglected in that country. That it abounded in fheep in what is called the middle age cannot be doubted. At the period when the Saracens extended themfelves in Spain, about the eighth century, to ufe the quaint words of Roderic, archbifhop of Toledo, "it was fruitful in corn, pleafant in fruits, delicious in fifhes, favoury in milk, clamorous in hunting, and gluttonous in herds and flocks,"—*gulofa armentis et gregibus*. He wrote in A.D. 1243. In England at that time fheep were fo fcarce, that a fleece was eftimated at two-thirds the value of the ewe which produced it, together with the lamb.

Into Spain the invaders either carried the arts of luxury, or, what is more probable, improved them by their fuperior induftry. The revenue of one of their fovereigns in the tenth century amounted to fix millions fterling; a fum, fays Gibbon, which at that time probably furpaffed the united revenues of the Chriftian monarchs. When, feveral centuries afterwards, the Saracens were gradually expelled by their Chriftian neighbours, Spain faw nothing but the change of religion to compenfate the lofs of population, of agricultural and mechanical fcience, of induftry, and wealth. On the recovery of the Seville from the Moors in 1248, not lefs than 16,000 looms are faid to have been found in that city. Of thefe, the greater number was probably employed in the fabric of woollen cloths. According to Uftarix, "Theory and Practice of Commerce," the manufactures of Segovia flourifhed moft, both in point of number and quality, and were in high efteem, being the beft and fineft that were known in ancient times. The temperature of the climate, and the luxurious propenfities of the inhabitants, would naturally determine thefe fabrics to be of the lighteft and fofteft kinds. Hence in the midft of the boafted ancient manufactures of England, we read only of two or three inftances of the importation of Englifh cloth into Spain. The Spaniards had certainly at that time their own native fleeces beft adapted to their own tafte and climate.

We are told by Dillon, in his "Hiftory of Peter the Cruel," that the woollen cloths of Barcelona were in high efteem in Seville in the reign of that prince, and in the preceding century. So far back as 1243, the woollen cloth of Lerida is fpoken of in terms of great eftimation. A few years after, Baurlas, Valis, Gerena, Perpignan, and Tortofa, were remarkable as manufacturing towns, and for the finenefs of their cloths, fuftians, and ferges. So great was their exportation, that in 1353 there were 935 bales of cloth taken on board a fhip from Barcelona to Alexandria by a Genoefe privateer; and 1000 bales of cloth were taken on board three Catalonian fhips in 1412, by Antonio Dorco, in the port of Callus. We are told by the fame author, that, according to records ftill extant in Barcelona, confiderable orders for wool were fent to England in 1446, in order to be manufactured there and returned to England in the form of cloth, the Spaniards themfelves difdaining to wear it.

According to Lucius Marineus Siculus, who wrote in the time of the emperor Charles V., Spain was then full of herds and flocks, more efpecially it contained innumerable fheep; fo that many fhepherds, whom he knew, had flocks of 30,000 each; on which account Spain not only fupplied its own people moft abundantly, but alfo foreign nations, with the very fofteft wool.

This account is confirmed by what is related by Sandoval, who ftates, that in an infurrection in Spain in 1519, the army of infurgents, among whom were many cloth-workers, ftipulated, among other points, that the cloths imported into Spain fhould be of the fame fize and goodnefs as thofe wrought there; and that the merchants and clothiers might have leave to feize, in order to work up, half the wools fold for exportation, paying the owners the price at which they had been bought. Hence we learn the fuperiority of Spanifh cloth, and the great fale of Spanifh wool to foreign countries at that time.

Damianus a Goes, who was page to Emanuel, king of Portugal, in 1516, has written a fhort account of the memorable things of Spain, which he dates at Louvain in the year 1541. In this work he fays, that there are annually exported from Spain to Bruges 40,000 facks of wool, each felling at the loweft for twenty gold ducats.

Now from an authentic acquittance, preferved in the Fœdera, from queen Elizabeth to Cofmo de Medici, for a fum borrowed by him of Henry VIII., we find that the gold ducat or florin was in 1545 equal to five fhillings of our money. In this year, the 36th of Henry VIII., the bafe coinages began; but as queen Elizabeth feems to have continued receiving the inftalments of the Florentine debt for

for ſeveral years at the ſame rate, when the ſhilling was of ſomething more than the preſent value, we think it probable that the rate was fixed at the beginning of the year 1545, when the ſhilling was at 1*s.* $1\frac{3}{4}$*d.* of our preſent coin. This wool was, therefore, worth at leaſt 5*l.* 14*s.* 7*d.* the ſack of $181\frac{1}{2}$ lbs., and 11*l.* 9*s.* 2*d.* the ſack of 364 lbs.

In 1560, in the time of Guicciardini, Spaniſh wool in the Netherlands was at a ſomewhat lower price. He tells us, "that they uſed formerly to ſend annually from Spain to Bruges more than 40,000 ſacks, but that in this year the Spaniards, having made more cloth at home, had ſent only 25,000 ſacks, at 25 crowns each." The crown being 4*s.* and the ſhilling 1*s.* $0\frac{1}{4}$*d.* of our money, this would be 10*l.* 1*s.* 1*d.* the ſack of 364 pounds. The depreciation ſeems in truth to have ariſen from a diminiſhed demand for this wool in the Netherlands. The wools imported into the Netherlands from Spain were the lower or coarſer kinds.

The ſuperfine wools of Spain ſeem to have been firſt introduced among the Italian ſtates. Thus Damianus a Goes in 1541, after having ſpecified the 40,000 ſacks to Bruges, as before-mentioned, adds, "and alſo to Italy, and other cities of the Netherlands, are annually ſent about 20,000 ſacks, of which thoſe uſed in Italy, being of the choiceſt wool, are ſold at from forty to fifty gold ducats each."

From this account, we have a fair opportunity of drawing two important inferences: the firſt is, that the Spaniſh wool which went to the Netherlands was, as we have before obſerved, of the coarſeſt kind, being of only half the price of that which was exported to Italy; ſecondly, we can compare the value of the latter with that of our Engliſh wool, the beſt of which, according to the act of parliament in 1534, already quoted, did not in England exceed 5*s.* the ſtone of 14 pounds, of 6*l.* 10*s.* the ſack of 364 pounds. The ſhilling, however, being then equal to 1*s.* $4\frac{1}{2}$*d.* of our coin, increaſes the price of the ſack 8*l.* 18*s.* 9*d.*; to which add cuſtom and ſubſidy, 3*l.* 13*s.* 4*d.* or 5*l.* 0*s.* 10*d.*, and the reſult will be 13*l.* 19*s.* 7*d.* The additional charges of freight and merchant's profit would ſcarcely bring the whole amount to 16*l.* 16*s.* On the other hand, according to the teſtimony of Damianus a Goes, the Spaniſh ſack of $181\frac{1}{2}$ pounds was in 1541 worth 14*l.* 6*s.* $5\frac{1}{2}$*d.*, and the ſack of 364 pounds 28*l.* 14*s.* 6*d.* of our preſent money. If the author ſpeaks only of the value of this wool in Spain itſelf, then a farther addition muſt be made of freight, merchant's profit, and probable duty to the crown. On the whole, this calculation is ſufficient to ſhew in the ſtrongeſt light the ſuperior price of ſuperfine Spaniſh wool, to that of the very beſt at that time produced in Britain.

Next in order of time to the Italians, the manufacture of ſuperfine wool ſeems to have been adopted by the French, who, according to Guicciardini, in 1560 ſent by land to Antwerp ſome very fine cloths of Paris and Rouen, which were highly prized.

It is probable, however, that theſe cloths were made only of mixed wool.

A ſtrong confirmation of the early uſe of the beſt Spaniſh wool, unmixed with coarſer by the Italian ſtates, is furniſhed by Richelieu's Political Teſtament, printed in 1635, in which, ſpeaking of the fine woollen manufactures of France, the author ſays, "the Turks prefer the draps de ſceau de Rouen to all others, next to thoſe of Venice, which are made of Spaniſh wool."

And the author of "England's Safety in Trade's Increaſe," written in 1641, tells us, that "the greateſt part of their (the Venetians) wools from Spain, and the reſt from Conſtantinople, is commonly brought in Engliſh ſhipping."

In 1646, Nicholas Cadeau and other Frenchmen had letters patent for twenty years, for making at Sedan black and coloured cloths, like thoſe of Holland, of the fineſt Spaniſh wool.

The inhabitants of the north of Europe, as before-mentioned, were not at firſt able to manufacture fine Spaniſh wool, without the aſſiſtance of that which was longer and coarſer. But what in the beginning was a matter of neceſſity, became afterwards an object of choice; and the more ſkilful clothiers, whether in Holland or elſewhere, either carding the finer and dearer Spaniſh with the coarſer and cheaper Engliſh, or forming a warp of the latter, which they covered with a woof of the former, contrived to make a cheap and ſerviceable cloth, which pleaſed the eye equally well with the more coſtly fabrics of entire Spaniſh wool. This though generally concealed with great care at the time, yet is afterwards candidly acknowledged by writers actually engaged in the commerce of wool, and ſufficiently refutes the prejudices which had here prevailed from the middle of the 16th to the middle of the 17th century. Hence it appears that our wool, when placed in connection with Spaniſh, was chiefly valuable from being well calculated not to improve but to adulterate it.

A treaty between France and Spain in 1659, enabled the former freely to obtain the wool of the latter, and thus to gain great advantage over us in the Levant trade. From the proximity of France to the woollen manufactures in the north of Spain, it might have been expected that the French would have earlier engaged in this manufacture; but owing to their frequent northern wars, and their attention being directed to the manufacture of ſilk, the French do not appear to have commenced the fabrication of woollens for exportation extenſively before the 16th century. About this time, France made great progreſs in her manufactures of wool, and in ſecuring the export trade, particularly that to Tartary, for which ſhe was better ſituated than Holland or England.

The nature of her trade to warm climates directed her attention to the fabrication of finer and lighter cloths, than thoſe made by her northern neighbours; in conſequence of which ſhe preſerved the greater part of the Turkey trade to the period of the French revolution, and in general fine French cloths had attained a celebrity for their ſuperiority, both in texture and dye, over thoſe of any other country in Europe. The native breeds of ſheep in France were greatly improved by intermixture with ſheep imported from Spain. With theſe advantages, France might have nearly ſecured a monopoly of the finer branches of the woollen manufacture, had not the abſurd policy of her rulers, in the revocation of the edict of Nantz, driven the manufacturing Proteſtants to other countries, where they contributed, by their exertion, their ſkill, connections, and capital, to form eſtabliſhments which rivalled thoſe of the country from which they were expelled.

Notwithſtanding this, as France ſupplied the greater part of her own population of twenty millions with cloth, beſides her foreign exports, we conceive that the woollens manufactured in that country, before the late revolution, equalled in quantity the cloth made in England at the time, and greatly exceeded it in value. Under the emperor Napoleon, the beſt Merino flocks were imported in multitudes from Spain, which have ſpread over the country, and are equal to ſupply extenſively her manufactures of woollens, when they ſhall be again fully eſtabliſhed. Conſiderable quantities of fine wool have been imported from France into England ſince the peace of 1815.

The

The confufion attendant on a great revolution, continued for twenty years, gave fo fevere a blow to the manufacturing eftablifhments of France, that a confiderable time muft elapfe before they are completely eftablifhed. Prior to this revolution, the fuperfine cloths of France were fuperior to thofe of England, in texture, colours, and foftnefs. In the finer articles of worfted goods, and in the mixed worfted goods made partly with long combing-wool, and partly with filk or goat's-wool from the Levant, they furpaffed the manufactures of this country; but the manufacturers of the commoner kinds of worfted goods, as tammies and fhalloons, could not rival us in foreign markets for want of a proper fupply of wool fuited to the purpofe. The following were the principal feats of the fuperfine and fine woollen manufactures in France, arranged according to the different qualities of the goods made at each, beginning with the fineft:

1. The manufactures of Gobelins.
2. Of Sedan.
3. Of Abbeville.
4. Of Louviers.
5. Of Elbœuf.
6. Of Rouen and Darnetal.

Befides feveral detached manufacturing eftablifhments of fuperfine cloth in Languedoc, Champagne, and other parts of France.

At the Gobelins, fuperfine cloths of the very firft quality were manufactured; but the manufactures there were confined folely to the broadeft white cloth intended to be dyed fcarlet or purple, and the brighteft colours from cochineal.

Sedan followed next to Gobelins for the beauty of its fuperfine cloths, where they were alfo made of various breadths and colours.

Abbeville may be placed next after Sedan: fome have even fuppofed that it equalled Sedan in the finenefs of its cloths; but this arofe from the cloths of the latter place being of various forts: the lower kinds were certainly inferior to thofe of Abbeville; but the quality of the greater part of the cloths of Sedan were of a better kind than the average quality of the cloths of Abbeville. In the manufactures of Sedan, each manufacturer confined himfelf to a particular kind of cloth, for which he became diftinguifhed, fome being celebrated for fine, and others for fuperfine cloths exclufively; whereas in Abbeville, Louviers, and the other diftricts enumerated, there were manufacturers who made various forts, and the proportion of the fine to the fuperfine was greater than at Sedan.

Elbœuf was one of the moft ancient feats of the woollen manufacture in France, but the quality of the cloths made there had greatly degenerated from the years 1760 to 1770; but afterwards the manufacturers returned to the former quality of their cloths, which were partly made of the fine wools from Berry, and partly from fine Spanifh wool, or from a mixture of Spanifh with the beft wools of Berry.

Rouen and Darnetal may be placed in the fixth clafs of manufacturing diftricts of fine cloth, in which the fineft wools of France were principally ufed, mixed with thofe of Spain.

The eftablifhments for the manufacture of common cloth and coarfe woollens were much more widely fpread over France. The goods appear to have been principally confumed in that country to fupply the demand of a population of twenty millions, and the numerous military eftablifhments, befides what might be fent to the French colonies.

As the French never exported any confiderable quantity of common or coarfe woollen cloths, the manufactures of thefe articles never equalled in extent thofe of England. The circumftance of the coarfe cloth manufacture being fo widely fpread over the country, tended alfo to prevent that degree of rivalry which promotes the fpirit of improvement where manufactures are more concentrated; add to this, the French had not that abundant fupply of the coarfer clothing-wools which could enable them to rival us in the export of heavy woollen goods.

The worfted manufactures of France, including ferges and thofe goods made with a warp of worfted, were principally carried on in four of the provinces of France, but more extenfively in Picardy than elfewhere. The long combing-wools which fupplied this manufacture, were partly the produce of France, and partly imported from Holland, England, Flanders, and Germany. M. Rolland, in the French Encyclopædia, defcribing the French manufactures in the year 1783, foon after the American war, fays, that during that war the Englifh adminiftration tacitly encouraged the exportation of wool to promote the interefts of agriculture. He defcribes the French combing-wool as being coarfer and more harfh than the wool of Holland, as wafting much more in the manufacture, and making goods of a very inferior quality. The combing-wools of England, though generally lefs found and fine, and of a lefs pure white, than thofe of Holland, were particularly well fuited to fome parts of the worfted manufacture.

The combing-wools from Germany were coarfe and harfh, and only ufed in default of other fupplies. Very fine worfted yarn was alfo obtained from Saxony and the environs of Gottingen; but this yarn was tender, and required to be mixed with worfted yarn from Englifh or Dutch wool. The yarn of Turcoign was fuppofed to be Dutch, but was principally from Flanders and Artois. The goat's-wool came from the Levant, by way of Marfeilles, in bales of from 200 to 300 lbs. It fold from four livres to twelve livres *per* French pound; the price of that moft generally ufed was about 4 livres 10 fous *per* pound. The filks ufed in filk camelots, &c. were obtained from Paris and Lyons.

The following table gives the quantity and value of wool yarns and worfted pieces in Picardy; but he fuppofes the quantity to be under the real amount, the manufacturers concealing the extent of their trade to avoid arbitrary taxation.

Wool confumed in the Worfted Manufactures of Picardy.

		fous.	livres.
French wool	3200000	at 22	3520000
Dutch ditto	180000	at 40	360000
Englifh ditto	200000	at 32	320000
German ditto	100000	at 22	110000
	3680000		4310000

Yarn imported.

		liv. f.	
Yarn of Turcoign	60000	at 8 10	510000
German yarn -	100000	at 7 0	700000
Levant yarn, or mohair -	220000	at 5 10	1210000
Silk ufed in fine worfted goods	20000	at 35 0	700000
Total value of wool and yarn - -			7430000

Brought

Brought forward - -	7430000
Combing and fpinning 3680000 lbs. of wool	4310000
Winding, warping, and weaving - -	4770000
Dyeing of yarn and pieces - - -	190000
Profit of the wool-dealers, manufacturers	1300000
Total value of 150000 pieces coming from the manufacturer - - -	18000000
Value of dyeing-wares - - -	500000
To which carriage and profit of the merchant and draper - - -	2000000
Total value of worfted goods in Picardy	20500000

One million and fifty thoufand pounds weight of wool were alfo confumed in hofiery in the fame province, of which the greateft part was native; and the remainder about two hundred and fifty thoufand pounds weight from Holland. The number of working manufacturers in Picardy is thus ftated:

50000 men who gain	140 livres *per annum*		7000000
50000 women	70	- -	3500000
150000 children	40	- -	6000000

The greater part of the manufacturers refided in the country, and were employed part of the time in agriculture; this was alfo the cafe with the manufacturers in the towns, fo that not more than eight months in the year were devoted to manufactures. This change of employment, fo conducive to the health and comfort of the labouring claffes, may be regarded as prefenting the happieft form under which manufactures can be carried on. This was alfo in a confiderable degree the fituation of the woollen and worfted manufacturers in Yorkfhire, before the late introduction of machinery had driven the population into large factories; a change which may be regarded as one of the greateft evils that ever afflicted civilized fociety, tending directly to degrade and enfeeble the human race, and to render man a wretched machine, a prifoner from the cradle to the workhoufe or the grave, devoid of moral feeling and phyfical energy.

What was the extent of the worfted manufacture in the other provinces of France where it was carried on, we have no correct means of afcertaining. In the middle of the laft century, the export of cloths and worfted goods from Languedoc alone amounted annually to about 60,000 pieces, fent to the Levant and to Barbary. At that time alfo, Spain, and all the countries bordering the Mediterranean, received worfted goods from France. In the variety of worfted articles, in the ingenuity of the patterns, and the fuperiority of the workmanfhip, as well as of the dyes, France may be regarded as having furpaffed any other nation in Europe, prior to the year 1780, or about the clofe of the American revolution. Since that period, the manufactures of England have aftonifhingly increafed, and have obtained a decided preference in foreign markets.

The woollen manufactures of Saxony and Germany have been long eftablifhed; the fugitives from the edict of Nantz contributed much to improve and extend them. During the late war, all the manufactures in Germany and every part of the European continent fuffered greatly, but are at prefent rapidly reviving, and will abridge the amount of our exports in Europe.

In Ruffia, Sweden, and Denmark, the woollen manufacture, as a diftinct occupation, is comparatively new; yet it has exifted long enough to produce great alteration in their flocks. And as this change was attempted in a more enlightened period, and conducted by fcientific men, the beft means were adapted to promote the improvement, and new breeds of fheep have been introduced into both countries. The fame remark applies to Saxony and other circles of the German ftates, and even Hungarian flocks are not without evident indication of a change for the better.

Of the worfted manufacture as diftinct from the woollen, we have little information refpecting its origin. It comprifes all thofe goods made of combed wool in diftinction from carded wool. We are unacquainted with the period when the wool-comb was invented, or when worfted goods were firft manufactured. It is probable, that worfted goods were originally woven in the Eaft, and that the knowledge of them was brought into Europe either by the Armenian merchants, or thofe who returned from the extravagant expeditions which were undertaken for the recovery of the Holy Land from the dominion of the infidels. The garments which are now worn by the Turks, fome of which feem to have been produced by means of the comb, the incidental mention of that inftrument in an account which we have of Angora, and the demand for worfted goods through the Levant, confirm the conjecture, and lead us to fuppofe, that there exift very confiderable manufactures of this kind in the Turkifh empire, although we know little more of its domeftic and rural condition, than can be obtained from the moft vague accounts and uncertain deductions. After the art of fpinning worfted yarn was known in the weft of Europe, the looms of the Netherlands became active in converting it into thofe peculiar kinds of goods to which it was adapted, and it feems as though the diftinction between thefe and woollen articles was not generally noticed until fome years afterwards. It might have been expected from the nature of the article, that the manufacture of worfted goods fhould in many fouthern countries have preceded that of cloth. Long-ftapled wool fuited to the comb feems more fpontaneoufly the produce of uncultivated fheep, than fhort wool, which is to be manufactured by carding, and its mode of manufacture more nearly refembles that of flax; hence it is not improbable, that worfted goods were made in Egypt and the Eaft before the manufacture of woollen cloth. This is, however, uncertain.

In the manufacture of long wool, the fibres are arranged parallel to each other, like thofe of flax; but before they are fpun, they require to be laid even by fome kind of inftrument, which fhall feparate the fibres, that they may draw out eafily in fpinning. A comb of a very fimple conftruction, with a few wires for the teeth, was probably firft made ufe of. It was afterwards found, that the application of heat to the comb contributed more effectually to the regular arrangement of the fibres; and thus the invention of the common wool-comb arofe, but at what period is unknown. Vulgar tradition afcribes the invention to bifhop Blaize, who firft ufed it in Alderney; but there does not appear any authority in fupport of this opinion. The bifhop lived in Armenia, and was raifed to the epifcopal dignity about the time of Dioclefian, and fuffered martyrdom under that tyrant. Before he was beheaded, he was tortured with iron combs, with which his flefh was torn; and hence when an inftrument of that kind was brought into common ufe, the workmen chofe him for their patron faint. The traditions of the origin and progrefs of the worfted manufacture are thus extremely imperfect; we fhall have occafion to fpeak of its introduction and progrefs in this country in the following fection.

Rife

Rife and Progrefs of the Woollen Manufactures in England. — The Romans, as we have ftated on the authority of Camden, had a cloth manufacture at Winchefter. The firft account of any diftinct body of manufacturers afterwards occurs in the reign of Henry I., but either the people of this country were wholly clothed in fkins or leather in the intervening fpace, or, what is more probable, coarfe cloths were manufactured in a rude manner in moft of the towns and villages in England. A great part, however, of the drefs of the labouring claffes in the country was made of leather, particularly the breeches and waiftcoats, even till the prefent reign. George Fox, the founder of the Quakers, in the reign of Charles I., travelled on his miffions through the country, buttoned up in a leathern doublet, or waiftcoat with fleeves, which fupplied the place of a coat. This was not, as his adverfaries afterwards affirmed, from any fuperftitious prejudice refpecting that coftume; it was the common drefs of the labouring mechanics at that time, to which clafs he belonged.

The firft account of any foreign weavers fettled in England is recorded by William of Malmfbury and Giraldus Cambrenfis, who relate that a number of Flemings were driven out of their own country, by an extraordinary encroachment of the fea in the time of William the Conqueror. They were well received, and firft placed in the neighbourhood of Carlifle, and on the northern frontier; but not agreeing with the inhabitants, they were tranfplanted by Henry I. into Pembrokefhire. They are faid to have been fkilful in the woollen manufacture, and are fuppofed to have firft introduced it into England as a feparate trade. Cloth-weavers are mentioned in the exchequer accounts as exifting in various parts of England in the reign of Henry I., particularly at London and Oxford. The weavers of Lincoln and Huntingdon are reprefented as paying fines for their guild in the 5th of Stephen; and in the reign of Henry II. (1189), there were weavers in Oxford, York, Nottingham, Huntingdon, Lincoln, and Winchefter, who all paid fines to the king for the privilege of carrying on their trade. (Chronicon Pretiofum, p. 64.) There were alfo cloth dealers in various parts of Yorkfhire, Norwich, Huntingdon, Gloucefter, Northampton, Nottingham, and Newcaftle-upon-Tyne; alfo feveral towns in Lincolnfhire, and at St. Alban's, Baldock, Berkhamftead, and Chefterfield, who paid fines to the king that they might freely buy and fell dyed cloths. Thefe are fuppofed to have been cloths imported from the Flemings. The red, fcarlet, and green cloths, enumerated among the articles in the wardrobe of Henry II., were moft probably foreign, as the Englifh had attained little fkill at that time in the art of dyeing. Madox's Hiftory of the Exchequer.

In the 31ft of Henry II. the weavers of London received a confirmation of their guild, with all the privileges they enjoyed in the reign of Henry I.; and in the patent he directed, that if any weaver mixed Spanifh wool with Englifh in making cloth, the chief magiftrate fhould feize and burn it. (Stowe's Survey of London.) This abfurd edict was iffued under the pretext of the inferiority of the Spanifh wool, but was doubtlefs intended to encourage the growth of Englifh wool, an article from which our kings derived a confiderable revenue. The circumftance rather proves the fuperior excellence of Spanifh wool at that time, and the jealoufy which its importation had excited among the Englifh wool-growers.

In the reign of Henry III. an act was paffed limiting the breadth of broad-cloths, ruffets, &c. to two yards within the lifts. In the year 1284, foreign merchants were firft permitted to rent houfes in London, and buy and fell their own commodities, without any interruption from the citizens. Previous to this date they hired lodgings, and their landlords were the brokers, who fold all their goods, and received a commiffion upon them. It was foon after pretended that the foreign merchants ufed falfe weights, and a clamour being raifed againft them, twenty of them were arrefted and fent to the Tower. Amidft the numerous abfurd reftrictions to which commerce and manufactures were fubjected, we need not be furprifed at the little progrefs which they made.

The materials which hiftory affords refpecting the woollen manufacture before the reign of Edward III. are but fcanty; it appears that the office of aulnager, or cloth infpector, was very ancient. In the reign of Edward I. we are informed by Madox, that Peroult le Tayleur, who held the office of aulnager of cloth in the feveral fairs of the realm, having forfeited it, the king, by writ of privy feal, commanded the treafurer to let Pieres de Edmonton have it, if he were fit for it, and a writ was made out accordingly, and he took the oaths of that office before the treafurer and barons. The facts above-ftated prove the exiftence of the cloth manufacture in England before the time of Edward III., who is generally fuppofed to have firft introduced the art into the kingdom. There is no doubt, that a new impulfe was given to it during this reign by the liberal protection granted to foreign manufactures here: in all probability, they firft introduced the manufacture of ftuffs from combed wool or worfteds; an art requiring more fkill, and more complicated proceffes, than are employed in the making of cloth.

In the year 1331, John Kemp, a mafter manufacturer from Flanders, received a protection to eftablifh himfelf here with a number of dyers and fullers to carry on his trade, and in the following year feveral manufacturers came over from Brabant and Zealand. It is faid, that the king's marriage with the daughter of the earl of Hainault enabled him to fend over emiffaries without fufpicion, to invite the manufacturers to this kingdom. Thefe manufacturers were diftributed over the country, at the following places:—The manufacturers of fuftians (woollens) were eftablifhed at Norwich, of baize at Sudbury in Suffolk, of fayes and ferges at Colchefter in Effex, of broad-cloths in Kent, of kerfies in Devonfhire, of cloth in Worcefterfhire and Gloucefterfhire, of Welfh friezes in Wales, of cloth at Kendal in Weftmoreland, of coarfe cloths, afterwards called Halifax cloths, in Yorkfhire, of cloth in Hampfhire, Berkfhire, and Suffex, and of ferges at Taunton in Devonfhire. (Rymer's Fœdera, vol. i. p. 195.) Frefh fupplies of foreigners contributed to advance the woollen trade of thefe diftricts.

Kendal, in Weftmoreland, claims the honour of firft receiving John Kemp, where his defcendants ftill remain, and the woollen trade is at prefent carried on. In the following reign, we find the manufacturers of Kendal petitioning to be relieved from the regulations impofed on broad-cloths. Kendal green is mentioned by Shakfpeare as an article of drefs in the time of Henry IV., and there is reafon to believe, that in the reign of Elizabeth, the woollen manufactures of that town were as extenfive as at prefent.

In the year 1336, two woollen manufacturers from Brabant fettled at York, under the king's protection: they are ftiled in the letters of protection, "Willielmus de Brabant & Hanckeinus de Brabant, Textores." Thefe perfons probably laid the foundation of the woollen and worfted manufactures, which have fince fo extenfively flourifhed in the weftern part of that county. It is not very improbable, that the manufacturer Hancks, called Hanckeinus, gave

gave the name to the ſkein of worſted, which is to this day called a hank.

The references which we have ſoon afterwards to the woollen manufacture, as exiſting in the diſtricts before-named, tend to confirm the belief, that the diſtribution of the foreign manufacturers we have given is correct. About this time, we learn that Thomas Blanket, and other inhabitants of Briſtol, ſet up looms in their own houſes, but were ſo haraſſed by the impoſitions of the mayor and bailiffs of the place, that they were obliged to obtain letters from the king to permit the free uſe of their trade, without impediment, calumny, or exaction. The letter to the mayor and bailiffs accuſes them in the following terms: "vos diverſas pecuniæ ſummas ab eiſdem Thomas et aliis exigitis et ea occaſione multipliciter inquietatis et gravatis, ut aſſerunt." Dr. Parry has conjectured, that blanket, which at firſt meant a coarſe white undreſſed cloth, derived its name from the ſame Thomas Blanket of Briſtol. The encouragement given to the woollen manufacturers during this reign, and the conſequent conſumption of wool at home, diminiſhed the export of it ſo much, that a duty was laid on cloth exported to ſupply the place. Blackwell-hall was appointed by the mayor and common council of London for the market, where cloth manufacturers might ſend their goods for ſale, in the year 1357.

In the courſe of the reign we find ſeveral other acts relating to the meaſurement and fulling of cloth, and the fees to be paid to the aulnager.

In order to form a more diſtinct idea of the relative value of wool, cloth, and other articles, after and before the reign, it may be proper to refer to the ſtate of the ſilver coinage.

	Grains.
The 28 Edward I. one ſhilling contained	264
18 Edward III. - - - -	236
27 Edward III. - - - -	213
9 Henry V. - - - -	176
1 Henry VI. - - - -	142
4 Henry VI. - - - -	176
49 Henry VI. - - - -	142
1 Henry VIII. - - - -	118
34 Henry VIII. - - - -	100
36 Henry VIII. - - - -	60
37 Henry VIII. - - - -	40
3 Edward VI. - - - -	40
5 Edward VI. - - - -	20
6 Edward VI. - - - -	88
2 Elizabeth - - - -	89
43 Elizabeth - - - -	86

at which it continued to the preſent reign.

The following account of the exports and imports in the 28th of Edward III., ſaid to be found in a record of the exchequer, was publiſhed by Edward Miſſeldon, merchant, in the year 1623.

Exports.	£	*s.*	*d.*
Thirty-one thouſand ſix hundred and fifty-one ſacks and a half of wool, at ſix pounds value each ſack, amount to -	189,909	0	0
Three thouſand thirty-ſix hundred and ſixty-five felts at 40*s.* value, each hundred at ſix ſcore, amount to - -	6,073	1	8
Whereof the cuſtom amounts to - -	81,624	1	1
Fourteen laſt, ſeventeen dicker, and five hides of leather, after ſix pounds value the laſt, amount to - - - -	89	5	0
Whereof the cuſtom amounts to - -	6	17	6
Carried forward -	277,702	5	3
Brought forward -	277,702	5	3
Four thouſand ſeven hundred and ſeventy-four cloths and a half, after 40*s.* value the cloth, is - - - - -	9,549	0	0
Eight thouſand and ſixty-one pieces and a half of worſted, after 16*s.* 8*d.* value the piece, is - - - - -	6,717	18	4
Whereof the cuſtom amounts to - -	215	13	7
Summary of the out-carried commodities in value and cuſtom - - -	294,184	17	2

Imports.	£	*s.*	*d.*
One thouſand eight hundred and thirty-two cloths, after ſix pounds value the cloth - - - - - -	10,922	0	0
Whereof the cuſtom amounts to - -	91	12	0
Three hundred and ninety-ſeven quintals and three quarters of wax, after the value of 40*s.* the hundred or quintal -	795	10	0
Whereof the cuſtom is - - -	19	17	0
One thouſand eight hundred and twenty-nine tons and a half of wine, after 40*s.* *per* ton - - - - - -	3,659	0	0
Whereof the cuſtom is - - -	182	0	0
Linen cloth, mercury, and grocery-wares, and all other manner of merchandize -	23,014	16	0
Whereof the cuſtom is - - -	285	18	3
Summary of the in-brought commodities, in value and cuſtom, is - - -	38,970	13	3
Summary of the impulſage of the out-carried above the in-brought commodities, amounteth to - - - -	255,214	3	11

Admitting the correctneſs of this ſtatement, which we have no reaſon to doubt, we muſt obſerve, that the cloth imported was of a higher value *per* yard than the cloth exported. Hence it may be inferred, that for ſeveral years after the arrival of the Flemiſh weavers, we were partly dependent on foreigners for our fine cloths; the coarſer kinds then, as at the preſent day, forming the larger quantity of our exports. It is obvious alſo, that worſted goods had become an article of manufacture, nearly equal in importance with the woollen; and hence it is not improbable, that the greater part of the Flemiſh manufacturers were makers of ſtuffs and worſted goods, which was probably an entirely new trade in England.

The ſtatutes in the following reigns, relating to the woollen manufacture, prove the narrow and ſelfiſh policy by which the manufacturers were influenced: theſe ſtatutes refer either to reſtrictions which they wanted to impoſe, in order to confine the trade to themſelves, or are made to prevent them from fraudulently packing or weaving their goods. In conſequence of theſe fraudulent practices, the 13th ſtatute of Richard II. makes the following regulations, which are curious, as marking the ſpirit of the manufacturers, and alſo as proving the early eſtabliſhment of the woollen trade in the weſtern counties, where it now flouriſhes. It runs thus: "Foraſmuch as divers plain cloths, wrought in the counties of Somerſet, Dorſet, Briſtol, and Glouceſter, be tacked and folded together for ſale; of which cloths a greater part be broken, bruiſed, and not agreeing in the colour, neither according to the breadth, nor in no manner to the part of the ſame cloths ſhewed outwards, but falſely wrought with divers wools, to the great loſs and damage

damage of the people, infomuch that the merchants that buy the fame, and carry them out of the realm to fell to ftrangers, be many times in danger to be flain, and fometimes imprifoned and put to fine and ranfom. Therefore it is ordained, that no plain cloth tacked and folded fhall be fet to fale within the fame counties." The fame act permits certain cloths of coarfe wool to be made of the breadth of three quarters, and appoints one weight and meafure through the kingdom, except in the county of Lancafter. Another ftatute, in the fame reign, allows every perfon to make cloth of what length and breadth he will, provided the aulnage and other duties are paid, and it be meafured and fealed by the king's aulnager, and contain no deceit. The kinds of worfted goods which might or might not be exported, were alfo fpecified in this ftatute. During this reign it appears, notwithftanding the increafe of our trade, that we annually exported about one hundred and thirty thoufand packs of wool, paying a duty of one hundred and fixty thoufand pounds.

In the 4th of Henry IV. the cloths made in London and the fuburbs were ordered to have a feal of lead attached, and in a fubfequent ftatute no cloths were to be folded before the aulnager had fet his feal to them. In the following reign, the narrow cloths, called the dozens of Devonfhire and Cornwall, are ordered to pay cocket cuftoms, after the rate of broad-cloths.

In the reign of Henry VI. the exportation of woollen yarn is prohibited, and this prohibition feems to have been in full force when wool was allowed to be freely exported. The only reafon affigned for this is, that the yarn paid no duty. During this reign two cloth-fearchers were appointed for every hundred throughout the realm, who were to infpect and feal all cloth, taking one penny for each. This proves that the manufacture of woollens had fpread over a great part of the kingdom. It is probable that this infpection extended to all cloths made in private families, which were fent to the fulling-mills.

The worfted trade was alfo increafing rapidly at this time: four wardens of worfted-weavers were appointed for the city of Norwich and two for the county of Norfolk, who were to make due fearch of worfteds, and of what length and breadth they were made. In the fame reign it was ordained, that "if our woollens were not received in Brabant, Holland, and Zealand, then the merchandize growing or wrought within the dominions of the duke of Burgoine fhall be prohibited in England, under pain of forfeiture." Hence we learn, that we very foon began to fupply thefe fame countries with woollens and worfteds, from which we had received workmen a century before.

In the third year of Edward IV. the woollen trade had increafed fo much, that the importation of woollen cloth, caps, &c. was prohibited. Woollen caps or bonnets were then univerfally worn; they were either knitted or made of cloth, and a large quantity of wool muft have been confumed in their fabrication. About the year 1482, hats made from felts were introduced; but the manufacturers of caps, called the cappers, continued a powerful body a century afterwards. In the fame reign, the wardens of worfteds at Norwich were doubled, or increafed to eight.

The manufacture of fine broad-cloth muft have been confiderably improved about this time; for in the fourth of Henry VII. it was thought prudent to fix a maximum on the price of fine cloth, by which every retailer of cloth who fhould fell a yard of the fineft fcarlet grained cloth above fixteen fhillings, or a yard of any other coloured cloth above eleven fhillings, was to forfeit forty fhillings *per* yard for the fame.

In the year 1493, in confequence of a quarrel between Henry VII. and the archduke Philip, all intercourfe between the Englifh and Flemifh ceafed, and the mart for Englifh goods was transferred from Antwerp to Calais. This interruption to the regular courfe of trade was feverely felt by the woollen manufacturers. Lord Bacon, mentioning the renewal of the trade with Flanders, which took place again in 1496, fays, "By this time the interruption of trade between the Englifh and Flemifh began to pinch the merchants of both nations very fore. The king, who loved wealth, though very fenfible of this, kept his dignity fo far as firft to be fought unto. Wherein the merchant adventurers likewife did hold out bravely; taking off the commodities of the kingdom, though they lay dead upon their hands for want of vent." The merchant adventurers he defcribes as "being a ftrong company, and underfet with rich men." It is not, however, very probable, that this company would continue to purchafe goods without a profpect of gain. Thefe merchant adventurers were divided into two bodies; thofe of London, which were the moft powerful; and the merchant adventurers of England, who paid a fine to the former on all goods fold at the foreign marts.

In the reign of Henry VIII. the woollen trade, and particularly all kinds of worfted manufactures, appear to have been in a very flourifhing ftate, though trade fuffered feveral fevere checks from the wars in which we were engaged. In the year 1527, Henry having entered into a league with France againft the emperor Charles V., all trade with Spain and the Low Countries ceafed. The goods fent to Blackwell-hall found no purchafers, the merchants having their warehoufes filled with cloths; the poor manufacturers being thus deprived of employment, an infurrection took place in the county of Suffolk, where four thoufand of them affembled, but were appeafed by the duke of Norfolk. The merchants were fummoned to appear before cardinal Wolfey, who in the name of the king reprimanded them in an angry tone for not purchafing the goods brought to market, and threatened them that his majefty would open a new mart at Whitehall, and buy of the clothiers to fell again to foreign merchants; to which menace one of them pertinently replied, "My lord, the king may buy them as well at Blackwell-hall, if it pleafes him, and the ftrangers will gladlier receive them there than at Weftminfter."—"You fhall not order that matter," faid the cardinal; "and I fhall fend into London to know what cloths you have on your hands, and by that done, the king and his council fhall appoint who fhall buy the cloths, I warrant you." With this anfwer the Londoners departed. Grafton's Chronicle, vol. ii. p. 1167-8.

The interference of the cardinal raifed the fpirits of the manufacturers for a time, but originating in ignorance of the nature of trade, it could only have a temporary effect, and goods fell again till a truce between England and Flanders was made for the benefit of trade. This fact fhews the dependance of England, even at that time, on the export of manufactured woollens. In this reign we find Lancafhire and Chefhire firft named as feats of the manufacture of coarfe woollens; they are mentioned, together with Cornwall and Wales, as diftricts where friezes were made. It appears from various references, that Norfolk and Suffolk were then flourifhing feats of the worfted manufacture, and of all goods made with a worfted warp. Wardens were allowed to the towns of Yarmouth and Lynn, but with a felfifh reftriction, that the pieces were to be dyed, fpun, or callendered in the city of Norwich. In the laft year of this reign, an act was paffed to prevent any perſons beſides woollen manufacturers, who bought wool for their own uſe, and merchants of the ſtaple, who bought for exportation, to purchaſe wool with the intent to ſell again. This act extended to twenty-eight counties, and ſecured a monopoly of the wool to the merchants of the ſtaple, and to the rich clothiers. In the firſt year of the following reign, Edward VI., it was repealed, ſo far as to allow every perſon dwelling in Norwich and Norfolk, to buy wool the growth of that county, by themſelves or agents, and retail it out in open market. The reaſon aſſigned is this: That almoſt the whole number of poor inhabitants of the county of Norfolk and city of Norwich had been uſed to get their living by ſpinning of Norfolk wool, which they uſed to purchaſe by eight pennyworth or twelve pennyworth at a time, ſelling the ſame again in yarn; and becauſe the grower choſe not to parcel it in ſuch ſmall quantities, therefore for the benefit of the poor, the wool of Norfolk was allowed to be purchaſed by wool-dealers. By this act, the 33d of Henry VIII., for prohibiting the exportation of yarn is made perpetual. The manufacture of woollens in the counties adjoining London appear to have been extenſive, particularly in the county of Berkſhire; for in the beginning of the reign of Henry VIII., John Winchcombe, of that county, commonly called Jack of Newbury, was celebrated as the greateſt clothier in England. He kept one hundred looms in his own houſe, and in the expedition againſt the Scotch, he ſent to Flodden-field one hundred men, fully equipped, at his own expence. Even ſo early as the 13th century, one Thomas Cole was diſtinguiſhed by the name of the rich clothier of Reading, in Berkſhire.

York, then the ſecond city in the kingdom, and from its connection with the port of Hull well ſituated for the export trade, was probably an early ſeat of the woollen manufacture. We have already mentioned the ſettlement of two clothiers from Brabant in the time of Edward III. We do not learn preciſely in our early hiſtorians, when the manufactures emanated from that city into the weſtern parts of the county; but from an act in the 34th of Henry VIII. we are informed, that the chief manufacture of that city was the making of coverlets; the act recites, "that the poor of that city were daily employed in ſpinning, carding, dyeing, weaving, &c. for the making of coverlets, and that the ſame have not been made elſewhere in the ſaid county till of late; that this manufacture had ſpread itſelf into other parts of the county, and was thereby debaſed and diſcredited, and therefore it is enacted, that none ſhall make coverlets in Yorkſhire but the people of York." Thus we ſee, under the flimſy pretext of public benefit, the manufacturers were willing to diſguiſe that ſelfiſh ſpirit of monopoly, which diſgraces almoſt every page of our commercial hiſtory. The municipal regulations of the city of York, which were, and ſtill continue to be, hoſtile to a free trade, probably obliged many manufacturers, who were not ſharers in the monopolies of the guild, to eſtabliſh themſelves in the weſtern villages of the county, where proviſions were cheaper, and where they could carry on their trade without reſtriction. In the reign of Philip and Mary, ſoon after this period, we have the following intereſting account of Halifax, in conſequence of an act paſſed in the 37th of Henry VIII. to prevent any other perſons than merchants of the ſtaple and woollen manufacturers from buying wool in the county of Kent and twenty-ſeven ſhires. The poorer manufacturers, who were unable to lay in their ſtock of wool at one time, being hereby deprived of their trade, made application for redreſs, which was granted. The act recites as follows: "Whereas the town of Halifax being planted in the great waſte and moors, where the fertility of the ground is not apt to bring forth any corn nor good graſs, but in rare places, and by exceeding and great induſtry of the inhabitants; and the ſame inhabitants altogether do live by cloth-making, and the greater part of them neither getteth corn, nor is able to keep a horſe to carry wools, nor yet to buy much wool at once, but hath ever uſed to repair to the town of Halifax, and there to buy ſome two or three ſtone, according to their ability, and to carry the ſame to their houſes, three, four, or five miles off, upon their heads and backs, and ſo to make and convert the ſame either into yarn or cloth, and to ſell the ſame, and ſo to buy more wool of the wool-driver; by means of which induſtry, the barren grounds in thoſe parts be now much inhabited, and above five hundred houſeholds there newly increaſed within theſe forty years paſt, which now are like to be undone and driven to beggary by reaſon of the late ſtatute (37th of Henry VIII.) that taketh away the wool-driver, ſo that they cannot now have their wool by ſuch ſmall portions as they were wont to have, and that alſo they are not able to keep any horſes whereupon to ride or fetch their wools further from them in other places, unleſs ſome remedy may be provided. It was therefore enacted, that it ſhould be lawful, to any perſon or perſons inhabiting within the pariſh of Halifax, to buy any wool or wools at ſuch time, as the clothiers may buy the ſame, otherwiſe than by engroſſing and foreſtalling, ſo that the perſons buying the ſame do carry the ſaid wools to the town of Halifax, and there to ſell the ſame to ſuch poor folks of that and other pariſhes adjoining, as ſhall work the ſame in cloth of yarn, to their knowledge, and not to the rich and wealthy clothier, or any other to ſell again. Offending againſt this act to forfeit double the value of the wool ſo ſold."

From this we learn that many woollen manufacturers had been either driven from York at an early period, by the oppreſſion of the municipal regulations, or had retired where proviſions were cheaper, and where they had better ſtreams for the erection of fulling-mills, and for other proceſſes of the manufacture, ſuch as dyeing and ſcouring.

The woollen manufactures alſo gradually retired from the vicinity of the metropolis, owing to the increaſed price of proviſions and labour, and probably alſo to the difficulty of obtaining commodious ſtreams for the ſcouring and fulling of cloth, when the country round London became more populous. In the latter part of the reign of Henry VIII. we are informed, that the king demiſed to William Webbe the ſubſidy and aulnage of all cloth made in the county of Monmouth, and in the twelve ſhires of Wales. A former act of this reign, ſpeaking of the manufacturers of North Wales, ſays, they had been uſed to ſell their cloths ſo craftly and hard rolled together, that the buyer could not perceive the untrue making thereof. Theſe acts prove the extenſion of the woollen manufactures weſtward.

In the ſame reign, an act mentions the woollen manufactures as being eſtabliſhed in Worceſterſhire, but prohibits any one from making cloth in the county, except within the city of Worceſter, and in the towns of Eveſham, Droitwich, Kidderminſter, and Bromſgrove; and forbids the owners of houſes in thoſe places from letting them at advanced prices to the cloth-manufacturers. The woollen manufacture has continued to the preſent day at the two laſt of theſe towns. In the reign of Edward VI. Coventry and Mancheſter are mentioned as manufacturing places. The manufacturers in the old eſtabliſhed ſeats of the woollen trade appear to have been greatly alarmed at the extenſion of the cloth manufacture, and to have exerted all their influence to reſtrain it. Near the concluſion of the reign of Philip

Philip and Mary, an act in 53 sections was passed, relating to the making of woollen cloths. It enacts, that no person shall make woollen cloth but only in a market-town, where cloth hath commonly been used to be made for the space of ten years last past, or in a city, borough, or town corporate. From this restricting act, however, the following exceptions are made: to all persons who dwell in North Wales or South Wales, Cheshire, Lancashire, Westmoreland, Cumberland, Northumberland, the bishopric of Durham, Cornwall, Suffolk, Kent, the town of Godalmin in Surrey, or in Yorkshire, being not within twelve miles of the city of York, or any towns or villages near the river Stroud in Gloucestershire. This act, so absurd and oppressive, was obliged to be modified in the first year of the following reign, by an act entitled "An Act for the continuing and making of Woollen Cloths in divers Towns in the County of Essex." Bocking, Watherfold, Cockshill, and Dodham, are the towns specified.

In consequence of the increase of our manufactures, the export of wool had nearly ceased before the reign of Elizabeth; and a considerable advance appears to have taken place in the price of food, clothing, and rents. The export trade of England was carried on very extensively by three companies of merchants, the merchants of the Still-yard, who were foreigners, the merchants of the Staple, and the merchant adventurers, who were English. See STILLYARD, STAPLE, and ADVENTURERS.

The merchants of the Stillyard were of ancient standing, and were originally from the Hanse towns: they had great privileges granted them, and particularly they were allowed to export and import all wares and merchandize, on payment of the small duty of one and a quarter *per cent.* This gave them a decided advantage over the other companies; and it is alleged that they lent their name to cover the import and export of goods belonging to private merchants, and thereby evaded the regular duties on such goods. This company had engrossed a considerable part of the cloth trade. In the year 1551 they exported 44,000 cloths; soon after which this company was dissolved. The merchant adventurers succeeded to that branch of their trade: according to the account of John Wheeler, secretary to the company, there were annually shipped by them 60,000 white cloths, worth 600,000*l.*, and 40,000 cloths of all sorts, baizes and kersies, worth 400,000*l.*, besides wool and woolfels. We are told by Camden, that, in this reign, the commerce between England and the Netherlands rose to above twelve millions yearly, and the woollen trade alone amounted to five millions. The Latin terms which Camden employs, *milliones aureorum*, leaves the amount intended uncertain: if we suppose it to be ducats, the quantity is much greater than England exported at that time; probably florins were intended, which makes the amount about 750,000*l.*

Besides the exports to Antwerp, English cloth was at this time sent to Amsterdam, Hamburgh, Sweden, Russia, and other countries. The woollen trade of England had now advanced to a higher state of prosperity than at any former period; and from this time it appears to have declined until after the revolution of 1668. In this reign, the price of wool, which we believe to mean long or combing wool, had advanced from 13*s.* 4*d.* to 22*s.* *per* tod; and the shilling containing the same weight of silver as our late coinage, *viz.* 86 grains, the relative value of a tod of long wool was considerably more than it has ever been during the present reign.

The declension of our manufactures in the succeeding reigns of the Stuarts, as we have reason to believe, extended much more to woollen cloths than to worsted pieces. Long wool, or combing-wool, was more the peculiar produce of England than clothing-wools. The latter were grown in abundance, and of a superior quality, in Spain, Portugal, and France; but the combing-wools of England, on account of the superior soundness of the staple or fibre, and the quantity supplied, gave a decided advantage to our manufacturers of stuffs or worsted pieces.

The persecution of the Protestants by the duke of Alva in the Netherlands drove multitudes of the manufacturers into England, where they were graciously received by Elizabeth, who gave them liberty to settle at Norwich, Colchester, Sandwich, Maidstone, and Southampton. These refugees contributed to extend our manufactures of worsted goods and light woollens, called bays and says; they also introduced the manufacture of linens and silks, and it is supposed that they first taught the art of weaving on the stocking-frame.

In the latter part of the reign of Elizabeth an act was passed to relieve the counties of Somerset, Gloucester, and Wiltshire, from those absurd and oppressive statutes which confined the making of cloth to corporate towns. This act, which gave to all persons residing in these counties the privileges of free trade, could not fail to extend and establish the woollen manufactures in these parts, and they have remained to the present time the principal seats of the superfine cloth trade, whilst many manufacturing corporate towns, which were then flourishing, have sunk to decay. Various acts, regulating the length, breadth, and tentering of woollen goods of different kinds, were also passed in this reign, referring to the counties of Oxfordshire, Devon, and the counties north of Trent, particularly Yorkshire and Lancashire. The importation of foreign wool-cards was also prohibited. The act recites, that many thousands of woollen card-makers and card-wire drawers, living in London, Bristol, Gloucester, Norwich, Coventry, and elsewhere, had heretofore subsisted themselves and families upon that business, which was now greatly impaired by the importation of wool-cards. No laws prohibiting the export of wool were thought necessary in this period of our history, and it continued to be exported during the whole of this reign, as appears by the account of the merchant adventurers, who exported it together with cloth; but though wool was freely exported, an act was passed to prevent the carrying of live sheep, lambs, or rams out of England; but the reasons for this act are not recited, though it states it was for divers good causes and considerations. The internal tranquillity that the country enjoyed during this long reign, the influx of foreign makers of new kinds of worsteds, and other articles not known before, the opening of a new trade to Turkey and the Barbary states, by treaty in the year 1579 and in 1585, all greatly contributed to the extension of the woollen trade and manufactures. There were indeed other circumstances which must have operated against our manufacturers in part of this reign. The interruption of commerce between England and the Netherlands in 1564, which lasted some time, the wars with Spain, the sacking of Antwerp, in which the English merchants suffered severely, gave a considerable check to the foreign trade; yet we have seen that the merchant adventurers alone exported woollens to the amount of one million sterling towards the latter end of this reign. The demand at home for woollens must also have greatly increased during the long period of domestic tranquillity which the nation at that time enjoyed, and particularly from the prevailing taste for costly dresses which has spread from the court through the country.

A great part of our woollen exports hitherto consisted of white undressed cloth; but in the following reign of James I. it was represented as bad policy to permit the exportation of cloth in this state, and thereby lose the profit on the dyeing and finifhing. A letter exifts addreffed to king James on this fubject, afcribed to fir Walter Raleigh, but without fufficient evidence, as "the moft ancient manufcripts of this letter in the libraries of the nobility afcribe it to John Keymer." (Oldy's Life of Sir W. Raleigh.) In this letter it is ftated, "that there have been eighty thoufand undreffed and undyed cloths exported yearly, by which the kingdom has been deprived of four hundred thoufand pounds for the laft fifty-five years, which is nearly twenty millions that would have been gained by the labour of the workmen in that time, with the merchants' gains for bringing in dyeing-wares, and return of cloths dreffed and dyed, with other benefits to the realm." The writer proceeds, in another part, to ftate, that there had alfo been exported in that time annually, of baizes and northern and Devonfhire kerfies, in the white, fifty thoufand cloths, counting three kerfies to a cloth, whereby had been loft about five millions to the nation in labour, profit, &c. The author informs us, that the baizes fo exported were dreffed and dyed at Amfterdam, and fhipped to Spain, Portugal, and other kingdoms, under the name of Flemifh baize, fetting their own feal upon them; "fo that we lofe the very name of our home-bred commodities, and other countries get the reputation and profit thereof." The author concludes with afferting, that the nation lofes a million a year by the export of white cloths, which might be dreffed and dyed as well at home. This letter has been often quoted as containing unanfwerable reafons for confining the whole procefs of the cloth manufacture to our own country; but, like other monopolifts, the writer feems to forget that there are two parties in all mercantile tranfactions, and that manufactured goods muft be fent in that ftate in which the purchafer is willing to receive them, unlefs it be proved that he cannot procure them elfewhere. Let us mark the refult. Alderman Cockayne, and other London merchants, had fufficient influence with the government to obtain the prohibition of the export of white cloths, and to fecure a patent for dreffing and dyeing of cloths. In confequence of which, the Dutch and Germans immediately prohibited the importation of dyed cloths from England, which gave fo great a check to our export trade, that in the year 1616, the whole amount of cloths exported of every kind amounted only to fixty thoufand, fo that the export trade in woollens had fallen to lefs than one-third of its former amount; and in the year 1622,

	l.	*s.*	*d.*
All our exports of every kind amounted only to	2,320,436	12	10
Whilft our imports were	2,619,315	0	0
Leaving a balance againft us of	298,878	7	2

It being from experience proved, that the policy of dreffing and dyeing all our goods at home had produced the greateft injury to the woollen trade, the reftrictions were taken off, and the export for white cloth left free. In the former reign, cloths about four pounds value were, by ftatute, to be fent out dyed, by all perfons except the company of merchant adventurers, who obtained a licence to export all forts of white cloths; and though this was itfelf a monopoly, yet, as it gave foreigners an opportunity of receiving our finer cloths in the ftate which they moft wanted, it was the means of increafing our trade: indeed it is faid by Miffelden, that "within a few years after granting this licence, the vent for cloth in foreign parts increafed to twice as much as it had been during the ftrict obfervance of the ftatute." With this fact before their eyes, it is fcarcely poffible that our ftatefmen at that time could have proceeded to the prohibition of white cloth exports, unlefs they had been (as was afferted) influenced by prefents from alderman Cockayne and the rich merchants, who expected to receive the benefit arifing from the prohibition, and the exclufive right of dyeing and dreffing. The wool-growers equally felt the ill effects of this prohibition. Wool is faid to have fallen from thirty-three fhillings *per* tod to twenty fhillings; if by this is meant the long combing-wools, the former price, confidering the value of money at that time, is much higher than it has been in the laft or the prefent century.

During the reigns of the Stuarts, the infamous policy they adopted ftruck not only at the liberty, but at the commercial profperity of the country. Archbifhop Laud, imbued with the malignant zeal of a bigot, commenced his attacks on the defcendants of the French Proteftants, eftablifhed as manufacturers of woollens in Norfolk and Suffolk, from which counties his perfecuting fury drove fome thoufand families. Many of them fettled in New England; but others went into Holland, where they were encouraged by the Dutch, who allowed them an exemption from taxes and rents for feven years. In return for this, the ftates were amply repaid by the introduction of manufacturers, with which they were before unacquainted. In the year 1622, king James iffued a proclamation to prohibit the exportation of wool, fuller's-earth, &c. In 1640 wool was again admitted to be exported on the payment of certain duties; and we are told, that in the fame year fir John Brownlowe, of Belton in Lincolnfhire, fold three years' wool at twenty-four fhillings *per* tod to a baize-maker of Colchefter. As it is reafonable to fuppofe that this was the long combing-wool of that county, it fhews the high relative price of the article at that time. In 1647, owing to the high price of wool, its exportation was again prohibited.

During the civil wars, the manufactures and export trade of England declined, and the Dutch availed themfelves of this to extend their own manufacture and export of woollens, particularly to Spain, from whence they brought fine Spanifh wool. At this time it appears, that the woollen manufactures in Poland and Silefia were rapidly increafing; and the Englifh government received information that two hundred and twenty thoufand cloths were made there annually, befides confiderable quantities made at Dantzic, and in the vicinity.

The duke of Brandenburg, it was alfo ftated to our government, had ordered one hundred thoufand ells of Silefia cloth at Köningfberg for his troops, which had been heretofore fupplied with Englifh cloth. The eftimation in which our cloth had been held is faid to have been loft by negligence in the manufacture, particularly in the fpinning and weaving. The Dutch and Poles had a little before this time received a great number of Proteftant manufacturers, who fled from the perfecution of the duke of Alva in Brabant and Flanders.

Here it may be proper to remark, that the Englifh as a nation had little intercourfe with other parts of the world, except through a few large trading companies: hence they were extremely ignorant refpecting the ftate of foreign countries, and fuppofed that the cloth trade had been confined to their own country for three hundred years; and they confidered the eftablifhment of other manufacturers as a novelty and infringement of their juft rights. With thefe views, it was propofed to obtain a complete monopoly of all the clothing-wools in Spain, in order to prevent the Dutch and other nations from rivalling our manufactures. This is the more extraordinary, as the Englifh had not then learned, like the Dutch, to manufacture Spanifh wool, without mixing it with that of their own country. It is needlefs to fay, that the negociation of fir William Godolphin for this felfifh monopoly of wool was not fuccefsful. During the whole reign of Elizabeth, when our woollen manufactures were in the higheft ftate of profperity, wool and woolfels were permitted to be exported. In the reign of James I. and Charles I., when the trade was declining, proclamations were iffued to prevent the exportation of wool, and alfo that of fuller's-earth. During the commonwealth, an ordinance of parliament was iffued to prohibit the exportation of wool and fuller's-earth, on pain of forfeiture of the wool, and a penalty of 3*s. per* pound on every pound of fuller's-earth. The firft act of parliament which abfolutely prohibited the exportation of wool by making it felony, and which could not be fet afide by a royal licence, is the 12th of Charles II., which was paffed foon after the Reftoration.

The grounds of this meafure are ftated in the preamble of the act: "For the better preventing the loffes and inconveniences which have happened by and through the fecret and fubtile exportation of wool out of the kingdom; and for the better fetting to work the poor people and inhabitants of the kingdom, to the intent that the full and beft ufe and benefit of the principal native commodities of the kingdom may redound to and be unto and amongft the fubjects and inhabitants of the kingdom, and not unto any foreign ftates." Previous to this time, the proclamations and ordinances iffued to prevent the exportation of wool, for the moft part, fignified nothing more than the impofition of a duty or a compofition for exporting by licence from the government, what on other terms was forbidden, under penalties of confifcation, fine, or imprifonment. We have feen that, from the death of Elizabeth to the Revolution in 1688, the woollen trade was generally in a languifhing ftate. In the year 1665, Thomas Telham of Warwickfhire, with two thoufand manufacturers, left the kingdom, and eftablifhed themfelves in the Palatinate, and commenced a woollen manufacture there, and were greatly encouraged by the elector. The eftablifhment was foon afterwards joined by a number of manufacturers from Hertfordfhire.

During the period from Elizabeth to the year 1668, the Englifh appear to have made no improvement whatever in their modes of manufacture of woollen cloth, whilft the neighbouring nations had been making a gradual progreffion, both in the ftyle of their manufacture, and the amount annually produced. It was efpecially in the manufacture of fine cloths that their fuperiority was manifeft. The Dutch, in particular, were far more expert than the Englifh in the dreffing and dyeing of cloth. This will appear from the following remarkable fact ftated by Coke, vol. ii. p. 169. In the year 1668, one Brewer, with about fifty Walloons, who wrought and dyed fine woollen cloths, came into England, and received the royal protection and encouragement. By him the Englifh were firft inftructed how to manufacture cloth of the beft Spanifh wool, without any admixture with inferior wool; and alfo to manufacture and dye fine cloths cheaper by 40 *per cent.* than they had done before. Ten years before this time, it had been publifhed and admitted in England, that "Spanifh wool alone could not be wrought into cloth." It may feem truly extraordinary that the Englifh, who had fo long carried on the manufacture of woollen cloth, had not availed themfelves of the revolution in Flanders, which drove away the beft mafter manufacturers, to encourage their fettlement in this country. M. Huet explains the fact in a way which is not very creditable to the liberality of the Englifh manufacturers, or to the wifdom of our inftitutions. "It was owing to the municipal laws of England, and its ufages towards ftrangers; who, befides being doubly rated at the cuftom-houfe, were excluded from all companies or fraternities of trade; and were not allowed to carry on manufactures as mafters or partners, unlefs fuch as the natives were unacquainted with; fo that none of the Flemifh mafter manufacturers of fine cloth went thither (to England), their's being a myftery not accounted new, though very much fuperior to the cloth working then known in England. It was only thofe who wrought in new kinds of worfteds, ferges, damafks, or ftockings, who went thither. The fame policy was alfo adopted by the Hanfe towns: hence the greater part of the vaft and profitable trade, which was loft to Antwerp, centered neceffarily in Holland, where the manufacturers from Brabant were cordially received." This appears a fatisfactory explanation why the Englifh, in 1668, were fo much inferior to the Dutch in the manufacture of fine cloth.

In the year 1660, however, our manufacturers began to be aware of the fuperiority of Spanifh wool, and to mix it with the beft Englifh, probably in what were called medleys or mixture-cloths, or elfe employing the Englifh wool for warp, and covering it with weft of Spanifh wool. The beft Spanifh wool was then 4*s.* and the fecond fort 3*s. per* pound, and the beft Englifh 1*s.* 6*d. per* pound.

It is deferving of notice, that, in the latter period of the Commonwealth, our trade is faid to have greatly revived, but to have fuffered a miferable depreffion almoft immediately after the reftoration of Charles II. In a letter of M. Downing of the Hague to the prefident of the council in London, 1660, printed in Thurloe's State Papers, vol. vii. p. 848. it is ftated, that great quantities of wool were brought fecretly from England to Holland; and he adds, that the Dutch had at that time got in a great meafure the manufacture of fine cloth, and would probably, with Silefia, engrofs alfo the manufacture of coarfe cloth, and leave England nothing but its native wool to export.

In the year 1662, great complaints were made againft the merchant adventurers for their neglect of the cloth trade; in reply to which they faid, that the demand for Englifh cloths failed in the foreign markets, the white clothing trade having abated from 100,000 cloths annually to 11,000. In the year 1663 our whole exports were only about two millions, and our imports four, leaving a balance of two millions againft this country. It is, however, deferving notice, that the number of wardens for the infpection of ftuffs at Norwich being too few, they were at this time increafed from five to eight. A letter on the ftate of trade, publifhed in 1667, fays, clothing-wools were fo much fallen at that time, that the beft Spanifh was fold at 2*s.* 2*d. per* pound, and Englifh at 8*d. per* pound. The writer afcribes the fall in the price of Englifh wool to our wearing fo much Spanifh cloth, a great part not manufactured by ourfelves, as Dutch blacks; but it is obvious, from the price of Spanifh wool, that the low price of clothing-wools at that time depended on a more general caufe, affecting all manufacturing countries. To relieve the cloth trade from the great depreffion under which it laboured between the years 1660 and 1678, various fchemes were devifed. Among others, the mayor and common council of London paffed an act "for the regulation of Blackwell-hall, Leaden-hall, and Welfh-hall, (the three public markets for cloth in London,) and for preventing foreigners buying and felling!" By foreigners are underftood all perfons not free of the city of London. This act, a moft fingular monument of the ignorance or felfifhnefs of its authors, prohibits the fale of all woollen cloths fent to London, except at the above halls, where certain duties were to be paid upon them, and from whence they could not be removed for three weeks, unlefs they were fold in the meantime to fome draper, or other freeman of the city. The hall-keepers were to attend ftrictly at the halls, and

 turn

turn out all foreigners and aliens coming to purchafe cloth; and every freeman of the city who fhould introduce a purchafer into the halls not free of the city fhould forfeit, for the firft offence, five pounds,—for the fecond, ten,—and for the third, fifteen pounds! Thus, in thofe days, turning purchafers out of the public markets, and fecuring the fale to a certain clafs of buyers, was confidered an act for the benefit of the public.

The Irifh had, a little before this time, commenced the manufacture of woollens and worfteds, which appears greatly to have alarmed the Englifh manufacturers. The wools of Ireland had increafed in quantity, in confequence of a tyrannical act paffed a little before this period, to prevent the Irifh from fending cattle to England, which obliged them to convert their grounds into fheep-paftures. They were, however, prohibited from exporting their wool to foreigners, it being made felony; and the exportation to England, in any other than a raw ftate, expofed it to confifcation. About the year 1640 fome clothiers from the weft of England eftablifhed a woollen manufacture at Dublin, where it flourifhed a confiderable time. About the fame period, fixty families of manufacturers from Holland fettled at Limerick: thefe were ruined by the wars which enfued. Other Englifh clothiers fettled at Cork and Kinfale; a few French manufacturers of druggets fettled at Waterford; and a more confiderable eftablifhment of the cloth manufacture was formed at Clonmel, fupported by the capital of fome London merchants, who had agents there. Thefe eftablifhments, though obvioufly inadequate to the fupply of one-fourth part of the population of Ireland, excited great jealoufy in the Englifh manufacturers; and during the great depreffion of the woollen trade between the years 1660 and 1668, a part of this diftrefs was afcribed to the rivalry of the Irifh clothiers. The Englifh farmers, at the fame time, afcribed the low price of wools to the great importations of wools from Ireland; and the merchants afcribed the failure of the foreign demand for cloth to the clandeltine exportation of Englifh and Irifh wools.

Sir William Petty, in the year 1672, eftimates the fheep in Ireland at four millions, and the weight of each fleece at two pounds. The latter, however, is obvioufly not more than half the true average weight of the fleece, and the number is fuppofed by fome to be below what it was a few years afterwards. If the number of fheep be correct, and taking the fleece of each at four pounds, this would make the total amount of Irifh wools only 66,000 packs, of which three-fourths were confumed in Ireland.

The alarm and jealoufly excited in England by the Irifh woollen manufactures produced meafures that almoft compelled the Irifh to export their wools clandeftinely to the continent. An act was paffed in the year 1699 prohibiting the exportation of woollen manufactures from Ireland, except to a few parts in England and Wales, where the duties impofed amounted to a total prohibition. Various addreffes have been prefented to the king and both houfes of parliament, "befeeching his majefty to take effectual meafures to prevent the growth of the woollen manufactures in Ireland." The Irifh parliament was influenced to impofe a duty in the fame year of four fhillings in the pound on their own manufactures when exported. Thefe unjuft proceedings were intended to annihilate the export trade for Irifh woollens; and, in confequence, their wool and worfted yarn that was not confumed at home were fent to England, or to the continent clandeftinely. The firft four years after the deftruction of their manufactures, thefe exports to England were as follow:

	Stone of Wool, 18lbs. *per* Stone.	Stone of Yarn, 18lbs.	Total of Wool and Yarn.
1700	336,292	26,617	362,909
1701	300,812	23,390	326,202
1702	315,473	43,648	359,121
1703	360,862	36,873	397,735

The average annual amount of wool and yarn, as above, may be ftated at thirty thoufand packs. But after this period the exports to England declined, owing no doubt to the clandeftine exportation of wool to the continent, for which the numerous creeks and harbours offered fuch facility.

In 1711, and the three following years, the quantity exported to England was as under:

	Wool.	Yarn.	Total.
1711	310,136	52,273	365,409
1712	263,946	60,108	324,054
1713	171,871	68,548	240,409
1714	147,153	58,147	205,800

A few years after this, the decline was ftill more confiderable in the amount of wool exported, but that of yarn continued to increafe a little:

1726	51,371	87,261	138,632
1727	58,182	72,047	130,229
1728	49,784	80,428	130,212
1729	38,667	91,854	130,521

A further encouragement to clandeftine importation was given by an impolitic duty of 2*s*. 4*d*. *per* ftone on wool fent to England, which, as the average price did not exceed 6*s*. 6*d*., was full thirty *per cent*. on the firft coft. It will be feen fubfequently, that the woollen manufactures of England were all this time progreffively increafing, fo that the decline in the imports of wool from Ireland were not occafioned by a declenfion of trade; the Irifh had found other markets for their wool.

From a work entitled "A New Difcourfe of Trade," by fir Jofhua Child, fuppofed to have been publifhed about the year 1667, we learn feveral important particulars refpecting the woollen trade. "Though our vent for fine cloths and ftuffs to Turkey, Italy, Spain, and Portugal, were, he fays, declined, yet we retained a confiderable part, principally becaufe the wool of which our middling coarfe cloths are made is our own, and confequently cheaper to us than the Dutch can fteal it from us." In another part he judicioufly obferves, that the acts for regulating manufactures, refolve themfelves at laft into a tax on the commodity, without refpect to the goodnefs of it, as moft notorioufly appears in the bufinefs of aulnager, which doubtlefs our predeceffors intended for a fcrutiny into the goodnefs of the cloth; and to that purpofe a feal was invented as a fignal, that the commodity was made according to the ftatute; which feal, it is faid, may now be bought by thoufands, and put upon what the buyers pleafe. Sir Jofhua Child admits that wool was eminently the foundation of Englifh riches, and that all poffible means fhould be ufed to keep it within the realm; but the only efficacious meafures to effect it are not penal ftatutes, but encouragement to trade. The impediments at that time he ftates to be, 1ft, The high rate of intereft; 2d, Want of hands, which an act of naturalization would cure; 3d, Compulfion (perfecution) in matters of religion. For he adds, "while our neighbours the Dutch have money at lower intereft and more hands, by reafon of general liberty of confcience, with other free privileges, both to natives and foreigners, there is no queftion but they will be able to give a better price for our wool than we can afford ourfelves, and they that can give the beft price for a commodity fhall never fail to have it by one means or another, notwithftanding the

 oppofition

oppofition of any laws by fea or land; of fuch, force, fubtilty, and violence, is the general courfe of trade."

The fame enlightened writer appears to have been the firft Englifhman who faw the injuftice, abfurdity, and impolicy of the numerous reftrictions by which the manufacturers were obliged to make cloths of certain weights and lengths, to keep only a certain quantity of looms, or to prohibit dyers, fullers, &c. from carrying on other branches of the trade. "It would be (he juftly obferved) for the advantage of the trade of England, to leave all men at liberty to make what cloth and ftuffs they pleafe, how they will, when and where they will, and of any lengths or fizes."

One of the principal caufes of the decay of our woollen manufactures fir Jofhua Child might not think it prudent to ftate. This was the encouragement given to the confumption of French cloths and woollens in England, together with the total prohibition of Englifh goods imported into France, or the impofition of duties which amounted to a prohibition. The French, under the adminiftration of Colbert, had been extending and improving every branch of the woollen manufacture, and were become our great rivals in foreign markets, as well as at home. In the year 1678, acts were paffed, the 29th and 30th of Charles II., prohibiting the importation of French commodities for three years. From this time trade began gradually to revive, and would have greatly increafed, had not political caufes operated as a check to our profperity.

The improvements introduced in the manufacture of fine cloths by Brewer in 1668, and the more extenfive confumption of Spanifh wool, enabled us to oppofe, with fome fuccefs, the rivalry of the French.

After the acceffion of William, our manufacturers, who were warmly attached to the caufe of religious liberty, being the greater part Proteftant diffenters, were animated to uncommon exertions in the reftoration of their trade. This is evident from the ftate of our exports in the following year after the revolution in 1689, when they amounted to near feven millions, of which the woollens were nearly three millions. This is the largeft amount till the year 1715. A fhort time after the revolution, about the clofe of the century, our writers on Political Arithmetic, Mr. King and Dr. Davenant, give the following eftimate of our national wealth, including wool, &c.:

	£
The annual income of England, of which the people fubfift - - - - - -	43,000,000
Yearly rent of land - - - - - -	10,000,000
Value of wool yearly fhorn - - -	2,000,000
Woollen manufacture of England - -	8,000,000
Woollen manufactures exported - -	2,000,000

From this period, the woollen trade of England kept progeffively increafing, though fubject to fome fluctuations. In the following years the amount exported were as under:

		£
1718	value of woollens exported	2,673,696
1719	- - - - - -	2,730,297
1720	- - - - - -	3,059,049
1721	- - - - - -	2,903,310
1722	- - - - - -	3,384,842

About the year 1722, the plague at Marfeilles, by preventing the exportation of French woollens, increafed the demand for Englifh manufactures confiderably. In the year 1737, the woollen exports amounted to 4,158,643*l.*; and it is remarkable, that at that period the price of wool was uncommonly low.

	£
The yearly medium value of woollen exports, from 1739 to 1748, or to the peace of Aix-la-Chapelle, was - - - - - -	3,327,057
Yearly medium of woollen exports, from 1749 to 1753, was - - - - - -	4,189,195

From this time to the period of the American war in 1775, the woollen manufactures, and particularly the worfted, ftill continued to increafe, with occafional checks. The quantity of long combing-wools grown in England had given to the manufacturers of worfted goods a decided advantage over thofe of France, though the ingenuity of the latter in the manufacture of les petites draperies, as the worfted goods are called, was greatly fuperior to what our own workmen had ever fhewn. The demand for worfted goods at home, for tammies and ftuffs, which were the general drefs of females before the year 1775, was very great; befides which, we fupplied with worfted goods many of the fouthern parts of Europe, and particularly Spain and Portugal, for the ufe of their South American colonies, and for the dreffes of the clergy, monks, and nuns, which form no inconfiderable part of the population in thofe countries. About the year 1775, the introduction of Arkwright's inventions for fpinning, carding, &c. into the cotton trade, produced a great change in the article of female drefs in England, ftuffs and tammies being fupplanted by cotton goods, which were become extremely cheap. The failure of the foreign trade alfo greatly affected our manufacturers, both woollens and worfteds. The price of Englifh wool at the latter end of the American war was lower than it had been in any period of our hiftory, when money was of much higher relative value. A tod of 28lbs. of the beft Lincolnfhire wool for combing was not worth more than nine fhillings, and the inferior kinds fix fhillings, or about threepence and four-pence *per* pound. From the time of Elizabeth to the middle of the laft century, fcarcely any alteration or improvements had taken place in the proceffes of manufacture, either in woollen or worfted, beyond the variation of colours or patterns, to fuit the fafhion of the day. The ingenious mechanical inventions of Arkwright, applied to the fpinning and carding of cotton, were foon after modified, and applied to the woollen and worfted trade, and produced an entire revolution in fome of the feats of their manufacture. Before that period, the manufacture of heavy woollens and coarfe worfted goods had been gradually concentrating into Yorkfhire and Lancafhire, where the cheapnefs of living, the active induftry of the inhabitants, and, above all, the cheapnefs and abundance of coal, gave the manufacturers a decided advantage over thofe in the midland and weftern counties. The following table, fhewing the amount of broad and narrow cloths made in the Weft Riding of Yorkfhire, will prove the fact moft decifively. It may be proper to remark, that eighty years fince, about 1738, when our woollen exports exceeded four millions fterling, the total number of pieces of broad and narrow cloth made in Yorkfhire was only fifty-fix thoufand nine hundred. At prefent our woollen exports are only about double what they then were; but the number of cloths manufactured in Yorkfhire is not lefs than four hundred and ninety thoufand pieces, or eight times more than the quantity made at the period above referred to. It muft be remarked alfo, that this account does not include the cloth manufactured in Lancafhire, and the borders of Chefhire adjoining Yorkfhire, nor the blankets, ferges, baizes, flannels, caffimeres, toilinets, carpets, rugs, worfted goods, or any other defcription of woollens or worfteds, except plain and narrow broad-cloths. The total amount of thefe different woollen articles exceed, we believe, in weight, if not in value, that of the woollen cloths.

An Account of the Number of Broad Cloths, milled at the feveral Fulling Mills in the Weft Riding of the County of York, from the 24th of June, 1725, (the Commencement of the Act,) to the 12th of March, 1726, and thence annually, diftinguifhing each Year; and of the Narrow Cloths, from the 1ft of Auguft, 1737, (the Commencement of the Act) to the 20th of January, 1738, and thence annually, diftinguifhing each Year; likewife the Number of Yards in Length, made each Year, from Eafter Seffions, 1768.

Years.	Broads.		Narrows.		Years.	Broads.		Narrows.	
	Pieces.	Yards.	Pieces.	Yards.		Pieces.	Yards.	Pieces.	Yards.
1726	26671				1772	112370	3223913¾	95539	2377517½
1727	28990				1773	120245	3635612¼	89874½	2306235
1728	25223½				1774	87201	2587364¾	88323	2133583
1729	29643				1775	95878	2841213	96794	2441007
1730	31579½				1776	99733	2975389	99586	2488140½
1731	35563				1777	107750	3153891	95786	2601583
1732	35548½				1778	132506	3795990	101629	2746712
1733	34620				1779	110942	3427150	93143	2659659
1734	31123				1780	94625	2802671	87309	2571324
1735	31744½				1781	102018	3099127	98721	2671397
1736	38899				1782	112470	4458405	96743	2598751
1737	42256				1783	131092	4563376	108641	3292002
1738	42404		14495		1784	138023	4094335	115500	3356648
1739	43086½		58848		1785	157275	4844855	116036	3409278
1740	41441		58620		1786	158792	4934975	123025	3536889
1741	46364		61196		1787	155748	4850832	128740	4058157
1742	44954		62804		1788	139406	4244322	132143	4208303
1743	45178½		63545		1789	154134	4716460	145495	4409573
1744	54627½		63065		1790	172588	5151677	140407	4582122
1745	50453		63423		1791	187569	5815079	154373	4797594
1746	56637		68775		1792	214851	6760728	190468	5531698
1747	62480		68374		1793	190332	6054946	150666	4783722
1748	60765		68080		1794	190988	6067208	130403	4634258
1749	60705½		68889		1795	250993	7759907	155087	5172511
1750	60447½		78115		1796	246770	7830536	151594	5245704
1751	60964		74022		1797	229292	7235038	156709	5503648
1752	60724		72442		1798	224159	7134114	148566	5180313
1753	55358		71618		1799	272755	8806688	180168	6377277
1754	56070½		72394		1800	285851	9263966	169262	6014420
1755	57125		76295		1801	264082	8699242	137231	4833534
1756	33590½		79318		1802	265660	8686046	137016	5023754
1757	55777½		77097		1803	266785	8942798	139575	5023996
1758	60396		66396		1804	298178	9987255	150010	5440179
1759	51877½		65513		1805	300237	10079256	165847	6193317
1760	49362½		69573		1806	290269	9561178	175334	6430101
1761	48944		75468		1807	262024	8422143	161816	5931253
1762	48621		72946		1808	279859	9050970	144624	5309007
1763	48038¼		72096		1809	311239	9826048	151911	5951762
1764	54916		79458		1810	273664	8671042	158252	6180811
1765	54660		77419		1811	269892	8535559	141809	5715534
1766	72575½		78893		1812	316431	9949419	136863	5117209
1767	102428		78819		1813	369890	11702837	142863	5615755
1768	90036		74480		1814	338869	10656491	147474	6045472
1769	92522	2771667¾	87762	2144019	1815	330310	10394466	162355	6649859
1770	93075	2717105	85376	2255625	1816	325449	10135285	120901	5650669
1771	92782	2966224½	89920	2235625	1817	351122	10974473	132607	5233616

In

In the table that will be afterwards given, it will be feen that the quantity of yards of different woollen articles exported, which are not included with cloths, greatly exceeds that of broad and narrow cloths. Taking this as a ftandard, it would appear that the cloth returned at the fulling-mills in the Weft Riding of Yorkfhire is not more than one-third of the total quantity of woollens and worfteds of every defcription made in the Weft Riding of Yorkfhire, and the borders of Chefhire and Lancafhire. Now to make the quantity of broad and narrow cloth given in the returns of the Weft Riding, would require about one hundred and ten thoufand packs: we may therefore ftate the annual confumption of wool in thefe diftricts to be from two hundred and fifty to three hundred thoufand packs of 240 pounds each; and we may further ftate the amount confumed in thefe diftricts to exceed that of all the other parts of England and Wales collectively by one-third, including hofiery and all other articles made of wool. This will make the total amount of wool manufactured in England to be nearly what we have before eftimated, or five hundred thoufand packs.

The number of perfons immediately employed in the various branches of the woollen manufacture in England was ftated, in the year 1800, to be 1,500,000, and that the trade directly and collaterally employed double the above number. This was afferted in the fpeech of Mr. Law, now lord Ellenborough, in the houfe of lords, as council for the petitioners againft the export of wool to Ireland. But we apprehend that the ftatement greatly exceeds the actual number employed in this trade, including their families.

The amount of the population of the Weft Riding of Yorkfhire is nearly afcertained, and perhaps two-thirds of the whole may be engaged in the woollen manufacture, including the families of the perfons employed. If we ftate thefe to be 340,000, exclufive of the woollen manufacturers in Chefhire and Lancafhire, we fhall certainly not under-rate them. A large part of the Weft Riding being agricultural folely, and in the manufacturing diftricts cutlery, as at Sheffield, and cottons in the more weftern parts, employ no inconfiderable portion of the people. If then we take 340,000 as the amount of perfons, with their families, engaged in the woollen trade in the Weft Riding, exclufive of Lancafhire and Chefhire, and if we fuppofe that they are one-third of the total number of perfons employed in the fame manufacture in England, it will make the whole rather exceed 1,000,000 of manufacturers, including their families, which we apprehend is not far from the true eftimate. We fhall, however, give the precife words of Mr. Law's fpeech in the houfe of lords on the above occafion, the object of which, it muft be recollected, was to enhance the importance of the woollen manufacture. "In order to give your lordfhips fome idea of its magnitude, I may venture to ftate, that there are no lefs than 1,500,000 perfons who are immediately concerned in the operative branches of this vaft manufacture; and if what Dr. Campbell ftates in his 'Political Survey of the Kingdom' be true, that from the wool-grower to the confumer a piece of broad-cloth paffes through 100 different hands, and that there are nearly the fame number of hands dependent on the woollen manufacture, though not actually concerned in it, I may affume that the trade directly and collaterally employs double the above number of hands, or 3,000,000. If we eftimate the magnitude of this queftion (the export of wool) according to the number of perfons interefted in it, it goes to nearly one-third of the entire population of this kingdom, eftimating that population at what is generally reckoned, namely between 9 and 10,000,000." Though the woollen manufactures of England have confiderably increafed within the laft fifty years, we do not apprehend the number of hands employed is greater than before the introduction of mechanical inventions for carding, fpinning, and combing. The working up of one pack of wool, particularly of combing-wool, formerly employed a great number of hands, and was divided into fmall portions, to be fpun in the houfes of cottagers in remote diftricts. This afforded employment to the wives and families of labourers who were engaged in agriculture; but fo much time was occupied in taking out and collecting in the work, that at the period we refer to, few, if any, of the mafter manufacturers in Yorkfhire confumed more than one pack of wool *per* week in their trade. At prefent there are numerous manufacturers in Yorkfhire and Lancafhire, who confume from twenty to fifty packs of wool *per* week.

The cotton manufacture, which may be regarded as of recent date, has employed the population that would otherwife have been thrown out of work in the woollen trade fince the introduction of machinery, and has prevented any inconvenience of this kind from being felt at prefent in Yorkfhire. We may, however, obferve, that many branches of the woollen and worfted trade have been gradually retiring from the fouth of England, and concentrating in the Weft Riding of Yorkfhire and in Lancafhire. Thefe diftricts were the firft to introduce mechanical improvements into the woollen manufacture, and thus gained a decided advantage over the more ancient feats of the woollen trade. For feveral years afterwards the effects were felt in the manufacturing diftricts in the weft of England, and great diftrefs from want of due employment for the labouring claffes was the confequence.

At prefent all kinds of machinery that have hitherto been applied to wool are extenfively employed in the weft of England, and the manufacture of fuperfine cloth is in a flourifhing ftate in the counties of Gloucefterfhire, Somerfetfhire, and Wiltfhire, all ancient feats of the clothing trade. The manufacture of broad-cloth in other parts of the fouth and weft of England is not carried on to any great extent. The manufacture of flannels, ferges, baizes, &c. though branches of the woollen manufacture, are diftinct from the cloth trade, and feldom carried on in the fame diftrict.

The export of woollen goods of all kinds from England, in the year 1815, amounted in declared value to ten millions one hundred and ninety-eight thoufand pounds. This was rather an extraordinary quantity; and in the following year the exports fell under nine millions, which may be taken as the regular annual amount of woollen exports at prefent.

The following table gives the amount of different kinds of woollens exported, with their value, and the places to which they were fent in the year 1816; a year in which our foreign trade was confidered as in a declining ftate. It may be worthy of remark, that though our woollen exports fcarcely reached eight millions and a half, the amount taken by the United States of America in that year exceeded three millions; a fact which proves the vaft importance of the American market to our manufacturers.

An Account of the Quantity of Woollen Goods exported from Great Britain, in the year ending the 5th
poſſible, the various Articles,

Countries to which exported.	Quantity and declared Value of Woollen									
	Cloths of ſuperfine, ſecond, and inferior Quality.		Napped Coatings, Duffles, &c.		Caſſimeres.		Baizes of all Sorts.		Flannel.	
	Quantity.	Declared Value.	Quantity.	Declared Value.	Quantity.	Declared Value.	Quantity.	Declared Value.	Quantity.	Declared Value.
	Pieces.	L.	Pieces.	L.	Pieces.	L.	Pieces.	L.	Yards.	L.
Ruſſia	79671	777074	27	153	2180	19857	128	565	62436½	5633
Sweden	56½	979	—	—	1	4	—	—	832	54
Norway	588	4921	217	949	60	378	27½	165	4335	389
Denmark	717	7447	34	130	354	2308	—	—	8142½	646
Poland	2	45	—	—	—	—	—	—	100	10
Pruſſia	83	1100	67	324	214	1544	3	18	1324	137
Germany	9274	54042	27740	110457	27882	103534	200	580	144972	9494
Holland	9892	53294	13374	63462	2374	9367	1741	11950	37928	3373
Flanders	3164	23086	6586	29540	1575	7364	13	94	44555	4602
France	73	721	—	—	67	910	¼	3	1944	154
Portugal, &c.	39854	292141	7466	38755	3931	30037	13114	80377	14859	1355
Spain, &c.	3395½	30286	1228	5071	930	5975	5584	38139	42554	4411
Gibraltar	4344	32520	1270	6805	950	5415	883	4886	79720	8913
Italy	7729	45360	2772	11765	658	3395	48	285	20623	1535
Malta	8453	45964	1305	5466	811	4274	53	198	4730	537
Turkey and Levant	185	2850	51	258	—	—	—	—	1450	160
Ireland and Iſle of Man	21734	327049	61	399	4008	60851	91	556	200707	18898
Iſles, Guernſey, Jerſey, & Alderney	991	13975	93	515	20¼	194	140½	540	25054	2213
Aſia	19433	407614	170	936	231	2777	330	1374	225487	28130
Africa	1485½	17396	498	2538	1122	6586	241	1460	14386½	1209
America; *viz.* United States	195124	1463028	19798	73143	39899	263284	4446	12787	2288758	187940
——— Britiſh Northern Colonies	32412	246504	1827	5544	2248½	15442	1051	4227	484129	35971
——— Weſt Indies	16649¼	114544	529½	1926	2708	16991	8109	40098	69729	6451
——— Foreign Continental Colon.	33319	238796	5409	30863	2911	18888	13926	80236	12999	895
——— Honduras	30	337	—	—	50	312	—	—	700	53
Total	488658¾	4201073	90522½	388999	95184¾	579687	50129¼	278538	3792454½	323163

of January, 1817, diſtinguiſhing the Countries to which exported, and alſo diſtinguiſhing, as far as
and their reſpective Value.

Goods and Yarn exported from Great Britain.

Blankets and Blanketing.		Carpets and Carpeting.		Stuffs, Woollen or Worſted.		Stockings, Worſted.			Sundry Articles conſiſting of Hoſiery not deſcribed, Rugs, Coverlids, Tapes, &c.	Woollens, mixed with Cotton.		Woollen and Worſted Yarn.		Total declared Value of the preceding.
Quantity.	Declared Value.	Quantity.	Declared Value.	Quantity.	Declared Value.	Quantity.		Declared Value.	Declared Value.	Quantity.	Declared Value.	Quantity.	Declared Value.	
Yards.	L.	Yards.	L.	Pieces.	L.	Doz.	Prs.	L.	L.	Yards.	L.	Lbs.	L.	L.
6742	885	30863	6335	2261	4723	208	0	276	1234	12433	2188	—	—	818923
58	7	1240	421	15	25	4	9	9	21	—	—	—	—	1520
268	37	645	155	479	1096	41	4	62	319	1715½	426	—	—	8897
382	51	1047	297	891	1850	10	0	13	152	786	270	—	—	13164
180	20	1130	265	52	120	—		—	—	—	—	—	—	460
—	—	1832	485	188	382	3	0	3	1028	2260	652	—	—	5673
12660	1285	73579	17742	37748	80244	3936	9	5201	15052	135862	26041	—	—	423672
7690	600	28737½	5462	31447	62391	8636	10	10384	3986	19730½	3968	—	—	228237
6663	685	6162	754	5635	13326	5145	6	6499	3645	31785	9072	—	—	98667
15	4	352	88	345	1112	196	0	240	443	2338	686	—	—	4361
44745	5026	18043	3394	27472	72091	3417	0	4153	35206	25190	5919	—	—	568454
10152	1189	6064	1086	11644	29281	2840	0	3666	25931	5846	1505	—	—	146540
2150	219	2600	474	10659	24874	892	10	1029	13846	19593	4563	—	—	103544
570	68	2765	627	14852	37930	62	0	84	1060	2894	720	—	—	102829
100	15	317	83	3682	9603	87	0	113	693	3382	389	—	—	67335
650	70	13595	3366	1816	4222	20	0	42	104	—	—	—	—	11072
30500	4727	46894	12042	8150	20883	12453	0	14156	11582	121483	25444	523638	65613	562200
4280	638	7211	1555	837½	2319	650	6	916	280	548½	150	—	—	23295
23824	3956	9879	2312	187820	572325	629	0	1039	8863	4044	895	—	—	1030221
14190	1237	3718	645	1638¼	3353	1520	0	1477	1139	2940	813	—	—	37853
1265746	165729	526964	109529	202061	609628	69059	6	75513	47802	198268	21284	—	—	3029667
258359	32455	69563	14293	21362	55511	18709	4	22190	8995	24103	4410	8757	2086	447628
233597	22153	3080	768	13094	27649	837	6	1133	4916	215912	14973	—	—	251602
39320	3750	9946	2008	9810	21845	2483	0	2851	7746	54805	9928	—	—	417806
1860	120	—	—	14	28	7	0	11	—	—	—	—	—	861
1964701	244926	866226½	184186	593972¾	1656811	131849	10	151060	194043	885918½	134296	532395	67699	8404481

If we ſtate the amount of woollen goods exported to be about one-third of our own conſumption, or from one-third to one-fourth, which is probably more correct, this would make the total value of manufactured woollens to exceed thirty millions annually. Of the woollen goods exported, the quantity conſumed on the European continent ſcarcely exceeds three millions ſterling in value, and a great part of that amount given in the preceding account was for army cloth. Hence it appears, that a very ſmall proportion of the general population of Europe is indebted to this country for its woollens, including under the term both woollen and worſted goods. The increaſed demand for woollens of every deſcription in England ariſes partly from the increaſe of population, but more from the increaſing demand for articles of luxury or convenience. In the middle of the laſt century, carpets were ſcarcely to be ſeen in the country, except in the houſes of the nobility; at preſent almoſt every houſe in England, except thoſe of cottagers and the labouring claſſes, has carpets ſpread in ſome of the rooms. The conſumption of worſted yarn in articles of furniture, and in the linings of carriages, and what is called horſe millinery, is very great; add to which the people of England are better dreſſed than they were formerly. We may from all theſe cauſes ſtate, that the home conſumption of woollens, in proportion to our population, is double that of any other nation in Europe. To prove that we do not over-rate the proportion of woollens conſumed at home, it may be ſufficient to ſtate, that the Weſt Riding of Yorkſhire alone manufactured, in the year 1817, nearly twice as many pieces of cloth as were exported in that year; but few woollen broad-cloths are made for exportation in the weſt of England, the manufactures there being principally fine and ſuperfine cloth for home conſumption, the value of which *per* yard on the average is much greater than that of the Yorkſhire cloth. In the preſent ſtate of Europe, we think it an encouraging circumſtance to our woollen manufacturers, that ſo large a proportion of their goods are conſumed at home, where the demand will remain certain; and again, that the United States of America take ſo conſiderable a part of our exports, as from the increaſing population of theſe ſtates, we may expect that the demand will be increaſing for many centuries, and will ſoon exceed what it will be in the power of this country to ſupply.

In the year 1800, the woollen manufacturers of England were greatly alarmed at the liberty which was intended to be granted, of exporting wool to Ireland, and petitioned parliament againſt the meaſure. The grounds on which their alarms reſted, were partly the preference given to the Iriſh, and partly the ſuppoſed facility that would be afforded to ſmuggling wool to the continent. Several manufacturers and wool-dealers from different parts of the kingdom were examined before the two houſes of parliament; but neither in their evidence, nor in the ſpeeches of the learned council, who were heard in ſupport of the petitioners, can we trace any comprehenſive or enlightened views of the ſubject. The objections urged againſt the export of wool were grounded principally on the practice of former reigns, particularly thoſe of Edward III. and queen Elizabeth: but the facts we conceive were in oppoſition to the ſtatements; for during the whole of the latter reign, in which our woollen manufactures were in a highly flouriſhing condition, the export of wool was freely admitted, on the payment of certain duties; and during the reign of Edward III., the prohibition to export wool under heavy penalties was confined to denizens and foreigners, in order to ſecure a larger amount of duties to the king, the former paying leſs duty on exports than natives; nor was it till the reign of Charles II. that the export of wool was ſtrictly prohibited. All the former prohibitions were evadable by licences, which were readily granted for money. It is from this reign, therefore, we muſt date the prohibition to export wool, as forming an eſtabliſhed law of the land; and it is not unworthy of remark, that immediately after this period, and to the time of the revolution in 1688, our woollen manufactures were in a very declining ſtate, which proves that they had not derived much benefit from the meaſure. The policy of admitting the export of wool has been again recently agitated in parliament, and has renewed the alarm of the manufacturers. It is not by precedents drawn from former ages, but ſolely by the wiſdom and juſtice of the meaſure, as applicable to one preſent condition, that a queſtion of this kind ſhould be determined. With reſpect to ſhort or clothing wool, we believe that a permiſſion to export it would not produce the leaſt effect, as we already import theſe wools from almoſt every nation in Europe; it is not, therefore, probable, that foreigners would give a better price for them than our own manufacturers can afford. With long combing-wools, the caſe is ſomewhat different, as by the acknowledgment of the French themſelves, theſe wools are wanted to mix with and improve their own. We apprehend, however, that as much is exported at preſent clandeſtinely in the form of worſted yarn, as the market may require, the free export of cotton yarn giving great facility for evading the penalty, by packing them together. The permiſſion to export wool to Ireland, which was granted in 1800, has not been attended with any one of the fatal effects which our manufacturers anticipated; nor do we apprehend, that permitting the free export of wool under certain duties would be found to injure our own woollen trade.

In taking this view of the ſubject, which we truſt is an impartial one, we readily admit that the permiſſion to export wool, were it granted, would not be attended with any permanent benefit to the landed intereſt. A ſmall pamphlet on the ſubject, recently publiſhed by John Maitland, eſq., contains the following judicious obſervations:—"The manufacturer of our native wool claims from government the preſervation of it for his uſe; for *by the ſtatute law of the land, he is confined to its ſoil for the expreſs purpoſe of working up the wool which grows upon it.* This wool cannot, therefore, upon any juſt or moral principle, be permitted to go out of the country in an unmanufactured ſtate, without allowing the manufacturer to follow it, or without obliging the grower and exporter of it to maintain him and his children." This is ſo obviouſly juſt, that whenever the export of wool is admitted, we cannot any longer, as at preſent, prohibit the woollen manufacturers from emigrating and carrying their induſtry to the beſt market. "The wool," as Mr. Maitland elſewhere obſerves, "does not on an average compoſe more than one-ſixth part of the value of the animal on which it grows; and the manufacturer, by obtaining this ſixth part, at ſuch a moderate rate as may enable him to ſell his goods, when manufactured at a reaſonable profit, inſures to the owner of land a moral certainty of obtaining the full value for the remaining five-ſixths, and receiving an ample price alſo for all the other productions of his ground." The truth of this obſervation we know to be fully proved in the Yorkſhire markets. Whenever there is any conſiderable depreſſion of the woollen trade, it is always attended with a decreaſed conſumption of animal food, ſupplied principally from Lincolnſhire, and the counties which produce the largeſt quantity of wool. Should the permiſſion to export wool be attended with any effect in diminiſhing our own manufactures, the reſult would be highly injurious to the land-owner, who would then have to find new cuſtomers for his

his general produce, and new aſſociates to ſhare with him the burden of taxation.

The prices of heavy combing-wool in Lincolnſhire, Nottinghamſhire, or Leiceſterſhire, may be taken as the average price of this kind of wool over the whole kingdom, there being little variation in the value of this wool from different diſtricts. The following table will ſhew what have been the prices for a great part of the laſt century:

Price *per* Tod of Lincolnſhire Fleeces, the Tod weighing 28 lbs.

	£	s.	d.
1706 - - - -	0	17	6
1707 - - - -	0	16	6
1711 - - - -	0	13	0
1713 - - - -	0	17	0
1714 - - - -	0	18	0
1715 - - - -	0	18	0
1716 - - - -	0	19	0
1717 - - - -	1	3	0
1718 - - - -	1	2	3
1719 - - - -	1	2	0
1720 - - - -	1	0	0
1721 - - - -	1	0	0
1722 - - - -	1	0	0
1723 - - - -	0	17	6
1724 - - - -	0	16	0
1725 - - - -	0	16	0
1726 - - - -	0	15	9
1727 - - - -	0	16	0
1728 - - - -	0	18	0
1729 - - - -	0	18	0
1730 - - - -	0	18	0
1731 - - - -	0	19	0
1732 - - - -	0	19	0
1733 - - - -	0	18	6
1734 - - - -	0	16	0
1735 - - - -	0	14	0
1736 - - - -	0	14	0
1737 - - - -	0	14	0
1738 - - - -	0	13	6
1739 - - - -	0	13	0
1740 - - - -	0	14	0
1741 - - - -	0	14	0
1742 - - - -	0	15	0
1743 - - - -	0	19	6
1744 - - - -	1	1	0

From the year 1744 to the year 1777, the prices, though occaſionally fluctuating, continued much the ſame as in the preceding years, but we have not the means of aſcertaining preciſely what they were in each year. The following table will ſhew the prices of Nottinghamſhire and Leiceſterſhire heavy combing-wool, taken from the moſt authentic ſource. We conſider the value of this wool to have been fully equal to that of Lincolnſhire on each year.

Price *per* Tod of 28 lbs. of Nottinghamſhire and Leiceſterſhire heavy Combing-Wools.

	£	s.	d.
1777 - - -	0	18	0
1778 - - - -	0	15	0
1779 - - - -	0	11	0
1780 - - - -	0	11	6
1781 - - - -	0	10	6
1782 - - - -	0	9	0
1783 - - - -	0	12	0
1784 - - - -	0	16	0
1785 - - - -	0	12	0
1786 - - - -	0	13	0
1787 - - - -	0	17	6
1788 - - - -	0	17	0
1789 - - - -	0	18	0
1790 - - - -	0	18	0
1791 - - - -	0	19	6
1792 - - - -	1	2	6
1793 - - - -	0	18	0
1794 - - - -	0	17	6
1795 - - - -	0	19	0
1796 - - - -	1	1	0
1797 - - - -	1	0	6
1798 - - - -	0	18	0
1799 - - - -	1	1	6
1800 - - - -	1	4	6
1801 - - - -	1	10	0
1802 - - - -	1	10	0
1803 - - - -	1	9	0
1804 - - - -	1	12	0
1805 - - - -	1	13	6
1806 - - - -	1	12	0
1807 - - - -	1	4	6
1808 - - - -	1	4	6
1809 - - - -	1	8	0
1810 - - - -	1	10	0
1811 - - - -	1	5	0
1812 - - - -	1	10	0
1813 - - - -	1	14	0
By the end of the year -	2	5	0
1814 - - 2 2 0 to	2	12	0
Spring of 1815 - -	2	16	0
1815 - - - -	2	10	0
1816 - - - -	1	10	0
1817 - - 1 14 0 to	2	0	0

The above were the average prices of the beſt lots; the inferior ones might range from one to two ſhillings *per* tod under the prices here given. It may be obſerved, that the price of this kind of wool was lower towards the cloſe of the American war, or about the year 1781 and 1782, than in any former or ſubſequent period of our hiſtory, if we take into conſideration the relative value of money. At that time, the quantity of wool unſold in the hands of the farmer was nearly equal to three years annual growth; a quantity too large to have been conſumed by our manufacturers, had not the introduction of machinery enabled them to work it up with much greater facility than formerly. The average weight of theſe fleeces may be ſtated at four or ſeven pounds each fleece to the tod of 28 pounds. Since the commencement of the preſent century, the price of this kind of wool, it will be ſeen from the above table, has been amply ſufficient to remunerate the wool-growers; and we confeſs we are utterly at a loſs to diſcover on what grounds of ſound policy or intereſt they would wiſh to make any change in the laws reſpecting the export of wool. With reſpect to ſhort or clothing wools, any change in the exiſting laws would make no alteration whatever in the price; for it is the extreme of prejudice to aſſert, that our native clothing fleeces are neceſſary to the foreign manufacturer, either to ſupply his demand or improve the quality of his own wool. We might with equal juſtneſs revive the abſurd opinion, ſo confidently maintained a few years ſince, that the beſt Spaniſh wool would not make cloth without an admixture with that of England.

Woollen *Manufacture, Process of.* In an early part of this work, under the article Cloth, we have given a general view of the process of cloth-making, furnished by a principal manufacturer in the west of England. In the present article, we shall confine our account chiefly to those improvements in the processes which have since been introduced, and shall add a description of the machines which were only slightly noticed in the article Cloth, and give references to the plates. The processes of the woollen manufacture may be classed under two heads; those by which wool is prepared for the weaver, and those by which the cloth is finished after it is taken out of the loom. The sorting of wool has already been referred to under the article Wool. English wool is supposed to be sufficiently cleaned from pitch marks or other extraneous substances by the wool-sorter, and left by him in a proper state to commence the process of cloth-making. Spanish wool in the bale has generally some part of the pitch employed to mark the sheep still adhering to it, which must be carefully cut off. It was till recently the practice to beat the wool with rods, in order to shake out the dust and open the staples; but this is now principally done by an opening machine with long coarse teeth, called a devil, or wool-mill. Spanish wool is frequently so hardly pressed together in the bag, that it requires to be opened out by beating, to prepare it for the further processes.

In the west of England, wool is generally scoured before it is dyed or carded; but in Yorkshire this is seldom practised on wool intended for white cloths, and among the smaller manufacturers who dye their own wool, it is frequently put into the dyeing-vat unscoured; a practice which injures the brightness of the colours, but which enables the manufacturer to make a greater weight of cloth with the same quantity of wool. There is also some saving of labour and expence; but this is more than counter-balanced by the increased quantity of oil *per* pack required for unscoured wool, which is at least one-third more than would be necessary if the wool were scoured. In the west of England, where the wool is scoured previously to its manufacture, the process is carried on with a degree of neatness and cleanliness, which form a perfect contrast with the horrid stench and disgusting filthiness of the woollen factories in Yorkshire. For fine cloths, olive-oil, called Gallipoli, from the part where it was supposed to be sent, is principally used; and for the coarser cloths rape-oil. Where attention to colour is not required in very coarse goods, fish-oil is sometimes employed; but if the latter remain in the wool or cloth, it turns it brown, undergoing a degree of fermentation injurious to the cloth, and which sometimes occasions spontaneous combustion. To lessen the expence of oil for coarse cloths, some manufacturers in Yorkshire make use of a mixture of soap and water with oil, which answers very well in moist weather, if the wool be immediately carded and spun; but if it remain some time unwashed, or the weather be very hot, the mixture evaporates. It has been attempted to work wool without any oil whatever, but without success. The use of oil is to cover the surface of the fibres, and enable them to slide easily over each other in carding or spinning. What we have before said of the structure of the surface of wool or hair, under the article Wool, will suffice to shew the advantage that must result from oiling. The wool is sprinkled with oil as evenly as possible. In Yorkshire the proportion on fine wool is about six gallons *per* pack, and this is more equally distributed over it by the wool-mill, through which it passes previous to the process called scribbling. This process is a kind of coarse carding, and is performed on a machine similar to that used for scribbling cotton, but larger, and with coarser cards, the principle being similar to that of the carding-machine, hereafter to be described. By this engine the longer fibres are broken down, and they are all laid straight and nearly parallel to each other. The wool leaves the roller of the scribbling-mill in one thin undivided sheet, and the more clear, even, and transparent it appears when held between the eye and the light, the more perfectly has the operation been performed. On the carding-engine, the operation is repeated on finer cards; but instead of leaving the machine in one continued sheet, it is finally divided into separate portions, which by a fluted roller are formed into separate round pieces about one inch in diameter, and two feet three inches in length. The fibres are now arranged so as more easily to slide over and twist round each other in the next process, which is a kind of coarse spinning called slubbing, performed with the slubbing-machine, which will be described. On this machine each of the rolls from the carding-machine are joined together, and drawn out into a loosely-twisted thread, and wound round a spindle, forming what is technically called a *slubbing*. These slubbings being taken to the spinning jenny, which will also be described, are twisted in an opposite direction, and drawn out into threads of yarn of the requisite length. For very fine yarn used in shawls, a machine called the mule is sometimes employed, nearly similar to the cotton mule (see *Manufacture of* Cotton), the slubbing passing through rollers which assist in drawing out the thread smaller and more regular. The yarn is now prepared for winding, sizing, warping, and weaving. (See Cloth.) Since the article Cloth was written, broad-cloth is almost universally woven by one person only in a loom, making use of the fly-shuttle. (See Weaving.) The next process is scouring and burling, already described under the articles Cloth and Fulling. The cloth is then sent to the fulling-mill; the finer kinds are prepared for fulling by a mixture of soap and water; in coarse kinds, fuller's-earth supplies the place of soap. (See Fulling-*Mill*, and a farther description at the end of the article.) The principle on which the felting depends has been described under the article Wool. By the process of fulling, the cloth becomes shortened in length and breadth, and the fibres are incorporated and intimately united with each other. In the best manufactured cloths, this incorporation is so complete, that the separate threads can scarcely be distinguished, the bottom of the cloth appearing to form one even continuous substance. An improvement in this respect has recently been made at Leeds, by spinning the wool much softer and thicker than has usually been the practice, and uniting the threads in the fulling-mill, and then working the substance of the cloth down to a requisite degree of thinness by the gig-mill, hereafter to be described. At the end of the process, the face or surface of the cloth is much softer, and greatly superior in appearance to cloth manufactured in the common process. A pack of wool of 240 lbs. will make when milled about one hundred and twenty yards of mixed or coloured cloth from fifty to sixty inches in breadth, according to the quality and fineness of the wool. The process of raising, shearing, and pressing, have been mentioned under the article Cloth, and will be more fully described when an account is given of the gig-mill and shearing-machine. The object of these processes is to cover the thread with a soft pile, consisting of the fibres of the wool, cut down to an even surface over the whole piece.

There are various kinds of woollen goods worked on the same principle as cloth, and made with both the warp and the weft

weft of carded wool, but which being unmilled, or finiſhed in a different manner, receive different names. Blankets are manufactured on the card, but from wool that poſſeſſes a greater length of ſtaple, and which therefore admits of a deeper pile, being raiſed on the ſurface. The yarn is ſpun thicker, and left as ſoft as poſſible, in order that it may form a full cover or pile. Fine blankets are made much ſtouter and heavier than coarſe ones; they are both ſcoured in the mill, but are ſcarcely ſuffered to undergo the fulling proceſs. Thick cloths with a long pile, called duffields, fearnoughts, and bear-ſkins, are manufactured on the ſame principle as blankets, but they are milled much thicker and dyed, and alſo raiſed to a deeper pile. Flannels and very light cloths, ſuch as Bath coatings, are uſually ſpun ſmall, in proportion to the quality of the wool. In weaving plain cloths, the chain or warp is equally divided by the gears, one half of the threads being above and the other half below, and they croſs each other every time the thread of the weft is thrown through by the ſhuttle. In weaving kerſeymeres or caſſimeres, on the contrary, the warp is unequally divided, to produce what is called the twill, or tweel, (ſee Weaving,) one-third being always above and two-thirds below the ſhuttle as it paſſes. It is owing to this arrangement of the warp, that it forms a ſlanting or diagonal rib acroſs the body of the cloth, which is the diſtinguiſhing character of this kind of woollens. See Draught *of Looms*.

Caſſimeres are uſually ſet in the loom from thirty-four to thirty-ſix inches wide, and milled to twenty-ſeven inches. Forty pounds of wool from the bag will make rather more than ſixty yards of common milled fine caſſimeres; the double milled ones make leſs in proportion to the degree of milling they receive.

Swandowns and toilinets are made with a cotton warp; the weft is woollen or worſted yarn of various colours, according to the patterns required. Woollen cords have alſo the warp of cotton and the weft of woollen; they are woven and cut preciſely in the ſame manner as cotton cords. See Fustian.

Serges are made with the warp of worſted and the weft of coarſe woollen yarn, and are twilled. Theſe goods have been for a very long time manufactured extenſively in Devonſhire, and are principally purchaſed by the Eaſt India company for the China trade.

Carpets have worſted warps and woollen wefts. See Carpet and Weaving.

From the moſt remote period of the woollen manufacture until the latter end of the laſt century, or about the year 1780, very few, if any, mechanical improvements had been introduced into it. During the whole time the various proceſſes were carried on nearly in the ſame manner, but with greater or leſs ſkill, and were employed upon materials more or leſs valuable. The carding and ſpinning of wool, and the weaving and finiſhing of cloth, in the early part of the reign of George III., were effected by the ſame machines as in the time of Edward III., which probably were ſimilar to thoſe of the ancient Romans, but more rude in their conſtruction. In an art which had ſeen ſo many centuries roll on without any change, it did not appear poſſible to the manufacturer that any improvement could be effected; and had not the genius of Hargreaves and Arkwright changed entirely the modes of carding and ſpinning cotton, the woollen manufacture would probably have remained at this day what it was in the earlieſt ages of civilized ſociety. That it would have been better for general ſociety if it had ſo remained we readily admit; but after the improved modes of working cotton were diſcovered, this was impoſſible. The ſpinning jenny, which was the ſame as that employed in the cotton manufacture, but ſomewhat larger, was introduced into Yorkſhire from Lancaſhire about the year 1780, but did not become general till about three years afterwards. In the firſt jennies, not more than eighteen or twenty threads could be ſpun, and the mode of winding the thread upon the ſpindle was very imperfect. The carding was ſtill effected by the hand, and the ſlubbing or roving was prepared on the common ſpinning-wheel. For ſome time conſiderable difficulty was experienced in carding by machinery, particularly in clearing the wool from the card; and a ſlight change in the conſtruction of the machine was found neceſſary to prepare the wool for the ſlubbing-billy, of which an account will be given in the deſcription of the carding-machine. Soon after this, the carding and ſpinning of wool and yarn by machinery became general through the manufacturing diſtricts of the Weſt Riding of Yorkſhire, and large mills were erected, in which the carding and ſcribbling machines were turned by a water-wheel, and the roving or ſlubbing performed on the billy. The wool carded at theſe mills was ſent to the ſmaller manufacturers in the ſtate of ſlubbing, and the farther proceſs of ſpinning was effected on jennies in their own premiſes. Before the year 1787, the old proceſſes of carding by the hand, and ſpinning on the wheel, were entirely diſcontinued in Yorkſhire; but it was ſome years after before the new proceſſes were generally introduced in the weſt of England, and thus, as we have before ſtated, the woollen trade became more concentrated in Yorkſhire, where cloths could be manufactured at leſs expence. About this time, machinery began to be applied to the combing and ſpinning of long combing-wool, to make worſted yarn. See Worsted *Spinning*.

In conſequence of the great increaſe of trade in Yorkſhire, it was found difficult to obtain ſituations for mills to be turned by water, and the application of the ſteam-engine to woollen machinery became very general. The abundance of fuel was highly advantageous to the Yorkſhire manufacturer; and it was found to be equally cheap to work the machines by ſteam as by water, where any conſiderable rent was paid for the water. The motion of the improved ſteam-engine was alſo rendered as regular as a water-wheel, and the great inconvenience and loſs from the interruption of the works by froſts or continued droughts were thereby avoided.

The ſmaller manufacturers in Yorkſhire were at firſt benefited by the introduction of machinery, but in a little time large capitaliſts began to engage in the woollen trade, and performing all the proceſſes with their own machinery, they were enabled to work cheaper and underſell the ſmaller makers. The facility alſo with which wool could now be worked up kept the markets always well ſtocked with goods, and prevented the manufacturers from taking the advantage of a temporary ſcarcity or a briſk demand, which they had formerly done, an overſtocked market always reducing the profits.

Soon after the year 1800, the number of ſmall manufacturers began rapidly to decreaſe many of them, being ruined by the change which had taken place, and compelled to become workmen in the factories of the large capitaliſts.

The gig-mill and the ſhearing-machine were not introduced into Yorkſhire until they had been ſeveral years employed in the weſt of England, owing to the reſiſtance made to them by the working cloth-dreſſers or croppers in the north.

The manufacture of worſted is properly a branch of the woollen manufacture, and noticed as ſuch in our hiſtory of its progreſs in England; yet the mode of manufacture, both in preparing the worſted yarn and finiſhing the goods, being entirely

entirely different from woollens made of carded wool, and part of it being applied to hofiery, we refer, for a further account of it, to the articles WORSTED *Manufacture*, and WORSTED *Spinning*.

Defcription of the Machines employed in the Woollen Manufacture.—The *wool-mill*, or *willy*, is the firft machine which is employed on the raw wool to open and difentangle the clofe matting, in which the wool comes from the wool-ftapler. It is alfo ufed for clearing the dyed wool from the dye ftuff, and again for mixing different parcels of wool together; alfo for incorporating the oil with the wool.

The wool-mill ufed in Yorkfhire confifts of a cylindrical drum, about three feet long and two feet and a half diameter, which is made to revolve near three hundred times *per* minute. Its circumference is furnifhed with teeth or fpikes, and immediately above it five fmall rollers are placed, which are alfo furnifhed with fimilar teeth. The teeth of the rollers and thofe of the drum interfect each other when they all turn round; and the teeth of the five fmall rollers alfo interfect each other. The cylinder and rollers are inclofed in a box or cafe, which is clofed on all fides, except a door in front, which turns down, the hinges being at the lower fide. When this door is fhut up it ftands in a perpendicular plane, very near to the teeth of the drum; when the door is opened, or turned down into the horizontal pofition, the wool is laid upon it, about one pound weight at once, and the door being clofed the wool is brought within reach of the teeth of the cylinder, which take the wool and carry it upwards, fo as to work it between the teeth of the cylinder and thofe of the five rollers placed over it. This effects the opening of the wool, and breaks the fibres if the ftaple is too long: it alfo feparates the matted fibres. In about three feconds, the pound of wool is generally fufficiently worked, during which time the cylinder has made about fifteen turns. The lower part of the cafe in which the cylinder revolves is a grating of wooden rods, through which the dirt and duft efcape. The cylinder is fitted very clofe to this grating, fo that the wool cannot efcape from the cylinder, but is carried round in it, and is thus repeatedly fubmitted to the action between the teeth of the cylinder and thofe of the rollers. When it is judged that the wool is fufficiently worked, the door is opened again, and the centrifugal force throws out the wool in an inftant; a frefh charge is then laid upon the door, and fhut up in the machine. A preferable mode is to have two doors on oppofite fides of the cafe; one to put in the raw wool, and the other for the finifhed wool to come out at.

The wool for coarfe goods is paffed feveral times through the wool-mill; firft, to break the mats of the raw wool and render it light; then a fecond time after it is dyed; a third time to mix the different forts together; and laftly, after the wool is oiled, it is paffed a fourth time through the wool-mill, with a view to incorporate the oil well with the fibres of the wool.

Scribbling-Machine.—This is the firft ftage of carding. The operation tends to difentangle the fibres which were before clofely entangled, and draw them out feparately, fo as to render the wool light and flaky. The fcribbling-machine is very fimilar to the carding-machine, having a large cylinder or drum, which is covered on the furface with fheets of leather ftuck full of projecting wire-teeth, called card-wires. The teeth are fo clofe together as to cover the whole furface of the cylinder, like the briftles of a brufh. This cylinder is turned rapidly round by the machinery, and the wool is regularly and flowly fupplied by feeding machinery to its teeth, which take it up, and the cylinder, as it were, clothes itfelf with wool. This wool is carded or worked by the teeth of feveral other fmaller cylinders, called workers and clearers, which are fixed around the great cylinder in pairs. The teeth of the workers take the wool from the great cylinder, and give it to the clearers, which return it again to the great cylinder. It is then transferred to another worker, and by its clearer is given back to the great cylinder, and fo on. It is by the repeated transferring of the wool from one cylinder to another, that the chief action of fcribbling or carding is performed. The teeth of the different cylinders do not actually touch each other, but they work fo near together, that the fibres of the wool which the teeth of one card contains are caught by the teeth of the other card, and drawn out a very few at a time. This action tends to feparate the fibres, and renders the wool light and open, and alfo diftributes the wool with great evennefs over the furfaces of the cylinders. After the wool has paffed between three or four pairs of workers and clearers, it is taken up by a cylinder, called the doffer, which is fmaller than the great cylinder, and turns round very flowly. The wool is ftripped off from this doffer by a fteel comb, which is fituated parallel to the axis of the doffer, and is moved rapidly up and down by a crank through a fmall fpace. In afcending, the comb does not touch the doffer; but when the comb makes its down ftroke, it comes in contact with the teeth of the cards, and combs out almoft all the wool they contain. As the doffer turns round very flowly, and the comb acts at fmall intervals, the fucceffive portions of wool which it combs or ftrips off, hang together in a continued fleece or web of a very thin texture, which hangs down from the doffer, and is received in a bafket.

The wool in this ftate is faid to be fcribbled, but the fibres are not yet fufficiently combed out or feparated; for on examination of the fcribbled wool, many fmall knots and films of wool are found, which are ftill clofely entangled. The fcribbling is therefore repeated twice or three times, and then the wool undergoes another operation, which is called carding, but which is very nearly the fame as the fcribbling, only the wool is formed into fmall cylindrical rolls, which are the firft rudiments of a thread.

We have thought it needlefs to give a drawing of a fcribbling-machine, as it may be readily conceived from the following defcription of the carding machine.

Carding-Machine. (See *Plate* IV. *Woollen Manufacture.*)—A is the wood frame of the machine, but the beft machines have caft-iron frames; C C is the outfide of the large cylinder, which is about thirty inches diameter, and twenty-fix inches wide: its axis is fupported on bearings at each fide of the frame, and it is put in motion by an endlefs ftrap applied upon a pulley at one end of its axis, which pulley cannot be feen in the figure. The cylinder revolves about 100 times *per* minute. B is an arch of wood to receive fcrews, which fupport the fix fmall cylinders marked 2 *a* and 2; thefe are the workers and clearers. The workers 2 *a* are larger, and turn flower than the clearers 2; each worker is acted upon by its clearer, and both worker and clearer act againft the cards of the great cylinder.

The raw wool is fpread evenly upon the feeding-cloth 5, at one end of the machine: it is an endlefs fheet ftretched over two rollers, one of which has a cog-wheel G upon the end of its axis, and receives motion from a pinion fituated behind the pulley F. This pulley is turned by an endlefs cord paffing round a pulley *n*, fixed upon the cog-wheel E, which is turned by a pinion 8 on the end of the axis of the great cylinder. The wool which is fpread on the cloth 5 is taken off, between a pair of feeding-rollers, which are clothed with cards laid on in fpiral fillets. Thefe rollers cannot be feen, being within the frame; they are about $2\frac{1}{2}$ inches

inches diameter, and are turned round by toothed pinions on the axis of the cloth-roller, fo as to move rather quicker than the feeding-cloth. The feeding-rollers give the wool to a cylinder 4 *a*, called the carrier, which is about nine inches diameter. The carrier works againft the cylinder C; but as its furface moves more flowly than the furface of the cylinder, the wool contained in the teeth of the carrier is taken up by the cylinder. The carding-machine reprefented in our plate is fhewn with a cylinder 3, beneath the carrier; this is not ufed in the prefent machines, but the feeding-rollers give the wool at once to the carrier 4 *a*.

That part of the cylinder which is adjacent to the carrier moves upwards, fo as to carry up the wool it has taken from the carrier, and give it to the workers 2 *a* and clearers 2. The furfaces of the workers 2 *a* move in the fame direction as the furface of the great cylinder, but they turn flowly, being put in motion by the chain 9, which paffes over wheels at the ends of all the three workers. Thefe wheels have cogs or teeth to enter into the links of the chain, and prevent it from flipping; the chain paffes beneath a wheel fixed on the axis of the cog-wheel E, but withinfide the frame. The wheel E is turned by a pinion 8, fixed on the extremity of the axis of the great cylinder; and the proportions are fuch, that the workers 2 *a* revolve once to about four turns of the great cylinder, and the workers being about $6\frac{1}{2}$ inches diameter, whilft the cylinder is 30 inches diameter, the furface of the cylinder moves about $18\frac{1}{2}$ times as faft as the furfaces of the workers.

The fmall rollers 2, called clearers, are placed fo as to card the wool on the workers, and on the great cylinder alfo. The clearers are turned round very quickly, and take the wool from the workers, but their furfaces do not move fo faft as the furface of the cylinder. Thus the ftrap 13 paffes over a wheel of about $8\frac{1}{2}$ inches diameter, fixed on the extremity of the axis of each clearer; this ftrap is put in motion by a wheel of about 22 inches diameter, fixed on the axis of the great cylinder; therefore, the clearers turn about $2\frac{1}{2}$ times to one of the great cylinder; but as they are only $3\frac{1}{4}$ inches diameter, and the great cylinder is 30 inches diameter, the furface of the cylinder moves near $3\frac{1}{2}$ times as faft as that of the clearer. The carrier 4 *a* is turned by the fame ftrap 13; but being larger than the clearers, its furface moves much quicker, fo that the cylinder's furface moves only about once and a half as faft as the carrier's furface.

The ftrap 13 alfo turns a cylinder 2, at the right-hand end of the machine, called the fly: its furface moves the fame way as the furface of the cylinder, but moves nearly once and a half as faft; the pulley at the end of the fly being only $4\frac{1}{4}$ inches diameter, and the fly itfelf nine inches. The fly is not placed fo clofe to the cylinder as to take the wool away therefrom, but is intended to raife and loofen it in the cards of the cylinder, fo that the cylinder 4 beneath it, called the doffer, can take off the wool more readily. This doffer is 14 inches diameter, and is covered with feparate fheets of card-wire, each about 4 inches wide, leaving vacant fpaces between them parallel to the axis of the cylinder. The doffer moves round very flowly, its furface moving only $\frac{1}{31}$ of the velocity of the furface of the cylinder: it is turned by a band from a pulley on the axis of the roller D, which we fhall next defcribe.

The comb which works againft the furface of the doffer, and ftrips off the wool from it, cannot be feen in the drawing. The comb is fupported by two upright rods, fcrewed to it one at each end; the upper ends of thefe rods are guided by two horizontal levers, and the lower ends are jointed to two fmall cranks formed on an horizontal axis, which is fituated at the lower part of the frame near the ground, and put in rapid motion by a ftrap, from a pulley at the bottom of the frame beneath the great cylinder. This pulley has a fmaller one fixed on the extreme end of its axis, and receives its motion from the fame ftrap 13, which turns the clearers. Every revolution of the cranks caufes the comb to rife and fall about two inches; and when the comb defcends, the teeth on its edge act againft the cards, on the furface of the doffer 4, fo as to take out the wool from them. This wool is feparated in a continued fheet or film, becaufe the ftrokes of the comb fucceed each other very quickly, and the doffer turns round flowly; but owing to the vacant fpaces between the cards on the doffer, this film only continues for a width of about four inches, and is then difcontinued until the vacant fpace on the doffer has paffed by the comb, which then acts again to ftrip off the wool, and fo on: hence the wool is drawn off from the machine in a carded ftate, in fmall and very delicate films or webs of about 4 inches wide, and 27 or 28 inches long, which is the length of the doffer.

Thefe detached portions of wool are next rolled up fo as to form fmall cylindrical rolls, which is done by what is called the roller-bowl D: it is a cylinder of wood, with fhallow flutes upon its furface, parallel to its axis; it is turned round flowly by a pulley H on the end of its axis, and an endlefs band, 14, which paffes round a pulley I, fixed on the wheel E. The lower part of the roller-bowl, D, is inclofed within a hollow cylinder of wood, called the fhell; it encompaffes the lower half, being fixed beneath the revolving cylinder; the fhell is fluted within fide, but does not touch the bowl, leaving a fmall interval between the two. The portions of wool, as they are ftripped or combed off from the doffer, fall down over the edge of the fhell, which for that purpofe is fituated clofe to the doffer, at that part of its circumference where the comb works: by this means, the wool which is ftripped off falls down into the fpace between the fhell and the roller-bowl; and when the portion of wool is completely detached and drops off, the motion of the bowl within its fhell rolls the wool between them with a rolling motion, which forms the wool into a very round and ftraight cylindrical roll, called a carding, when thefe cardings drop out from between the roller-bowl and its fhell; they fall upon a flat table, *a a*, as fhewn at 7 7 7. This table is covered with an endlefs cloth, which is ftretched over two horizontal rollers; one of thefe rollers has a crofs, marked 16, 16, fixed on the end of its axis; the arms of the crofs are feized by a cranked lever, 15, which is fixed to the axis of the roller-bowl, and at every revolution the crofs 16 is turned round one-fourth: this moves the endlefs cloth forwards, and carries the cardings away in the manner fhewn at 7 7 7, as faft as they drop out from the fhell, and from this table they are carried away to the flubbing-machine, or billy.

In moft modern machines the latter movement is altered, the endlefs cloth being kept in a continual and flow motion by an endlefs band paffing round a fmall pulley fixed to the pulley H, and a larger pulley fixed in place of the crofs 16.

In fome old carding-engines many of the motions were performed by toothed wheels and pinions; but of late years all the parts are moved by bands or ftraps, which produce a much more equable and fteady movement. The large cylinders are generally made by placing two or more wheels of caft iron on one axle, the circumference of the wheels being cafed with wood, which is attached to them by fcrews or rivets. The fmaller rollers are formed in a fimilar manner on wooden difks, but all are made hollow, to avoid warping, which would render the action of the cards irregular and uncertain.

We

We muſt now return to the ſcribbling-machine: it is the ſame as the carding-machine, except that the breadth of the cylinder is greater, and the teeth are coarſer; there is no roller-bowl D, and the doffer 4 is completely covered with cards, without any breaks or intervals; hence the film of wool which is taken off is continuous, and is ſuffered to fall down into a baſket.

Double Scribblers.—In Yorkſhire it is common to employ double ſcribblers; that is, two of the machines combined together, and placed in one frame; there are two large cylinders, each ſurrounded with its workers and clearers, and doffer, as we have deſcribed, making in all ſeventeen ſmall cylinders. The firſt great cylinder has a feeding-cloth and carrier, to ſupply the wool to the cylinder; but the ſecond large cylinder is ſupplied with wool from the doffer of the firſt cylinder, which doffer ſerves in place of a carrier to the ſecond; it therefore has no comb. The doffer of the ſecond cylinder has a comb to take off the wool, which then falls into a baſket.

This machine is ſaid to ſave trouble of attendance, and does more work than two ſingle machines. The uſual practice is to paſs the wool once through the double machine, and then once through a ſingle machine. A double machine will ſcribble about a hundred weight of wool *per* day.

After the wool is ſcribbled it is weighed, and when it is taken to the carding-machine, a certain weight is ſpread over a certain length of the feeding-cloth, ſo as to ſupply the wool to the machine with perfect regularity. The proper weight which ſhould be allowed is aſcertained experimentally, according to the fineneſs of the thread which is required to be ſpun. The cardings are weighed from time to time, to aſcertain if each one contains the proper quantity of wool.

The cardings produced by the united operations of ſcribbling and carding are compoſed of fibres of wool laid very lightly together with the leaſt poſſible entanglement; they are very regular and even in ſize, and upon this circumſtance the perfection of the ſpinning chiefly depends.

Slubbing-Machine, or Billy.—This performs the firſt proceſs of ſpinning. It reduces the cardings, and draws them out in length; joins them together, and gives them a ſlight twiſt, in order to form a coarſe and looſe thread, called a ſlubbing or roving, which muſt be ſpun over again in the jenny, to make a thread fine enough for the loom.

This operation was formerly performed by hand on the common hand ſpinning-wheel, which is ſimilar to that uſed for ſpinning wool, but of a ſmaller ſize. Machines were then contrived by which a number of ſlubbings could be drawn out together; but the aid of the hands was required for joining the rolls or cardings of wool together in ſucceſſion, and for other purpoſes, which were found to take ſo much time, that very little, if any, ſaving of labour was effected by the uſe of ſuch machines.

A perſpective view of the ſlubbing-machine, now univerſally employed, is given in *Plate* I. *Woollen Manufacture.* A A is the wood frame of the machine; within this frame is a moveable carriage, D D, which runs upon the lower ſide-rails at *a a*, with wheels 1, 2, to make it move eaſily; and it is capable of running backwards and forwards in the frame from one end to the other. The carriage contains a number of perpendicular ſpindles, marked 3, 3, which are put in rapid motion by a long cylinder F, and a ſeparate band from each ſpindle, which paſſes round a ſmall pulley on the ſpindle. The cylinder F extends horizontally acroſs the whole breadth of the carriage; it is made of tin plate, hollow like a tube, and covered with paper on the outſide.

The ſpindles are placed in a frame, ſo as to ſtand nearly perpendicular, at about four inches from each other; their lower extremities are ſharp-pointed, and turn in ſockets, and they are retained in their perpendicular poſition by a ſmall collar of braſs for each, which ſurrounds the ſpindle at about the middle of its length. The upper half of each ſpindle projects above the frame, and on the lower part the ſmall pulley or whirl is fixed, to receive the band from the horizontal cylinder, which is about ſix inches in diameter, and a little longer than the row of ſpindles; it is placed before them with its centre at a lower poſition than the row of whirls. The cylinder receives motion by a pulley at one end, with an endleſs band from a wheel E, made like the large wheel uſed in ſpinning wool by hand, and of the ſame dimenſions. The wheel is ſituated at the outſide of the great frame of the machine, and its axis is ſupported by upright ſtandards erected from the carriage D; the wheel is turned by the left-hand of the ſpinner, applied to a winch, which is plainly ſeen in the drawing, and gives motion to the cylinder F, which again turns all the ſpindles at once with a great velocity.

Each ſpindle receives a thread, or ſlubbing, which threads iſſue from beneath a roller, C C, at one end of the frame, and proceed to the row of ſpindles placed in the carriage, ſo that the ſlubbings are extended nearly in an horizontal direction. The ſpindles, by the motion of the carriage, are capable of advancing or retreating from the roller C, ſo as to extend any required length of ſlubbing.

The cardings of wool, which are to be ſpun into ſlubbings, are extended ſide by ſide upon an endleſs cloth, which is ſtrained in an inclined poſition between two horizontal rollers, one marked B B, and the other cannot be ſeen. There is one carding for each ſpindle, and the number is uſually from 50 to 80. C is a light wooden roller to bear upon the cardings which lie upon the cloth, and preſs ſlightly upon them by its weight. Immediately before this roller is a wooden rail G, and another beneath it, which is fixed horizontally acroſs the frame: the cardings are conducted between theſe two rails, the upper of which is capable of riſing; but when it falls by its weight, it holds the cardings faſt between the two, and hence theſe rails are called the claſp; the upper moveable rail G of the claſp is guided between ſliders, and a wire 7 deſcends from it to a lever 6. When the carriage D is wheeled cloſe home to the end of the machine, a wheel 5 lifts up the end 6 of the lever; and this, by the wire 7, raiſes the upper rail G ſo as to open the claſp, and releaſe all the cardings: in this ſtate, if the carriage is wheeled or withdrawn back from the claſp, it will draw the cardings forward. There is a ſmall catch which receives the upper rail G of the claſp, and bears it up from falling until the carriage has retreated a certain diſtance, and drawn out about eight inches length of the cardings; a ſtop on the carriage then comes againſt the catch and withdraws it; the upper rail of the claſp G then falls and holds the cardings faſt, whilſt the carriage continues to recede, and draw out or ſtretch that portion of each carding which is between the claſp and the ſpindle. All this time the wheel is turned to keep the ſpindles in motion, and give twiſt to the cardings in proportion as they are drawn out, by which means it is prevented from breaking; becauſe as the carding diminiſhes in ſize, and increaſes in length, the increaſing twiſt combines the fibres of the wool, ſo as to give ſtrength to the coarſe thread or ſlubbing which is thus produced.

The ſlubbing is lapped round the ſpindle, but the claſp being higher than the upper ends of the ſpindles, the direction of the ſlubbing is not quite at right angles to the ſpindle; hence the ſpindle, when it is turned round, will give twiſt to the ſlubbing, without winding or gathering it up up upon the ſpindle, becauſe the ſlubbing always ſlips over the top-end of the ſpindle; but when a portion of each ſlubbing is finiſhed, and it is required to wind it up round the ſpindle in a ball, the ſlubbing muſt be preſſed down by a wire 8, ſo as to bear it from the point of the ſpindle, and place it oppoſite to the middle part of the cop or ball upon the ſpindle, and then the motion of the ſpindle will cauſe it to wind up upon the ſpindle, and form a ball.

The wire 8 is made to operate upon the whole row of ſlubbings at once, and for this purpoſe a horizontal rail 4 is placed in the front of the row of ſpindles, being provided with pivots at its extreme ends, on which it is ſupported in ſtandards riſing from the carriage D. It has a ſmall arm or lever projecting from it at each end, and the wire 8 is ſtretched between theſe arms. By turning the rail 4 round upon its pivots, the wire is capable of being raiſed up, as in the figure, or lowered down at pleaſure: when the wire is lowered, it deſcends below the level of the top of the ſpindles, ſo as to bear down the threads which, when the wire is raiſed up, as ſhewn in the figure, proceed from the points of the ſpindles.

The ſpinner holds the rail 4 in his right-hand, and it is by this that he draws the carriage either in or out, according as it may require; and by turning the rail 4 round, he can elevate or depreſs the wire 8, ſo as to make it bear down the ſlubbings to any degree at pleaſure; by this means, he diſtributes the ſlubbings upon the ſpindles in a proper manner, to form a regular ball or cop, as ſhewn in the figure.

As the cardings are very ſlight and tender, they would be liable to break if they were dragged forwards on the inclined cloth, or even if the cloth were to be moved round its roller by the force applied to the cardings. To avoid this, a cord is applied round a groove in the middle part of the upper roller, and after paſſing over proper pulleys, as ſhewn in the drawing, it has a weight ſuſpended to one end, and a ſmaller weight to the other; the ſmall weight is only to keep the rope tight, but the large weight tends to turn the rollers and endleſs cloth round in a direction to deliver out the cardings, ſo that there will be no ſtrain on them. Every time that the carriage is wheeled home, the large weight is wound up by means of a piece of wood projecting from the carriage, which ſeizes a knot in the cord at the part which lies horizontally; this puſhes the cord back a certain diſtance, ſo as to draw up the great weight; but the endleſs cloth cannot turn backwards, becauſe there is a ratchet and click at one end of the roller which prevents it; the rope, therefore, ſlips round upon the roller. When the carriage retires, the great weight turns the roller and endleſs cloth round, ſo as to deliver out the cardings at the ſame rate as the carriage retreats and takes them up; but when the proper quantity is given out, the knot in the rope arrives at a fixed ſtop, which does not permit it to move any farther; and at the ſame inſtant the roller 5 quits the lever 6, and allows the upper rail G of the claſp to fall, and hold the carding faſt from being drawn out any farther; the wheel E is then put in motion to turn the ſpindles round, and the carriage is drawn back, which extends the ſlubbings, and twiſts them at the ſame time, as before mentioned.

When the carriage is drawn out to its full extent, and the neceſſary twiſt is given, the wire 8 is put down to bear down the ſlubbing from the point of the ſpindle, and the motion of the wheel being continued, the ſlubbings are wound up upon the middle part of the cop or ball which is formed upon the ſpindle; but as faſt as the ſlubbings are wound up, the ſpinner muſt puſh back the carriage towards the claſp; and he muſt turn the wheel round at ſuch a rate that the ſpindles will not wind up any faſter than the carriage returns, otherwiſe the ſlubbings would be broken or unequally ſtretched; he muſt alſo raiſe and lower the wire 8 continually, by turning the rail 4 round in his hand, in order to diſtribute the ſlubbing on the cop in a regular manner, ſo as to make a firm ball or cop.

A child attends the machine to bring the cardings from the carding-machine, and place them upon the inclined cloth; and when they are exhauſted, freſh ones are joined on, ſo as to keep the machine conſtantly ſupplied.

The degree of twiſt which is given to the ſlubbing is regulated by the diſcretion of the ſpinner in turning the wheel at a proper rate, correſponding to the quickneſs with which he draws out the carriage. Slubbings which are intended to be ſpun into yarn for the warp of the cloth require to be more twiſted than the ſlubbings intended for the weft; but the proper quantity of twiſt depends on the fineneſs of the wool, and the length of its fibres. In general it may be ſtated, that no more twiſt is given to the ſlubbings than is neceſſary to make them draw out to the required extent without breaking. This twiſt is of no uſe to the yarn, becauſe the ſlubbing will be twiſted in the contrary direction, when it is ſpun the ſecond time in the jenny.

An improved ſlubbing-machine has been introduced, which is put in motion by the mill, and the carriage is made to draw out by the power of the machine. The ſpinner has only to puſh the carriage in, and turn the handle, in order to wind up the ſlubbings; by this means, a greater degree of regularity is attained in the quantity of twiſt which is given to the ſlubbings when they are drawn out. The movements to effect this are taken from the mule uſed in cotton-ſpinning. See *Manufacture of* COTTON.

Spinning Jenny.—In this machine, the ſlubbings are ſpun over again, and reduced to the requiſite fineneſs for weaving. The jenny has nearly the ſame parts as the billy, but differently arranged. The ſpindles are placed at one end of the frame, and the claſp which holds the ſlubbings is placed on the carriage, ſo that it can be moved backwards and forwards, to and from the ſpindles by the ſpinner, in order to draw out and extend the yarn at the ſame time it is twiſted.

A perſpective view of the jenny is given in *Plate* II. *Woollen Manufacture.*

The ſpindles 3, 3, 3, are placed perpendicularly at about four inches aſunder at one end of the frame A A of the machine. The lower extremities of the ſpindles are pointed, and turn in ſmall cups or ſockets in a croſs-rail of the frame; they are ſupported near the middle of their length by paſſing through braſs-collars in a horizontal rail. Near the lower end of each ſpindle a ſmall pulley is fixed, to receive an endleſs band, which paſſes round the horizontal cylinder or roller 2, about ſix inches diameter. The cylinder is ſupported on pivots at its ends in the ſides of the frame, and lying in a direction parallel to the row of ſpindles, it turns them all round by a ſmall band for each. This cylinder is uſually made of tin-plate, that it may not alter its figure by the weather, as wood would do; and its ſurface is covered with coarſe brown paper, to prevent the bands from ſlipping upon it. The cylinder 2 is put in motion by a ſtrap or band 1, 1, which paſſes round a pulley at the end of it, and alſo round the great wheel B B, which is ſupported in a framing ſuſpended over the machine from the ceiling, but which is not ſhewn in the drawing. The wheel B is turned by applying the right-hand to the winch B. In front of the row of ſpindles, and about a foot higher than their points, a long croſs-rail 16 is ſituated horizontally: it is ſupported at each extremity by being mortiſed into blocks of wood *c c*, which are furniſhed with

with ſmall wheels or caſtors, forming a ſort of carriage, to run horizontally upon the ſide-beams of the main-frame in grooves, which guide them, ſo that the rail 16 can be moved backwards and forwards through a ſpace of about ſix or ſeven feet, in a horizontal poſition, without varying from its parallelism with the row of ſpindles. The underſide of the rail 16 is formed into a number of narrow notches for the ſlubbings to paſs through; and theſe notches are partly filled up by projecting pieces, riſing up from a ſecond croſs-rail 5, 5, ſo as to form the claſp which confines or pinches the ſlubbings in the notches when the lower rail is raiſed up; but the ſlubbings can draw freely through the notches when the lower rail is let down. This lower rail is guided and limited to move up and down only a ſmall ſpace by ſtaples, which project downwards from the rail 16, and receive the ends of the lower rail 5 of the claſp. The riſing and falling of the lower rail is effected by ſmall cords faſtened to it at about every yard of its length; theſe cords are conducted over ſmall pulleys (concealed in the ſubſtance of the upper rail 16), and are all attached to a handle, ſituated over the middle of the upper rail at 16, and beneath an arched bar, which is fixed on the top of the claſp. The ſpinner holds this handle in the left-hand, whilſt the right is employed in turning the wheel; and by the fingers of the left-hand ſhe can raiſe up the lower rail 5 of the claſp, and draw it cloſe to the upper one. It will then be retained in that poſition by a ſmall ſpring-catch, and will claſp the ſlubbings faſt in the notches, through which they paſs; but when the ſpring-catch is puſhed back, ſo as to relieve the handle, the lower rail will fall down by its own weight, and releaſe the ſlubbings, to allow them to ſlide through the notches.

The cops of ſlubbings which are to be ſpun are ſupported in an inclined frame 4, 4, faſtened within the main frame of the machine. The cops are mounted upon iron wires; they are placed in two rows, one above the other, as ſhewn in the drawing; but each row ſhould only contain half as many cops as there are ſpindles.

Each ſlubbing is conducted through a notch in the claſp, and thence it proceeds nearly in an horizontal poſition to the ſpindles 3, 3.

When the yarns have been drawn out and twiſted they are wound up on the ſpindles in balls, in a ſimilar manner to the billy. The wire which is uſed for bearing down the thread from the points of the ſpindles is marked 12; it is attached to a horizontal rail, which is ſupported on pivots at its ends, cloſe to the row of ſpindles. There is a ſmall pulley 11, fixed at one end of the rail, and a ſhort lever at the other, which lever is hidden in the drawing by a part of the framing. Between the pulley 11 and the lever, the wire 12 is extended, and by turning the rail round upon its pivots, the wire will have a motion up or down.

The ſpinner can communicate motion to the pulley 11 by means of a cord 7, 7, which paſſes round it, and extends the whole length of the frame, the end being made faſt to a pin at A; this cord lies over the ſurface of one of the blocks *c*, which contains the wheels of the carriage, and paſſes between three ſmall pulleys 9, 6, and 8. The centre pins of the pulleys 9 and 8 are fixed to the block; but the centre pin of the pulley 6 is fixed to a ſmall ſlider, and can be drawn in the direction of the rail 16, by applying the finger to a ſmall trigger near the handle 16. This action removes the pulley 6 out of the line of the other two pulleys, ſo as to ſhorten the cord 7, and turn round the pulley 11; this brings down the wire 12, and bears down the threads upon the ſpindles. A ſmall counterweight is ſuſpended from the wheel 11, to return the wire to its former poſition when the preſſure of the finger on the trigger is removed. By this movement, the ſpinner has full command of the wire 12, to raiſe or lower it in any degree ſhe thinks proper; and this is done independently of the motion of the carriage, becauſe the pulleys 9, 6, and 8, run freely along the cord 7, and their motion has no tendency to move the wheel 11 either way.

The jenny is worked by one perſon, who ſtands within the frame, and turns the wheel B with the right-hand, whilſt he holds the claſp in the left, ſo as to run it backwards and forwards along the frame at pleaſure. The ſlubbings are drawn between the moveable rails 16 and 5, in the notches of the claſp, and each ſlubbing is faſtened on to its correſponding ſpindle. The claſp being left open is drawn backwards from the ſpindles, and the ſlubbings run freely through the notches of the claſp; the ſlubbings are drawn off the balls at 4, when the claſp retires from the ſpindles, until a certain length of each ſlubbing is drawn out and extended nearly in an horizontal poſition between the ſpindles and the claſp: this length is regulated by a mark made on the frame of the machine, to indicate when the claſp has arrived at its proper poſition. The bars of the claſp are then brought together by raiſing up the handle under the catch, as before deſcribed, and it faſtens all the ſlubbings in the notches. This being done, the ſpindles are put in rapid motion by turning round the large wheel B B; they twiſt thoſe parts of the ſlubbings which are extended, and the motion being in a contrary direction to the twiſt of the ſlubbing, the firſt tendency is to untwiſt the ſlubbing, at the ſame time that the carriage and claſp are gently drawn back, or from the ſpindles. By this means, the ſlubbings are ſtretched or drawn out in length at the ſame time that they get a new twiſt in the oppoſite direction; this keeps them from breaking, and when they are drawn to their intended extent by the carriage being moved back to the ſtops at the extremity of the main frame, the great wheel is turned round as many turns as is neceſſary to give them all the twiſt which thoſe portions of thread are intended to have.

The threads extended between the claſp and the ſpindles are now finiſhed, and it only remains to wind them up upon the ſpindles, previouſly to drawing out a freſh portion of each ſlubbing, in order to ſpin it in the ſame manner. To wind up the threads, they are puſhed down upon their reſpective ſpindles, by preſſing the trigger which moves the wire 12; and the motion of the great wheel B is continued, in order to wind up the ſlubbings in balls upon the ſpindles, at the ſame time that the carriage and claſp are puſhed back towards the ſpindles. When the carriage is got home, the thread is finiſhed and wound up, and a freſh portion of ſlubbing is extended. To do this, the lower rail of the claſp is dropped down, and it releaſes the ſlubbings; the carriage is then drawn back to the mark upon the frame, as before deſcribed, which ſhews that a proper length of each ſlubbing is drawn off from the balls, and extended between the ſpindles and the claſp. The claſp is then cloſed, and the wheel B put in motion to twiſt the threads whilſt the carriage is drawn out; thus the ſpinning operation is repeated as before, and prepares another length of each of the threads. When finiſhed, they are puſhed down from the points of the ſpindles, in order to make them wind up thereon in the balls, as before.

There is ſome diſcretion required in ſpinning with the jenny, to draw out the carriage with a movement correſpondent to the rapidity with which the ſpindles give the twiſt, or rather untwiſt, to the ſlubbing; for the principal extenſion of the thread is effected whilſt the ſlubbing is untwiſting, and whilſt the firſt portion of twiſt is given to the threads. Theſe motions muſt be properly proportioned by the

the ſpinner, who muſt alſo be careful to give an equal degree of twiſt to each ſucceſſive portion of thread which is ſpun, otherwiſe the thread will conſiſt of hard and ſoft places.

When the yarn is intended for the warp of the cloth, the ſpindles are turned for a given time after the thread is extended to its full length, as we have before mentioned; but for the yarn which is to be uſed as weft, it is different: the whole of the twiſt is given during the extenſion of the thread, and none afterwards; this difference is to render the weft ſofter than the warp, becauſe in the cloth the weft appears more on the ſurfaces than the warp, and it is principally the felting and interlacing of the fibres of the weft that will form the ſurface of the cloth when finiſhed.

The yarns are uſually extended in the jenny two and a half or three times the length of the ſlubbings from which they are ſpun; and that degree of twiſt given to them which is ſuitable to the purpoſe for which the yarn is to be employed.

The *Mule for ſpinning of Yarn* is very nearly the ſame machine as the mule for ſpinning cotton; this is uſed for ſpinning ſome kinds of woollen yarn inſtead of the jenny. When the mule is employed for ſpinning yarn for weft, it is uſed in the ſame manner as deſcribed in our article Cotton *Manufacture*; but for ſpinning warp, the ſpindles are made to revolve, and twiſt the thread ſome time after the carriage is run completely out, and the ſtretching of the yarn is finiſhed. There is a movement in the machine that ſhifts the endleſs ſtrap which turns the mule upon a larger pulley, as ſoon as the carriage is run fully out, ſo as to give a more rapid motion to the ſpindles after the ſtretching, or drawing out, is finiſhed, than they had during the drawing back of the carriage. By this means ſome time is ſaved, becauſe the ſpindles may be allowed to run very quick when it is only required to twiſt the threads; but whilſt the extenſion is going on, the twiſting motion muſt be moderate, or the threads would be broken. A very ſimilar movement is uſed in the mule for ſpinning cotton, and is called the double-ſpeed; but the deſcription of this mechaniſm is omitted in the article Manufacture.

The mule has not, till lately, been in much repute for ſpinning woollen yarn, and the jenny is ſtill thought to ſpin better yarn: but we have no doubt that when certain modifications are made, it will become a much more perfect method than the jenny, being much leſs dependent on the diſcretion and dexterity of the ſpinner; for if the machine is once conſtructed ſo as to ſpin properly, it will always continue to do ſo.

To keep the yarn to the ſize which is intended, a few of the coppins are reeled off, in order to meaſure out a certain length of the yarn, which is weighed; and if it does not prove of the weight expected, the quantity of wool which is ſpread over a given ſurface of the feeding-cloth of the carding-machine muſt be increaſed or diminiſhed accordingly; and when the right quantity is formed, the lead weights which are uſed for weighing the given quantity of wool are altered to ſuit it. The draft of the jenny may alſo be altered to effect the ſame thing.

The ſpinning proceſſes are now finiſhed, and it remains to weave the yarns into cloth. From the deſcription we have given, it will appear that woollen yarn is ſpun in a very different manner from cotton. The opening proceſſes and the ſcribbling and carding are very ſimilar, except that the carded wool, inſtead of being drawn into a continued ſliver like cotton, with the fibres ſtretched the lengthways of the ſliver, is formed into ſeparate rolls, with the fibres diſpoſed croſſwiſe or ſpirally round the roll.

By the ſlubbing-machine theſe are joined together, drawn out in length, and ſlightly twiſted, by operations ſimilar to that of roving in cotton-ſpinning; but the operation of drawing, which is ſo frequently repeated for cotton, would be uſeleſs, and to a certain extent even prejudicial for wool. The object of that proceſs is to elongate and ſtretch the fibres of the cotton ſtraight, and lay them parallel to each other; but it does not reduce the ſliver to a ſmaller ſize, becauſe as many times as the ſliver is extended in length, ſo many ſlivers are put together into the drawing-frame at once, leaving the ſliver which has been drawn the ſame ſize as it was before, but elongated to three or four times the length, and all its fibres fully extended.

As woollen cloth is intended for felting, it is not deſirable to ſtraighten the fibres, but only to diſentangle all knots, and unfold any fibres which may be doubled, alſo to lay the fibres in the direction of the length of the thread. There is a natural curl in the fibres of wool which ſhould be preſerved, and will contribute to the firmneſs with which the fibres will entangle in the felting.

The operation of ſpinning by the jenny and billy are very ſimilar, but both differ from the manner in which the extenſion is made in the cotton ſpinning-machines by rollers. In the jenny, the extenſion is made upon a conſiderable length of the carding or ſlubbing at once; but in the rollers, the length of cotton which is ſubmitted to the action of drawing out is very ſhort, indeed very little longer than the length of the fibres of the cotton. In mule ſpinning both modes of extenſion are practiſed; firſt, drawing the roving by rollers, and then a certain length is ſtretched out to a greater extent.

Warping.—The coppins of yarn are mounted on wires in a frame, and the yarns are drawn off from them, in order to combine a ſufficient number of them together, to form the warp for the web of cloth which it is intended to weave. For inſtance, for making the cloth called double drab, which we ſhall take as an example, 2960 threads, each 65 yards long, are laid parallel to each other; but a ſeparation is preſerved at every 40 threads, dividing the whole into 74 parcels, for the convenience of the weaver.

The warping is performed by the warping-mill, which is a large reel, with its axis horizontal; the ends of the threads are made faſt to the reel, which is turned round, and it draws the threads off the coppins, ſo as to wind them upon its circumference; and to prevent the different turns of the threads from lying one over another, the threads are guided through an eye or ring affixed to a ſlider, which is moved along a wooden rail, in a direction parallel to the axis of the reel, by a cord that winds round one end of the axis of the reel.

A warping-mill for ſilks is deſcribed in our article Silk, and will give a clear idea of the preſent, which only differs in the horizontal poſition of the axis, and in the greatneſs of its dimenſions. The threads for the warp being thus aſſembled together, are taken off the reel, and rolled up into a bundle.

The warp is then ſcoured in urine, to remove the greaſineſs of the wool, and is next ſized; to do this, it is dipped into the cauldron of ſize, about ten yards in length at a time, and well worked in by the hands. After ſizing, the yarns are ſtretched out at length in a field, till they are dry, and the warp is then ready for the loom.

The yarn for the weft is wound off from the cops of the jenny to the quills or ſmall bobbins, which are to be put into the ſhuttle.

The loom for weaving broad-cloth has the ſame parts as the ſimple loom deſcribed in our article Weaving; but it is made very ſtrong, to enable it to reſiſt the ſtrain of weaving fuch broad and heavy cloth. The fly-fhuttle, invented by John Kay in 1737, is now in general ufe; it enables one weaver to do the work, which formerly employed two men at oppofite fides of the piece, to throw the fhuttle from one to the other, the width being greater than a man can reach. The warp is wound on the yarn-beam, which is placed in the loom, and the threads being drawn through the heddles and the reed, and faftened to the cloth-beam, the loom is ready for working, in the ufual manner of weaving plain cloth. At each edge of the warp a few threads of ftrong and coarfe yarn are placed; thefe form what are called the lifts when the cloth is woven, and ferve to give ftrength to the cloth, and receive the hooks by which the piece is ftretched in the tenters after milling.

The width of the cloth is meafured between the lifts and the number of yarns, which we have fpecified will make 100 inches in width for the double drab-cloth, or for common cloth 3000 threads will make a piece $103\frac{1}{2}$ inches wide. The quantity of weft ufed for thefe cloths is upon an average one pound weight to a yard in length. The length of the warp contracts a little in the weaving, fo that the fixty-five yards of yarns will make only fixty-two yards of cloth.

Scouring.—The piece of cloth muft be cleanfed from the greafinefs of the oil before it can be felted; for this purpofe, it is firft foaked three hours in a mixture of urine and pig's dung, it is then fcoured in the mill for two hours, and laftly, for half an hour with fair water. The fcouring is performed at the fulling-mill by a pair of ftocks. (See FULLING-*Mill.*) The pair of ftocks are two large wooden hammers, fufpended with the helves or handles in an inclined pofition, and the heads are lifted in fucceffion by cogs or tappets, fixed on the axis of a water-wheel. When the cogs quit the hammers, they fall by their own weight, and ftrike the piece of cloth, which is contained in a wooden ciftern or trough, in which the hammers work. The action of the hammers is to beat and comprefs the folds of cloth, and to turn the piece continually round in the trough or ciftern in which it is placed. The form of the trough is fuch, that the weight of the piece of cloth caufes it to occupy the lower part of the trough, and each hammer when it defcends drives the cloth out from this loweft part, and forces it up a curved fweep. When the hammer is lifted up, the cloth falls again into the fpace which it before occupied, and at the fubfequent defcent of the hammer it is again driven out; the heap of cloth is of a confiderable bulk, and this action of the hammers is chiefly on the lower part of the heap; the beaks of the hammers ftrike nearly horizontally under it, as it were to undermine the heap, fo that the top part falls over when the hammers retreat. This action caufes a continual circulation or turning round of the piece of cloth within the trough, and effects the fcouring, by continually bending and folding the cloth in a frefh direction; and as the ftrokes act upon a great number of folds at once, the different furfaces of the cloth are caufed to rub againft each other, with a very fimilar action to wafhing cloth by hand.

When the fcouring is finifhed, the piece of cloth is taken out, and extended in a vertical plane, in a frame called the tenter, where it remains till dry.

The *tenter* confifts of a number of vertical pofts fixed in the ground with a continued horizontal rail, which is fixed on the top of them, and is as long as the piece of cloth; there is alfo another line of horizontal rails, which are fitted between the upright pofts, fo as to flide freely up and down; and they can be fixed at any diftance beneath the upper rails by means of pins in the pofts, according to the width of the piece of cloth. Both the upper and lower horizontal rails are driven full of tenter-hooks, which are fmall iron rails fharpened at both ends, and bent at right angles, like an L; on thefe hooks the lifts of the cloth are faftened, and the lower or moveable rails are fixed at the proper diftance beneath the upper rails, in order to extend the cloth to its full width.

Burling.—The cloth being dried is burled, that is, examined minutely in every part, and all knots and uneven threads or ftraws, or extraneous matters, removed; any rents or defects which can be found are repaired, by introducing frefh threads. This being done before the milling or felting, the fibres of the new threads will become fo entangled as to render fuch defects nearly imperceptible in the finifhed cloth.

Fulling-Mill for felting the Cloth.—There is another kind of ftocks in a fulling-mill; but the fhape of the trough in which the ftocks or hammers work on the cloth is different from that defcribed in the article FULLING-*Mill*, which is only proper for fcouring. In order to fubject the cloth to the blows of the hammers, the trough for milling is formed in fuch a manner that the cloth cannot efcape from them, becaufe that part of the trough which is oppofed to the beaks of the hammers is nearly a flat furface, and perpendicular to the direction in which the hammers ftrike, fo that the cloth is actually beaten between the beaks of the hammers and the flat bottom or rather fide of the trough.

The hammers are made to ftrike very heavy blows; but they do not bruife or injure the cloth, becaufe there is always a great number of folds of cloth on which they ftrike. The helves or handles of the hammers are placed in a different pofition from the fcouring-ftocks, in order to make the hammer-heads fall in a more perpendicular direction when they make their ftroke, and hence they ftrike with more force. On this account they are called falling-ftocks, whilft thofe ufed for fcouring are called hanging-ftocks, in which the helves of the hammers being nearer to the perpendicular, the heads move in a more horizontal direction, in the manner of a pendulum, and exert lefs force on the cloth; the other difference is, that the hammers of the fcouring-ftocks only drive the heap of cloth round in the trough, there being no part directly oppofed to the beaks of the hammers but a fair curve, which is fo much inclined to the direction in which the hammers move, that the cloth mounts up the inclined curve when the hammer ftrikes, and evades the direct force of the blow.

There is another kind of fulling-ftocks, in which the trough and hammer are conftructed with a view to mill or felt the cloth; but the hammers are put in motion in a different manner: thus the helves are fufpended in a vertical pofition, like pendulums, and the force of the cogs on the horizontal fhaft, which is turned by the water-wheel, is applied to drive the hammers forwards againft the cloth, and produce the felting. To return or draw back the hammers, a chain is attached to each, and thefe chains are linked to the oppofite ends of an horizontal lever, like a fcale-beam, which is fixed in front of the ftocks. This lever and chains draw back one hammer when the other is pufhed forwards; and as the hammers are actuated alternately by the cogs, a conftant action is kept up.

The moft fimple fulling-mill by a water-wheel has no other wheels, but the tappets or cogs which lift the hammers are fixed immediately into the axis of the water-wheel, and it ufually gives motion to two pair, one at each fide of the wheel. It rarely happens that this conftruction of a mill allows the water to be ufed to the greateft advantage, becaufe the circumference of a water-wheel fhould not move with a greater velocity than between 180 and 240 feet *per* minute;

minute; and the hammers of a fulling-mill ſhould be ſo timed, that each one will make from about 30 to 36 blows *per* minute. This requires that the cogs for the hammers ſhould be numerous, and fixed in the circumference of a large wheel fixed on the axis of the water-wheel, otherwiſe the water-wheel muſt be made to turn ſo quickly as to loſe a great part of its force. A better way is to apply a cog-wheel on the axis of the water-wheel to turn a pinion on the horizontal ſhaft, which carries the cogs for the hammers, and this horizontal ſhaft may have a fly-wheel upon it, to regulate the motion and render it uniform.

Mr. Smeaton's proportions for a fulling-mill for two pair of ſtocks were as follows:—The water-wheel, 14 feet diameter, 7 feet broad; it was a breaſt-wheel, and the fall of the water was five feet from the ſurface of the mill-pond to the tail-water below. The ſpur-wheel on the axis of the water-wheel 72 cogs, and 9½ feet diameter; the lantern turned by it 23 rounds. Upon the ſame ſhaft as this lantern was a fly-wheel of eight feet diameter, with a rim of caſt-iron ſeven inches ſquare, and alſo the two cogs or tappets for each of the four hammers forming two pair of ſtocks. The ſame mill was adapted to be turned by the power of horſes in dry ſeaſons; for this purpoſe, another lantern of 13 teeth was applied on the other end of the ſame horizontal axis, which could be occaſionally turned by a horizontal cog-wheel of 90 teeth and 12 feet diameter, fixed on the vertical ſhaft, which the horſes turned. The levers by which the horſes drew were 15 feet long, ſo that the horſes' track was 30 feet diameter.

It required four horſes to work one pair of ſtocks in this mill, and when Mr. Smeaton tried the expenditure of water at this mill, and alſo at another mill with an overſhot-wheel, he found it required from 1200 to 1400 cubic feet of water *per* minute, falling one foot, to work a pair of ſtocks. Taking the force of a horſe at 352 cubic feet *per* minute raiſed one foot, this is very nearly equal to four horſes. Theſe ſtocks were uſed for fulling of bays, and we apprehend the power for working the fulling-mills for broad-cloth is greater.

Proceſs of Milling.—A piece of cloth of ſixty-two yards long has ſix pounds of ſoap allowed for it, which is diſſolved in water, and a handful ſpread upon every yard in length; the piece is then put into the trough of the mill, and worked for three hours; during this time the cloth is frequently moved in the trough, to expoſe freſh ſurfaces to the action of the hammers. The blows upon the cloth cauſe a motion of the fibres of the wool amongſt one another, and the ſoap facilitates this motion; the fibres of the wool have the ſingular property of moving always forwards in the direction of the roots of the hairs, when a number of hairs are rubbed or worked together, but they will not retreat in the oppoſite direction; this produces the matting or entangling of all the fibres together. After three hours milling, the piece of cloth is taken out of the trough, and ſoaped again, then returned and milled again for three hours. This is repeated four times, making twelve hours milling in the whole, and then a ſtream of fair water is admitted into the trough, to waſh away the ſoap. The piece of cloth, when taken out of the mill the laſt time, is generally found reduced to about 60 inches broad, and 40 yards in length; before the operation, it was 100 inches broad, and 62 yards in length.

The operation of felting is ſo well explained by M. Monge, in the Annales de Chimie, that we think proper to give an extract from his memoir, in addition to what is ſtated in our articles Felting, Fulling, and Wool.

If we examine a human hair, a fibre of wool, or the hair of a rabbit, hare, beaver, &c. in a microſcope of the greateſt magnifying power, the ſurface of each hair appears ſmooth and even; or at leaſt if any inequalities are perceptible, they ſeem rather to ariſe from ſome difference in the colour and tranſparency of particular parts of the fibres than from the irregularity of their ſurfaces; for their images, when viewed by a ſolar microſcope, are terminated by even lines, without any roughneſs. Neverthcleſs it is probable the ſurfaces of theſe objects are formed either of *laminæ*, which cover each other from the root to the point, much in the ſame manner as the ſcales of a fiſh cover the animal from the head to the tail; or ſtill more probably of zones placed one over the other, like what is obſerved in the ſtructure of horns; to this conformation it is, that ſuch ſubſtances owe their diſpoſition to what is called felting.

If with one hand we take hold of a hair by the roots, and draw it between two fingers of the other from the root towards the point, we are hardly ſenſible of any friction or reſiſtance, nor can we diſtinguiſh any ſound; but if, on the contrary, we draw it between the fingers from the point towards the root, we are ſenſible of a reſiſtance which did not exiſt in the former caſe. A ſort of tremulous motion is alſo produced, which is not only perceptible to the touch, but may alſo be diſtinguiſhed by the ear.

It is evident, therefore, that the texture of the ſurface of a hair is not the ſame from the root towards the point, as from the point towards the root. As this texture is the principal object of the preſent memoir, it is neceſſary to demonſtrate it by ſome other obſervations.

If a hair is held between the fore-finger and thumb, and rubbed by them backwards and forwards alternately in the direction of its length, a progreſſive motion of the hair will take place; but this motion is always with the root forwards, although the rubbing of the finger and thumb is alternately in both directions. This effect does not at all depend on the nature of the ſkin of the fingers, or its texture; for if the hair be turned, ſo that the point is placed where the root was, the movement then becomes contrary, *viz.* its motion is always directed towards the root.

What is obſerved in the above inſtance is entirely analogous to what happens when country children, by way of ſport, introduce an ear of rye between the wriſt and the ſhirt-ſleeve; the points of the beards of the ear are directed outwards, and by the various motions of the arm, this ear, ſometimes catching againſt the ſhirt, ſometimes againſt the ſkin, takes a progreſſive motion backwards, but the beards always reſiſt its return, ſo that it ſoon gets up to the arm-pit. It is very clear, that this effect is produced by the aſperities upon theſe beards, which being all directed towards the point, do not permit the ear to move in any other direction than towards that part which was united to the ſtalk. There can be no doubt that it is the ſame with reſpect to hair, and that its ſurface is beſet with aſperities, which being laid one upon the other and turned towards the point reſiſt all motion, except towards the root.

Theſe obſervations, which it would be uſeleſs to multiply, relate to long hair, which have been taken as examples; but they apply with equal propriety to wool, furs, and in general to every kind of animal hair. The ſurface of all theſe is, therefore, to be conſidered as compoſed of hard *lamellæ* placed one upon another, like tiles, from the root to the point; which *lamellæ* allow the progreſſive motion of the hair towards the root, but prevent a ſimilar motion towards the point.

From what has been ſaid, it will be eaſy to explain why the contact of woollen ſtuffs is rough to the ſkin, while that of cotton or linen cloths is ſmooth: the reaſon is, that notwithſtanding the flexibility of each particular fibre, the aſperities

perities upon the furface of the fibres of the wool, by fixing themfelves in the fkin, produce a difagreeable fenfation, at leaft till we are accuftomed to it; whereas the furface of the fibres of hemp or flax, of which linen is made, being perfectly fmooth, do not caufe any fuch fenfation. It is alfo probable, that the injury arifing to wounds or fores from the application of wool does not proceed fo much from any chemical properties, but is occafioned folely by the form of the furface of the fibres, the afperities of which attach themfelves to the raw and expofed flefh, which they ftimulate and irritate to fuch a degree as to produce inflammation.

The afperities with which the furface of wool is every where furrounded, and the difpofition which it has to affume a progreffive motion towards the root, renders the fpinning of wool and making it into cloth difficult operations. In order to fpin wool and afterwards to weave it, we are obliged to cover its fibres with a coating of oil, which, filling up the cavities, renders the afperities lefs fenfible; in the fame way as oil, when rubbed upon the furface of a very fine file, renders it ftill lefs rough.

When a piece of cloth is finifhed it muft be cleanfed from this oil, which, befides giving it a difagreeable fmell, would caufe it to foil whatever it came in contact with, and would prevent its taking the colour which is intended to be given to it by the dyer. To deprive it of the oil it is fcoured at the fulling-mill, by working it with hammers in a trough full of water or urine, in which fuller's-earth is fometimes mixed. This earth combines with the oil which it feparates from the cloth, and both together are wafhed away by the frefh water, which is afterwards brought to it in the machine. Thus after a certain time the oil is entirely wafhed out of the cloth.

The fulling, which fucceeds the fcouring of the cloth, is aided by the application of the foap. The alternate preffure given by the hammers to the piece of cloth, efpecially when the milling is pretty far advanced, occafions an effect analogous to that which is produced upon hats by the hands of the hatter; the fibres of wool which compofe one of the threads, whether of the warp or the weft, affume a progreffive movement with their roots forwards, and introduce themfelves among the fibres of the threads neareft to them, then into thofe which follow; and thus by degrees all the threads, both of the warp and the woof, become felted together. The cloth, having by the above means become fhortened in all its dimenfions, and thickened in its fubftance, partakes both of the nature of cloth and of that of felt; for at the fame time that the threads give it confiderable ftrength, it may be cut without being fubject to ravel, and on that account we are not obliged to hem the edges of the pieces of which wearing apparel is made. Laftly, as the threads of the warp and thofe of the weft are no longer fo diftinct and feparated from each other as to leave interftices between them, the cloth forms a warmer clothing, independently of its having acquired a greater degree of thicknefs. Knit worfted is alfo rendered lefs apt to run, in cafe a ftitch fhould drop, by the operation of fulling.

Tentering.—When the milling is finifhed, the cloth is ftretched again on the tenter. It is ufual to extend the piece to forty-two yards in length, but not at all in breadth; indeed only one inch of extenfion in each yard is allowed by law. The cloth remains in the open air until it is perfectly dry and ready for the fucceeding operations of finifhing, which are only intended to give it a beautiful furface, for it already poffeffes all the ufeful qualities of cloth.

Dreffing the Cloth with Teafels.—This operation is to raife up the nap or loofe fibres on the furface of the cloth, by fcratching it over with a fpecies of thiftles called teafels, in order to form a wool on the furface, which can be removed by fhearing. The teafels are the balls or ears which contain the feed of the plant called *dipfacus fullonum;* the fcales which form the ball project on all fides, and are terminated with fharp points, which turn downwards, like hooks, and are very elaftic. See TEASEL.

A number of teafels are put into a fmall frame, which is compofed of a handle eight or ten inches long, having a fmall ftick paffed through it at one end about eight inches long, which is fplit into two at each end nearly all its length. There is alfo another fimilar ftick, which is paffed through the handle near the middle of its length; the two fplit fticks are perpendicular to the ftem or handle, and parallel to each other. The fpace between them is filled with teafels, which are jambed in very faft between them, and alfo in the clefts of the fplit fticks, where they are fecured by ftrings extended between the ends of the fplit fticks, and twifted, until they draw the fticks forcibly together, and bind the teafels very faft. This frame filled with teafels forms a tool, which very much refembles the curry-comb ufed to clean horfes, and is ufed in a fimilar manner, to fcratch over the whole furface of the cloth, and draw out all loofe ends of the fibres of the wool, which are not firmly confined by the entanglement of the felting.

The dreffing is performed by two men, who hold the teafel-frame by its handle, and work the cloth, when it is hung up in a vertical pofition over two rails fixed to the ceiling; when they have worked over as much furface as they can reach, they draw down a frefh portion, which they work in turn, and thus proceed until they have finifhed the whole piece. The firft time the cloth is dreffed it is wetted with water; it is worked three times over in the wet ftate, by ftrokes in the direction of the length of the piece, and then it is worked again three times in the other direction; by this means all the fibres are raifed, and the cloth is prepared for fhearing.

In the moft improved manufactories, the dreffing is performed by the gig or gig-mill. This is a cylinder covered on its furface with teafels, and turned rapidly round whilft the cloth is drawn over it.

The *Gig-mill* is reprefented in perfpective in *Plate* V. *Woollen Manufacture.* M is the wood frame of the machine; F F is the cylinder or drum, which is compofed of 12 rails or troughs, filled with teafels F F, 3, 4, &c. Thefe are faftened on the circumference of two or three wheels fixed upon a wooden axis 7; the drum is put in motion by a pulley E D at one end of its axis, which receives an endlefs ftrap, 2, from the drum C, fituated above the machine. There are two pulleys, E and D, one fixed faft on the axis, and the other fitted on loofely, with liberty to turn round freely upon it; the ftrap can be fhifted to either pulley, and accordingly the machine will be put in motion, or will ftand ftill.

The drum C is fixed on one end of an iron fhaft 1, which is put in motion by a bevelled wheel B, from the larger wheel A, fixed on the great horizontal fhaft, which proceeds the whole length of the mill. The drum, F F, covered with teafels, is mounted on bearings fupported by the frame, and the piece of cloth G is conducted over it, to receive the action of the teafels; one end of the piece of cloth is wound round a roller J, and the other end of the piece is wound on the roller L; both thefe rollers are put in motion from a bevelled wheel 6, fixed on the extremity of the axis of the drum; this turns a wheel H upon an inclined axis, which has a pinion at each end; one of thefe pinions, 9, turns a bevelled wheel, K, on the end of the axle of the upper roller

roller L; and the other, 8, turns the wheel I belonging to the lower roller J. By means of this wheel-work both rollers are turned round in the proper direction, to make the upper roller L wind up or draw the cloth, whilft the lower roller unwinds and gives out the cloth. N is a pipe, which conveys water to the machine; it is pierced with a number of holes to throw jets of water on the cloth, and wet it.

As faft as the cloth is taken up by the roller L, it is given out by the other roller J, and is then drawn over the furface of the cylinder, as at G, the teafels of which, as it revolves, act very effectually on the cloth to raife the nap. When the whole piece has paffed, and is gathered up on the roller L, the machine is ftopped, by fhifting the ftrap 2 to the loofe pulley D, then the two rollers L and J are exchanged, and the operation is repeated as before, and fo on till the nap is fufficiently raifed.

The mode of repeating the action on the cloth by exchanging the rollers is troublefome, and a better mode is to provide the means of difengaging either of the wheels K or I from its refpective pinion, making the machine fo that only one wheel and pinion can be engaged at once; alfo to make the motions in fuch direction that the roller which is engaged fhall always wind up the cloth upon itfelf. Each roller muft have a fmall wheel upon one end of it, as fhewn at 10, with a lever and weight 11, to prefs upon the circumference of the wheel with fuch force as to occafion a friction, and make the cloth draw tight when it is drawn off the roller. In this way, the cloth can be made to work either backwards or forwards; becaufe that roller which is engaged with the wheel-work will wind up the cloth, and draw it off from the other roller acrofs the drum; but when all the cloth is wound off, that roller which has taken the cloth muft be difengaged, and the other put in action, which will make the cloth work back again.

The moft improved gig-mills ufed in Yorkfhire have a ftill better method of moving the cloth. This is by means of a pair of rollers in the place of the upper roller L: they are turned round by a large fpur-wheel on the end of the roller, which works in a fmaller wheel on the end of the drum; one roller is mounted over the other, like the two rollers of a flatting-mill, and preffed together by fcrews with fufficient force to draw the cloth between them. The piece of cloth, when brought to the machine, is laid down on a board on the ground before the machine, and one end is paffed under the roller J, which is merely to guide it; then it is carried over the drum, as at G, and introduced between the pair of rollers at L, which draw it flowly forwards; from thefe the cloth turns upwards, and is extended horizontally over two rollers which are fufpended from the ceiling. After quitting thefe rollers, it defcends perpendicularly, and is gathered on the ground in folds on a board or bench, clofe to the place where the piece of cloth was laid before the dreffing was begun. In order to make the piece of cloth pafs a fecond time through the machine, or as many times as is required, the two ends of it are fewed together, fo that it circulates continually over the drum without any interruption or trouble: it is ufually done three or four times.

It is an advantage of this method, that the cloth, in defcending from the ceiling, hangs perpendicularly, and with that fide which has been dreffed oppofite to the light, fo that the workman who gathers it in folds can examine the progrefs of the work; and when he judges that the cloth is fufficiently dreffed, he cuts the fewing which unites the two ends together, and then the end of the piece comes out of the machine, and the cloth is carried away to give place to another piece.

The drum or cylinder of the gig-mill is compofed of a number of fhallow troughs, fixed on the circumference of the wheels of the drum, and parallel to its axis: into thefe troughs, frames filled with teafels, like thofe we have before defcribed, are faftened in a very fimple manner; and the frames are placed fo clofe together, that the trough is wholly filled, and forms a continuous furface of teafels to act upon the cloth when the cylinder revolves. When the hooks of the teafels become filled with flocks or fibres of wool, which they have drawn out from the cloth, they are removed from the cylinder, in order to be cleaned by children, who pick out the flocks with a fmall fteel comb.

The teafels are cultivated very largely in the clothing countries; but it fometimes happens, in particular feafons, that the crops fail, and they are then very dear. This has produced many trials of metallic teeth as fubftitutes for teafels. Mr. Price of Stroud, in Gloucefterfhire, has two patents, dated 1807 and 1817, for this object; Mr. Laffalle of Briftol took a patent in 1816, Mr. Williams of Furfley in 1817, and Meffrs. Lewis of Brinfcomb in 1817. We are not informed if any of thefe inventions are yet brought into real ufe in the manufacturing diftrict.

Shearing or Cropping the Cloth.—By the operation of the teafels, the wool is become raifed all over the furface of the cloth in a loofe fur, which muft be removed by fhearing before the cloth will be fit for wearing, becaufe the fur would gather dirt and duft, and would wear very unequally.

The fhears ufed for cropping by hand are the fame as thofe ufed in the common fhearing-machine, and are reprefented at E, E, in *Plate* III. *Woollen Manufacture.* The clothier's fhears confift of two very large flat blades of fteel, united together by a ftem of fteel, which is bent into a circular bow, and is fufficiently flexible to allow one of the blades to be moved upon the other, in order to make them cut. Both blades are ground to fharp and ftraight edges, which apply one to the other, but the blades are not in parallel planes like fciffars, for one of the blades is laid quite flat upon the cloth, and the plane of the other blade will then be inclined to the cloth at about an angle of 45 degrees, as is fhewn in *Plate* III. The cutting-edge of this inclined blade bears upon the furface of the flat blade, and the fpring of the bow is fo fet, as to prefs the two edges always in contact. The lines of the edges of the two blades are not parallel to each other, but inclined, fo that the edge of the upper blade croffes the edge of the lower blade, and bears upon the flat furface of that blade, at the end neareft to the bow, whilft the other end of the edge of the upper blade is removed over the edge of the lower blade, thus leaving an interval between the two edges, when the fhears are open, as is plainly fhewn in the figure. In this ftate, the fhears being open, if the lower blade is laid flat upon the furface of the cloth, the nap or wool, which is to be removed by the cropping, will ftand up above the edge of the lower blade, in the interval between the two edges; then if the blades be forced together, the edge of the upper blade will pafs or crofs over that of the lower, and cut away all the wool which projects above the edge of the lower blade. The contact of the cutting-edges begins at the end neareft to the bow, and proceeds regularly to the other, becaufe, as before mentioned, the edges are not parallel to each other. The blades open or return to their former pofition by the elafticity of the bow, but in order to make the cut they are clofed by means of a handle or lever 10, which is fitted or lodged on a round part of the ftem of the bow, fo as to play thereupon as upon a centre of motion. A double cord is made faft to the lever or handle near to this centre, and the

the other end of the cord is faftened to a block of wood, which is fcrewed to the flat of the lower blade, and rifes up to a proper height. By depreffing this handle, the fhears are clofed, and make their cut with the greateft facility, the elafticity of the bow returning the handle.

The manner of cropping with thefe fhears is as follows: — The piece of cloth is laid down in folds upon a plank or low bench placed on the ground, and the end is drawn acrofs a table or bench, which is covered with cloth, and ftuffed with horfe-hair, like a cufhion. The cloth is ftretched out flat upon the furface of the table, and is retained by hooks and weights. Two workmen are employed to fhear a piece of cloth; they place the lower blades of their fhears flat on the furface of the cloth, with the line of the edge in the direction of the length of the piece; one of the fhears is laid on the edge or lift of the cloth, and the other exactly in the middle of the breadth of the cloth. The bows and ftems of the fhears project over the edge of the table, and the workmen place themfelves at that edge. Each man guides the fhears with his left-hand, and makes the cut with his right. To hold the fhears by, a fhort ftaff is lafhed to the bow of the fhears, and fecured by a ftay to the lower blade; its direction is nearly parallel to the back edge of the upper blade. The workman puts his arm through the bow as far as the elbow-joint, then lays the fore-arm flat againft the ftaff, which he grafps with the hand; and in this way he has a great command of the fhears, leaving the right-hand at liberty to work the handle which clofes the fhears. This handle is moved backwards and forwards with great rapidity, to make cuts or clips on the cloth, and between every cut the lower blade is moved a fmall fpace on the cloth, to cut in a frefh part.

The art of fhearing confifts in moving the fhears with great regularity and parallelifm, fo that every part of the furface fhall be equally cropped. The clofenefs with which the fhears cut is regulated by weights laid upon the flat of the lower blade; thefe prefs the blade down into the foft cufhion on which the cloth is fpread, fo that the fur will ftand up more above the edge of the blade.

As the two fhearers advance in their work, their fhears proceed acrofs the breadth of the piece of cloth, and when the man who began in the middle has worked to the lift of the cloth, the other who began at the lift will have worked to the middle, where the firft began; the whole breadth is now fhorn, and they remove the fhears, and draw the piece of cloth forwards acrofs the table, to obtain a frefh furface to work upon.

For fhearing common cloth, it is cut wet the firft time, then it is dreffed again with teafels, dried on the tenter, and cut again in a dry ftate three times over.

Shearing-Frame. — The moft common machine ufed in Yorkfhire is only applied to give motion to the fame kind of fhears as are ufed for cropping by hand, and is ufually called the fhearing-frame. At the fide of the table or cufhion on which the cloth is fpread, a long ftool is placed, having grooves at the edges to guide the wheels of a carriage, to which the fhears are affixed by their bows. There is a carriage for each pair of fhears, and they are flowly and gradually moved along the ftool, by a cord which winds upon a roller turned by wheel-work; and at the fame time, the handles of the fhears are continually pulled by a cord connected with a fmall crank, which turns round very rapidly. The direction of the cuts is the lengthways of the piece of cloth, and the two pair of fhears advance acrofs the breadth of the piece until a whole breadth is cut; the machine is then ftopped, the fhears removed, and the piece of cloth fhifted upon the table. Thefe fhearing-frames operate very well, but require great care and attention to make the different cuttings join, in order to cut equally over the whole furface.

The machine invented by Mr. Harmar of Sheffield was of this defcription; his firft patent was in 1787, and another in 1794. At one period his machines were in general ufe, but the prefent fhearing-frames, although of the fame kind, are very much fimplified, and work equally well.

A perpetual Shearing-Machine is reprefented in *Plate* III. *Woollen Manufacture*; it is ufed in the weft of England, and is beft adapted for narrow cloths. The fhears lay croffwife over the piece, which is drawn regularly beneath the fhears in the direction of its length without any interruptions; hence it is called a perpetual fhearing-machine.

The fhears, E E, are the fame as what we have already defcribed. Each pair is faftened acrofs the frame by means of a piece of wood, to which the lower blade of the fhears are fcrewed; immediately beneath this blade is the cufhion to bear the cloth, which paffes between the blade and the cufhion. The piece of cloth is wound round the roller C, upon the end of which is a wheel N, and a lever M, which bears up againft the lower part of this wheel with fo much friction as to make the cloth ftrain tight in drawing off from the roller. The cloth firft paffes over a rail B, from which it proceeds in an horizontal direction beneath the two pair of fhears E E, then turns over another rail at the other end of the frame, and defcends to a roller D, which is turned flowly round by the machinery, in order to wind up the cloth.

The machine is put in motion by the endlefs ftrap round the drum F upon a fhaft, which proceeds all the length of the mill. The ftrap turns the pulley G upon the end of the fmall horizontal fpindle H: in this fpindle two cranks are formed at *a* and *b*, which are connected, by wires 7 and 8, with the handles 9 and 10 of the fhears E, fo as to give them a continual motion, and make a cut of each pair of fhears every time the fpindle H makes a turn. The motion of the machine can be ftopped by releafing the lever P, on which the bearing of the fpindle is fcrewed: when the lever P is depreffed, and kept down by the catch, as reprefented in the drawing, the endlefs ftrap is drawn tight, fo as to turn the fpindle; but if the catch is removed, and the lever raifed up, the ftrap becomes loofe, and flips round upon the pulley without turning it. A fmall pulley is fixed upon the fpindle at I, to receive an endlefs ftrap which paffes round a larger wheel J. Upon the fame axis with this are three other pulleys of different diameters, which receive a ftrap 2, and give motion to three fimilar pulleys fixed upon a fpindle 3: the latter fpindle has a pinion on the end of it, which works a bevelled wheel fixed on the end of the roller D, and thus it is turned flowly round. The three pulleys on the fpindles 3 and J are placed reverfed to each other, that is, the fmalleft pulley on one is oppofite to the largeft on the other; by this means, the fame ftrap 2 may be fhifted, and will work on any of the three pair of pulleys, but each one will communicate a different degree of movement to the roller D, and confequently to the cloth, fo as to draw it quicker or flower, and make the fucceffive cuts of the fhears at a greater or lefs diftance afunder at pleafure.

The cufhions which bear up the cloth againft the fhears are moveable on centres of motion, and are capable of being raifed or lowered. When they are lowered down, the cloth can be readily introduced beneath the lower blades of the fhears; and when raifed up, they prefs the cloth up to the fhears, and the force of this preffure can be regulated by turning a fmall handle. In many machines this motion is

applied

applied to the ſhears themſelves, inſtead of to the cuſhion or bed, and is much more convenient.

The perpetual machines anſwer very well for ſhearing narrow cloth, when the ſhears can cut at once acroſs the whole breadth; and then as the two ſhears E work in ſucceſſion over the ſame ſurface, they crop the cloth twice over in paſſing once through the machine. It has been attempted to ſhear wide cloths in this machine, by making one pair of ſhears take one half the breadth, and the other pair the other half; but it is very difficult to draw a wide piece of cloth ſo evenly over the cuſhions, as to keep it ſtretched to the full breadth without any wrinkles in the lengthways of the piece; and if there are any ſuch wrinkles, the cloth will be cut very irregularly. In this particular, the firſt machines have the advantage, becauſe the cloth is ſtretched over the cuſhion by the workman with diſcretion, and he makes it tight before the cropping is begun.

There have been many patents for the improvements of ſhearing-machines. Mr. Buffington's, in 1804, is for a method of ſtretching or extending the cloth breadthways whilſt it is in the ſhearing-frame. His plan is to attach a narrow web of ſtrong cloth to the liſts of the cloth, by ſewing or lacing; the outer edge of this web is alſo ſewed to a cord or ſmall rope, ſo that the cloth becomes edged or bordered with ropes. Theſe ropes are conducted through holes or openings in the frame, which will ſuffer the cloth and ropes to be moved in the direction of their length; but as the ropes cannot draw ſideways out of theſe openings, the cloth may be continually ſtretched in its breadth. The openings ſhould have rollers to facilitate the motion of the ropes.

Mr. Joſeph Fryer's patent ſhearing-machine, dated 1802, acts with three ſhearing-blades, one long one, which extends acroſs the breadth of the piece to form the lower or fixed blade, and two other moveable blades of half the length, which are jointed to the long blade at the two ends, and are moveable thereon, ſo as to cut in the manner of ſciſſar-blades. The moveable blades are preſſed into contact with the edge of the fixed blade by ſprings, and are put in motion by means of two cranks upon an horizontal ſpindle, ſo that the blades make their ſtrokes or cuts alternately. The edge of the lower blade is a ſtraight line, but the edges of the moveable blades are convex on the cutting ſide, ſo as to cauſe them to interſect the edge of the lower blade always at the ſame angle when they are wide open, as when they are nearly cloſed.

The piece of cloth is conducted over proper rollers, and wound up by one, which is turned round by the machine, ſo as to draw the piece of cloth from one end to the other with a ſlow and progreſſive motion. The cloth, when it is immediately beneath the edge of the long blade, is bent ſuddenly over a narrow ridge of metal, which is parallel with the edge of the lower blade, but ſo far diſtant as to permit the cloth to paſs between them. This ridge of metal is capable of adjuſtment by means of ſcrews, and can be placed ſo that the nap of the cloth will be ſhorn longer or ſhorter, as it is required.

In ſome caſes, eſpecially in finiſhing broad-cloths, inſtead of drawing the piece from end to end, it may be more convenient to cauſe it, or part of it, to move under the ſhearing-blades from liſt to liſt, or from one ſide to the other. This will require a machine conſiderably larger, though the ſame blades will ſuffice; or it is found equally convenient to cauſe the blades, at the time they are cutting, to move over the cloth in any direction, but more eſpecially from liſt to liſt.

Mr. Fryer alſo contemplated the finiſhing of the cloth by the ſame machine which performed the ſhearing. Thus after the cloth has undergone the operation of ſhearing or cropping, in its paſſage down to the cylinder on which it is wound up, it is expoſed to a current of ſteam thrown out from a horizontal tube at a number of ſmall apertures, ſo as to give ſoftneſs and pliability to the cloth; a bruſhing cylinder is next made to move againſt it, by which the remaining wool or fur is laid in one direction. It then paſſes between two poliſhed metal cylinders, which are made hollow, and kept hot by the admiſſion of ſteam or otherwiſe. Theſe occaſion a great preſſure on the cloth, and diſſipate all the water imbibed from the ſteam.

Rotatory Shearing-Machine.—A very complete machine for cropping cloth of any breadth was invented by Mr. Price, of Stroud, in Glouceſterſhire, and for which he obtained a patent in 1815. This machine ſhears or crops the cloth acroſs the breadth, beginning at one end of the piece, and continuing regularly to the other. For this purpoſe, the cloth is conducted through the machine by the motion of rollers, and is drawn over a bed or ſupport which lies beneath the ſtationary or fixed blade of the ſhears or croppers, (which anſwers to what is called the ledger-blade in the common ſhears,) ſo that the cloth paſſes between the bed and the ſtationary blade.

The moving blades of the ſhears are fixed on the circumference of a cylinder ſituated above the fixed blade, with its axis exactly parallel thereto, and capable of revolving by the power of machinery, ſo that the edges of the moving blades will be carried againſt and paſſed over the edge of the fixed blade, in order to cut away all the wool of the cloth which riſes above the edge of the fixed blade. Several ſuch moving blades are fixed upon the ſame cylinder, to act in ſucceſſion againſt the fixed blade; and theſe moving blades are placed obliquely to the axis of the cylinder, or in ſuch a manner as to form portions of ſpirals; but as all parts of the cutting edges are equidiſtant from the axis of the cylinder, it is manifeſt, that in the revolution of the cylinder, every part of each ſpiral edge is brought in ſucceſſion into contact with the fixed blade, ſo that in its revolution it crops off all the wool, which by the progreſſive motion of the cloth over its bed is raiſed up againſt the fixed edge. The edges of the moving blades are placed at ſuch a degree of obliquity to the axis of the cylinder, that at the ſame inſtant the end of one ceaſes to cut againſt the edge of the fixed blade, the following revolving blade will begin its action at the other end of the cylinder; therefore, by the time that any one of the revolving edges has paſſed over and made its cut againſt the whole length of the fixed blade, and is ready to quit it, the ſucceeding revolving edge is brought into action, and when this has paſſed, the next in ſucceſſion begins, ſo as to keep up a continued action.

The cloth is ſtretched in width by a contrivance which he calls ſtretching-bands, to prevent it getting into folds or wrinkles, which would be injured by the ſhears, or make irregularities in the ſhearing. Theſe ſtretching-bands are endleſs ſtraps or bands, each of which is extended over two wheels. The bands have ſharp pins projecting from them to prick into the liſts at the edges of the cloth, and the bands being ſo ſituated that one of them lies exactly beneath each liſt, they will be cauſed to circulate round their reſpective wheels by the motion of the cloth. The ſtretching of the cloth is effected by the poſition of the wheels on which the bands circulate, the direction of the bands being ſlightly oblique to the lengthways of the cloth. The endleſs ſtraps are ſo fitted into grooves or troughs, that they are firmly retained to move ſtraight forwards in their oblique direction; and the direction of the obliquity is ſuch, that the bands are neareſt together at that end where their pins take hold of the liſts of the cloth; but as the bands move forwards with the cloth, they recede from each other, and extend the cloth in breadth in conſequence of their obliquity, which may be increaſed or diminiſhed as is found neceſſary. The actual width between the two bands can alſo be regulated according to the width of the piece of cloth.

It is not uſual to crop the liſts of the cloth, and indeed as the liſts are uſually of thicker ſubſtance than the other parts of the cloth, they would bear up the fixed blade too high from the cloth to cut the nap quite cloſe.

For this reaſon, the bed or ſupport on which the cloth is cut is ſo conſtructed, that it can be adapted in length to the breadth of the piece of cloth between the liſts, in order that the cloth only may be ſupported or borne up to the edge of the fixed blade; whilſt the liſts, being depreſſed or borne down below the level of the bed, (by thin ſlips of metal called guards,) will eſcape the action of cropping, and thereby remain with the long wool upon their ſurfaces. The bed by which the cloth is borne whilſt it is cut is only a narrow ridge of metal, over which it paſſes, ſo as to be bent with a ſudden curvature, and in this way, the nap can be cut more cloſe and even than upon a flat bed or ſoft cuſhion. The operation of cutting is facilitated by a row of pieces of metal ſcrewed to a ſtrong bar, to form a ſtraight edge, very ſimilar to the cutting edge of the fixed blade, but thin and elaſtic; this edge is placed cloſe to the elevated ridge of the bed, and preſſes the cloth gently down upon the bed immediately before it comes to the edge of the fixed blade, againſt which the nap is to be cut off; this elaſtic edge being placed on one ſide of the ridge, and the cutting edge of the lower blade on the other ſide, the cloth is only expoſed for a very narrow ſpace juſt where it comes to the cutting edge. By this means, the cloth can with ſafety be brought nearer to a level with the upper ſurface of the fixed blade, ſo as to ſhear it cloſer than could otherwiſe be done without endangering the cloth.

The ends of the ridge part of the bed are compoſed of a number of narrow plates of metal, accurately fitted together, and placed ſide by ſide in a mortiſe made in the end of the ſolid bed; their upper ends project out of the mortiſe ſo as to line with the elevated ridge, and form a continuation thereof; but there is a ſliding piece in the bottom of the mortiſe on which they all bear, and the point of it is of a wedge form. By removing this wedge, any number of the moveable pieces may be let down, ſo as to diminiſh the length of the elevated part of the bed at pleaſure, according to the breadth of the cloth. The whole of this machine is very well contrived to effect the deſired object; it will be found fully deſcribed with drawings in the Repertory of Arts, vol. xxix. p. 65.

Frizing is an operation ſometimes uſed in the finiſhing of woollen cloth: it conſiſts in rolling up and entangling the fibres, which form the nap on the ſurface of the cloth into ſmall knots or burs, which cover near the whole ſurface, ſo that the cloth appears covered with ſmall grains, which almoſt touch each other.

This operation is of no utility to the cloth, and it is difficult to ſay for what reaſon it was ever practiſed at all. The French firſt introduced it, and it was ſo much the faſhion many years ago, that no other cloth was thought comparable in beauty. At preſent it is but little uſed, except for foreign markets, where our cloth meets the French cloth, which is ſtill prepared in this manner, but generally on the back-ſide of the cloth only.

The frizing is done by a ſimple machine, in which the cloth is drawn acroſs a narrow table by means of rollers, to give it a very ſlow progreſſive motion. The table is covered with a coarſe ſtrong cloth, and over the table is placed a heavy plank of wood, of the ſame ſize as the table. The lower ſide of this plank, which bears upon the cloth, is covered with an artificial ſtone, compoſed of coarſe ſand, which is ſtuck together into a ſolid maſs by glue or other cement, and a ſmall but rapid reciprocating motion is given to the plank by means of two cranks of very ſmall radius. Theſe cranks are formed at the tops of two vertical ſpindles, the upper ends of which are fitted in ſockets at the ends of the fixed table, and the ends which project up a few inches above the ſurface of the table are received into ſockets formed in each end of the moveable plank. The projecting parts of the ſpindles are not in ſtraight lines with thoſe parts which are fitted in the fixed collars at the ends of the table, but are ſlightly cranked; hence, if the ſpindles are turned round, they muſt communicate motion to the plank, and ſlide it over the cloth backwards and forwards; or rather they move it with a circular motion, cauſing every point and grain of ſand cemented to the plank to deſcribe a ſmall circle upon the cloth. It is this action which gathers together the fibres of the nap, and entangles them into knots or grains, as before mentioned.

To put the two ſpindles in motion, each one has a trundle or lantern fixed on the middle part of it, and the lower end is received in a ſtationary ſocket. Theſe lanterns are turned round by the teeth of two face-wheels, fixed upon an horizontal axis, which lies beneath the machine. By this means, both the ſpindles and cranks are turned round at the ſame time, and with a very rapid motion. The rollers which draw the cloth forwards are turned round ſlowly by a communication of wheel-work, and draw the piece of cloth through the machine, that is, acroſs the frizing-table, ſo that every part is in turn ſubjected to the action of the ſand cemented to the plank. The nap muſt be left long for that cloth which is intended to be frized, and the operation is repeated twice or three times. See ſome further particulars in our article FRIZING, vol. xv.

Bruſhing.—After being ſhorn for the laſt time, the cloth is bruſhed all over, to remove the looſe cuttings. This operation is now commonly performed by a machine which has two horizontal drums, or cylinders, covered with hair-bruſhes on the circumference. The piece of cloth is conducted over a ſyſtem of rollers to extend it and draw it ſlowly forwards: it is conducted over one of the bruſhing-cylinders, and under the other; and as they are kept in rapid motion by the machine, they bruſh over both ſides of the cloth at the ſame time, and lay all the fibres one way.

Preſſing.—This is the laſt finiſh to the cloth, and gives it a ſmooth and even ſurface. The piece of cloth is folded backwards and forwards at every yard, ſo as to form a pack on the board of a ſcrew-preſs; and between every fold ſheets of glazed paper are placed, ſo that no part of the ſurfaces of the cloth can come in contact; alſo at every twenty yards three hot iron plates are put in between the folds, the plates being laid ſide by ſide, ſo that they occupy the whole ſurface of the folds; and thin iron plates, which are not heated, are alſo put above and below the hot plates to moderate the heat. When the pack of cloth is properly folded, and the preſs contains a proper quantity, the ſcrew is forced down to give a very ſevere preſſure to the pack. The cloth remains in the preſs until the plates are quite cold; it is then taken out and folded again, ſo that the creaſes of the former folds will come oppoſite to the ſurfaces of the paper, in order to be preſſed with other hot plates.

The heat tends to ſoften the fibres of the wool, and the preſſure

preſſure againſt the glazed paper, whilſt they are ſo ſoftened, lays all the fibres flat and ſmooth, ſo that the cloth has a very gloſſy appearance, and feels ſmooth, like ſatin; but this high finiſh to the cloth is very objectionable, becauſe the ſlighteſt ſhower of rain will take it away, and when the drops of rain only wet it in parts, the cloth will become ſpotted and disfigured. For this reaſon, in preſſing ſuperfine cloth, the plates are very ſlightly warmed, and the cloth has but little gloſs given to it. The glazed paper is a thick kind of cartridge, which is prepared by glazing or rubbing it very forcibly with a flint, as it lies upon a hard metal table. This operation is done by a water-mill.

For coarſer cloths, ſome manufacturers gloſs them with a large hot iron: it is a hollow box, into which a red-hot heater is introduced. The cloth is ſpread out upon a large flat table, and extended by hooks. The iron box is ſuſpended by a tackle from the ceiling, ſo that it can be hoiſted over to the middle of the table, and then two men work it backwards and forwards over the whole ſurface of the cloth, by means of two long poles or handles, which are jointed to it at one end.

The cloth is now finiſhed, and is packed up in bales of twenty or twenty-five pieces, in order to be tranſported. The bale is firſt incloſed in paper, and then in canvas, and cloſely compreſſed by the ſcrew-preſs. Some manufacturers uſe the hydroſtatic preſſes for this purpoſe.

In conſidering the proceſſes of the woollen manufacture, as they were practiſed forty or fifty years ago, and comparing them with the preſent practices, we find great changes and improvements, but they are by no means carried to ſo great an extent as in the cotton manufacture. This is owing in a great degree to the circumſtance that the manufacture of woollen cloth was rendered very perfect, as far as the goodneſs and beauty of the cloth was concerned, long before the improved ſyſtem was begun; and there were great numbers of experienced and able workmen trained up for each proceſs, who by habit and dexterity performed their work as well as it could be done by machinery. The reduction of labour, or the ſubſtitution of ordinary hands for experienced workmen, was in this caſe all that machinery of the moſt perfect kind could effect; both theſe were advantages to the public and the manufacturer, but were ſo directly oppoſite to the inclination and intereſt of the able workmen, that we find they have made greater and more effectual oppoſition to the introduction of improvements in the woollen than in any other of our great manufactures.

At various periods attempts have been made by the workmen to ſuppreſs machinery, and many mills have been deſtroyed. In July 1802, conſiderable riots took place in Wiltſhire and Somerſetſhire, in conſequence of an attempt to ſet up the machines called gig-mills. It was contended that this was the ſame machine which was prohibited by an ancient ſtatute of Edward VI. The diſputes ran ſo high, that the attention of parliament was called to the ſubject of the laws then exiſting for the regulation of the woollen manufacture, and a committee was appointed to inveſtigate the policy of encouraging or regulating machinery. In conſequence, all the prohibitions of machinery were ſuſpended. The report of this committee contains the following remarks, ſome of which are applicable to other manufactures as well as the woollen.

The introduction of the gig-mill and other machines was oppoſed from an idea that it would throw a conſiderable number of hands out of work; and it was contended, that it was highly injurious to the quality and texture of the cloth. With reſpect to the actual effects of the gig-mill and ſhearing-frame on the cloth, the committee report that deciſive evidence has been adduced before them by merchants and manufacturers of the greateſt credit and experience, to prove that theſe machines, eſpecially the gig-mill, when carefully employed, finiſh the cloth in the moſt perfect manner, and that manufacturers reſiding in parts of the country where the gig-mill is not uſed, frequently ſend their cloths to a diſtance to be dreſſed by it.

It alſo appeared in evidence, that alarms ſimilar to the preſent had exiſted among workmen at the introduction of ſeveral of the machines which are now in general uſe. Such alarms have gradually ſubſided as prejudice died away; and the machines are now fully eſtabliſhed, without, as it appears, impairing the comforts or leſſening the numbers of workmen. The committee remark with much ſatisfaction, that in many inſtances in which it was apprehended that the introduction of particular machines would throw ſuch a number of people out of employment as to occaſion great diſtreſs, the reſult has been very different; for beſides the occupations which the attendance on ſuch machines has given riſe to, a freſh demand for labour to an immenſe extent has ariſen out of the increaſed ſale of the article, in conſequence of the cheapneſs and ſuperior quality of the manufacture.

They approve the ſyſtem of patents, by which the inventor of any new machine ſecures to himſelf the excluſive benefits of his diſcovery for fourteen years; and only, at the end of that term, they are thrown open to the public; this provides in moſt caſes againſt the too ſudden and general eſtabliſhment of any invention, by which a number of workmen might at once be thrown out of employment.

They next obſerve, that if the principles on which the uſe of theſe particular machines is objected to were once admitted, it would be impoſſible to define the limits or to foreſee the extent of their applications. If the parliament had acted on ſuch principles fifty years ago, the woollen manufacture could never have attained to near its preſent extent. The rapid and prodigious increaſe of late years in all the manufactures and commerce of this country is univerſally known, as well as the effects of that increaſe on our revenue and national ſtrength. In conſidering the immediate cauſes of that augmentation, it appears to the committee, that it is principally to be aſcribed, under the favour of Providence, to the general ſpirit of enterprize and induſtry among a free and enlightened people, left to the unreſtrained exerciſe of their talents in the employment of a vaſt capital, puſhing to the utmoſt the principle of the diviſion of labour, calling in all the reſources of ſcientific reſearch and mechanical ingenuity, and, finally, availing themſelves of all the benefits to be derived from viſiting foreign countries, not only for forming new and confirming old commercial connections, but for obtaining a perſonal knowledge of the wants, the taſte, the habits, the diſcoveries and improvements, the productions and fabrics, of other civilized nations. Thus bringing home facts and ſuggeſtions, perfecting our exiſting manufactures, and adding new ones to our domeſtic ſtock; opening, at the ſame time, new markets for the product of our manufacturing and commercial induſtry, and qualifying ourſelves for ſupplying them.

The committee declare it to be their opinion, that by theſe means alone, and above all by the effect of machinery in improving the quality and cheapening the fabrication of our various articles of export, notwithſtanding a continually accumulating weight of taxes, and with all the neceſſaries and comforts of life gradually increaſing in price, (the effects of which on the wages of labour could not but be very conſiderable,) our commerce and manufactures have alſo been increaſing in ſuch a degree as to ſurpaſs the moſt ſanguine calculations of the ableſt political writers who have ſpeculated

lated on the improvements of a future age. The exports of woollen goods at the time of this report, (1807,) amounted to fix millions of pounds official, or nine millions of real value.

It appeared alfo to be an important confideration, of which we fhould never lofe fight, that we are at this day furrounded by powerful and civilized nations, who are intent on cultivating their manufactures and pufhing their commerce; and who are more eager to become our competitors in trade, from having witneffed the aftonifhing effect of our commercial profperity. The attempts which have been made to carry our machines and implements over to foreign countries, and to tempt our artifans to fettle in thofe countries, evince the importance of machinery, under the directions of men of approved fkill, in conftructing and ufing them. It is needlefs to remark how much thefe attempts would be favoured by our throwing any obftructions in the way of enterprize and ingenuity, and the free application of capital in this country; for any machines which fhould be prohibited here would infallibly find their way into foreign nations in a very fhort time.

Among the attempts to improve the woollen manufacture, we muft not omit to notice the invention of Mr. Jofeph Booth, for fabricating woollen cloth without fpinning or weaving. This was effected by felting wool into a web by the aid of machinery, which operated mechanically upon a tiffue of carded wool, to entangle and interlace the fabrics together. The inventor took a patent for this in 1793 or 1794, but before the time for the enrolment of the fpecification of his procefs, he obtained an act of parliament, the preamble of which ftates, that on account of the great importance of the art, and the danger of its being carried abroad to the injury of the ftaple manufacture of the kingdom, parliament had determined to keep the fpecification fealed; hence we are not able to give the details of this machinery.

We find thefe expectations have not been realized; for, although the procefs has been repeatedly tried on a large fcale and in the moft complete manner, it has been abandoned. Three large mills were eftablifhed at Taunton and near Salifbury, by experienced woollen manufacturers of the weft of England; another mill was converted to the purpofe at Lewifham, in Kent; and the laft mill was erected at Merton, in Surrey, the property of James Perry, efq. We learn from this gentleman, that he was able to manufacture cloth of a fine furface, and of a very even and regular fubftance, but it was rather deficient in ftrength, for want of the threads which form the fubftance of common cloth; and in refpect to wear it was lefs durable than common cloth, as it did not long withftand brufhing; otherwife the expence of the procefs, which was not one-fourth of the common procefs, would have brought it into general wear.

There has been a great number of other projects and patents for the improvement of different branches of the woollen manufacture; but as we have already noticed moft of thofe which have come into ufe, we fhall not enumerate any more of the unfuccefsful attempts.

The machinery for manufacturing long combing-wool is defcribed in the article WORSTED.

WOOLLEN *Nets*, in *Gardening*, a kind of nets employed as a protection in the fetting of the fruit of different forts of tender trees. See WOODEN *Frames*, &c.

WOOLLEN *Rags*, in *Agriculture*. See *Woollen* RAGS.

WOOLLENS, *Bleaching of*. See BLEACHING.

WOOLLEY-WOOLLEY, in *Geography*, a town of Africa, in the kingdom of Yani.

WOOLLI, a kingdom of Africa, bounded by Walli on the W., by the Gambia on the S., by the fmall river Walli on the N.W., by Bondou on the N.E., and on the E. by the Simbani wildernefs. The country every where rifes into gentle acclivities, which are generally covered with extenfive woods, and the towns are fituated in the intermediate valleys. Each town is furrounded by a tract of cultivated land, the produce of which is thought to be fufficient for fupplying the wants of the inhabitants; the foil appeared to Mr. Park to be every where fertile, except near the tops of the ridges, where the red iron-ftone and ftunted fhrubs fufficiently marked the boundaries between fertility and barrennefs. The chief productions are, cotton, tobacco, and efculent vegetables; all which are raifed in the valleys, the rifing grounds being appropriated to different forts of corn. The capital is Madina, or Medina, fignifying in the Arabic *city*. (See MEDINA.) The inhabitants are Mandingoes, (fee MANDING,) who, like moft of the Mandingo nations, are divided into two great fects, the Mahometans, who are called Bufhreens, and the Pagans, who are denominated indifcriminately Kafirs, *i. e.* unbelievers, and Sonakies, *i. e.* men who drink ftrong liquors. The latter are the moft numerous, and the government of the country is vefted in them; for though the Bufhreens are confulted in all matters of importance, they are not allowed to take any fhare in the executive government, which refts folely in the Manfa, or fovereign, and great officers of the ftate. Of thefe, the firft in point of rank is the prefumptive heir of the crown, called the Farbonna; and next to him are the Alkaids, or provincial governors, who are more frequently ftyled Keamos. Then follow the two grand divifions of freemen and flaves, the Slatees being confidered as the principal of the former; but in all claffes great refpect is paid to the authority of aged men. Park's Travels, vol. i.

WOOLLIMA, BA, a river of Africa, called alfo *Wonda*; which fee.

WOOLLY-PASTINUM, in *Natural Hiftory*, a name given by the Eaft Indians to a fpecies of native red arfenic, or orpiment, found in that part of the world.

It is of a paler colour than the red orpiment of Germany.

WOOLMAN, JOHN, in *Biography*, a minifter of the fociety of Friends in North America, chiefly remarkable as an early and faithful advocate of the rights of the enflaved Africans, was born at Northampton, in Burlington county, Weft New-Jerfey, in the year 1720. From fome memoirs of his life left by himfelf, it appears that he had ftrong impreffions of religion in childhood, which being feconded by the care and admonition of pious parents, he arrived at manhood, after a ftruggle of fome years with youthful levities, with a decidedly religious character. An incident which befel him when a child, and which he records as a proof of the early influence of divine grace on the mind, may be mentioned here, as connected alfo with his future character, and with the firft developement of thofe tender fympathies of the heart which, under the guidance of Chriftian principle, fitted him fo eminently to efpoufe the caufe of the oppreffed negroes. Going on an errand to a neighbour's, he obferved that a robin quitted her neft at his approach, and flew about in alarm for her young ones. He ftood and threw ftones at her, till being ftruck, fhe fell down dead. "At firft," he fays, "I was pleafed with the exploit, but after a few minutes was feized with horror. I beheld her lying dead, and thought thofe young ones, for which fhe had been fo careful, muft now perifh for want of their dam to nourifh them: and after fome painful confiderations on the fubject, I climbed up the tree, took all the young birds, and killed them, fuppofing that better than to leave them to pine away,

away, and perish miserably. I then went on my errand, but for some hours could think of little else but the cruelties I had committed, and was much troubled. Thus He, whose tender mercies are over all his works, hath placed a principle in the human mind, which incites to exercise goodness towards every living creature: and this being singly attended to, people become tender-hearted and sympathising, but being frequently and totally rejected, the mind becomes shut up in a contrary disposition." Of his opinions at one-and-twenty he writes thus: "I was early convinced in mind that true religion consisted in an inward life, wherein the heart doth love and reverence God the Creator, and learns to exercise true justice and goodness, not only toward all men, but also toward the brute creatures. I found no narrowness respecting sects and opinions, but believed that sincere, upright-hearted people in every society, who truly loved God, were accepted of him."

The right of every individual, of whatever colour, who has not offended against society, to liberty and the common gifts of providence, was consequently at this time an article of John Woolman's *religious creed:* and we shall see that he soon brought himself to act in consistency with his faith. The first occasion of trial occurred while he was yet in servitude; for he had engaged himself as clerk and assistant to a shop-keeper at a place called Mount-Holly. His employer parted with a negress, and desired Woolman to write out a bill of sale for her. "The thing," says he, "was sudden, and although the thought of writing an instrument of slavery for one of my fellow-creatures felt uneasy, yet I remembered that I was hired by the year, that it was my master who directed me to do it, and that it was an elderly man, a member of our society, who bought her. So through weakness I gave way and wrote; but at the execution of it I was so afflicted in my mind, that I said before my master and the friend, that I believed slave-keeping to be a practice 'inconsistent with the Christian religion.' This in some degree abated my uneasiness; yet as often as I reflected seriously upon it, I thought I should have been clearer if I had desired to be excused from it, 'as a thing against my conscience:' for such it was." Accordingly, on the next occasion he took this second step. "A young man of our society," he proceeds, "spoke to me to write a conveyance of a slave to him, he having lately taken a negro into his house. I told him I was not easy to write it: for though many of our meeting and in other places kept slaves, I still believed the practice was not right." Other cases followed, in which being employed (as it appears for an adequate fee) to write the will of a neighbour or a friend, he uniformly refused to be accessary to their bequeathing as property the persons of his fellow-men. "Deep-rooted customs," he observes, "though wrong, are not easily altered; but it is the duty of all to be 'firm in that' which they certainly know is 'right for them.' A charitable benevolent man, well acquainted with a negro, may, I believe, under some circumstances, keep him in his family as a servant for no other motive than the negro's good. But man, as man, knows not what shall be after him, nor hath assurance that his children will attain to that perfection in wisdom and goodness necessary rightly to exercise such power," *viz.* as that of the owner over his slave. As the first-fruits of this firmness, and which no doubt were highly grateful, he relates instances in which his refusal, and the reasons he gave for it, procured the freedom in lieu of the transmission of the slaves in question.

Having been acknowledged by his friends in the capacity of a minister of the gospel, he made some journies in the exercise of his gift, which served to give him a further insight into the condition of the negroes on that continent, and further excited his attention to the then practice of the society of friends, in common with others, of holding them in bondage, and even of buying them. In the year 1746 he passed through Virginia, Maryland, and Carolina, of which he writes as follows: "Two things were remarkable to me in this journey: first, in regard to my entertainment, when I ate, drank, and lodged at free-cost with people who lived in ease on the hard labour of their slaves, I felt uneasy; and as my mind was inward to the Lord, I found, from place to place, this uneasiness return upon me at times through the whole visit. Where the masters bore a good share of the burthen, and lived frugally, so that their servants were well provided for, and their labour moderate, I felt more easy; but where they lived in a costly way, and laid heavy burthens on their slaves, my exercise (trouble of mind) was often great, and I frequently had conversation with them in private concerning it. Secondly, this trade of importing slaves from their native country being much encouraged among them, and the white people and their children so generally living without much labour, was frequently the subject of my serious thoughts. And I saw in these southern provinces so many vices and corruptions, increased by this trade and this way of life, that it appeared to me 'as a gloom over the land;' and though now many willingly run into it, yet in future the consequence will be grievous to posterity. I express it as it hath appeared to me, not once nor twice, but as a matter fixed on my mind."

It is probable that the inhabitants of the southern provinces of North America now see pretty clearly that their negro population, without consummate prudence, as well as great kindness in the management of them, are likely one day to justify these anticipations.

On his return from the above-mentioned journey, he committed to paper his sentiments on slave-keeping, and after the MS. had lain long by him, it was published, with the approbation and at the expence of his friends, who began (in Pennsylvania and the Jerseys at least) to be more generally influenced by the humane and Christian views of Woolman, Benezet, and others on this subject. It was entitled "Some Considerations on the keeping of Negroes;" and in 1762 was followed by a "Second Part," the expence of which he preferred to take upon himself, for a reason which evinces his strict regard to justice. He considered that many, who did not yet see the evil of the practice, nor approve of his writings against it, were contributors to the general fund of the society, out of which the cause was proposed to be defrayed.

Some other reflections, written in 1757, while he was on a journey among slave-holders, and recorded in his "Memoir," are forcibly descriptive of his views and feelings.

The necessary brevity of this article will permit only a general account of John Woolman's labours in the cause of humanity. From private conferences with the holders of slaves, he proceeded to public addresses to the society in their meetings for discipline: and when at length the principle of the unlawfulness to Christians of this degrading practice had been generally recognized among them, he united other members with himself in paying visits to such of the society, within his sphere of action, as required the stimulus of remonstrances to induce them to comply with the sense of their brethren on this subject. These proceedings were prosecuted through several journies; in which at one time the religious welfare in a more general sense, at another the right conduct in this particular of his fellow-members, engaged his attention. He did not live to see the completion of his wish, as it related to the society; for it was not

till

till the year 1787 that the laft flave difappeared from among them. But the near approach of this confummation was witneffed by his coadjutor, Anthony Benezet, who died in 1784, whofe fame has fpread wider than Woolman's, becaufe his opportunities were more extenfive, who lived for the caufe throughout Europe, and carried its fuccefsful plea from the narrow limits of the fociety of Friends into the world at large. Of this excellent man, whofe biography efcaped the early part of this work, it may not be too late here to record in brief,—that he was born at St. Quintin, in Picardy, of a refpectable family, in 1713; that he was carried by his father, who fled from the perfecutions which fell upon the Huguenots, to London, and there formed for mercantile purfuits; that upon removing to Philadelphia with his family in 1731, having now entered into the fociety of Friends, he devoted his life, upon principle, firft to the education of youth in ufeful knowledge and the Chriftian faith, and ultimately to the nobleft toils of humanity. But to return to our prefent fubject: in the year 1772, John Woolman, believing it his duty to pay a religious vifit to the friends in England, embarked for that purpofe at Chefter, on the Delaware, and arrived at London in time to attend their yearly meeting. After it he travelled, exercifing his miniftry among his friends, through feveral counties, as far as York. Here, at a large quarterly meeting, he once more pleaded for the negroes, endeavouring, and probably with effect, to engage the fupport of thofe prefent to the caufe of humanity: foon after which he was feized with the fmall-pox. During a fevere ftruggle with this difeafe, he manifefted great patience and humility, with a firm faith in the Redeemer: and nature finking in the conflict, he expired in peace in his fifty-fecond year.

As a preacher, we hear not of his eloquence nor of his learning, except, fays one of the refpectable friends who has favoured us with the documents of this article, "in heart-knowledge, and in the fchool of Chrift;" but in life, he was a bright example of the integrity, meeknefs, charity, and beneficence which in that fchool alone are to be acquired; and his memory for his works' fake is bleffed. Memoir of John Woolman, chiefly extracted from a Journal of his Life and Writings, London, 1815.

WOOLPER'S CREEK, in *Geography*, a river of Kentucky, which runs into the Ohio, N. lat. 38° 53'. W. long. 85° 7'.

WOOLPIT, a village of England, in the county of Suffolk; 8 miles E. of Bury St. Edmunds.

WOOLSTANTON, a village of England, in Staffordfhire; 2 miles N. of Newcaftle-under-Line.

WOOL-STAPLE, denotes a city or town where wool ufed to be fold. See STAPLE.

WOOLSTED. See WORSTED.

WOOLSTON, THOMAS, in *Biography*, an Englifh divine, was born in 1669 at Northampton, and admitted in 1685 of Sidney college, Cambridge, where he was diftinguifhed by his diligence and regularity. He was elected fellow of his college, took orders, preached with approbation, and was efteemed for his learning and piety. In his exercifes for the degree of B.D. he maintained "the exact fitnefs of the time in which Chrift was manifefted in the flefh," in a difcourfe which was well received. But his temper being naturally enthufiaftic, and perufing the works of Origen, he indulged a great fondnefs for allegorical interpretations of fcripture, which afterwards led him into a variety of fingular and extravagant opinions. He began in 1705 with "The old Apology for the Truth of the Chriftian Religion againft the Jews and Gentiles revived," maintaining that all the actions of Mofes were typical of Chrift, and of his church; and the book was iffued from the univerfity prefs. Woolfton remained in college till the year 1720, when he went to London, and publifhed a Latin differtation concerning the fuppofed epiftle of Pontius Pilate to Tiberius, relative to Jefus Chrift. In the fame year he alfo publifhed two Latin epiftles, addreffed to Whitby, Waterland, Whifton, and others: "Circa Fidem vere Orthodoxam et Scripturarum Interpretationem," defending Origen's allegorical interpretation of fcripture. His deviation from the eftablifhed faith was more apparent in his inquiry, "Whether the people called Quakers do not the neareft of any other fect in religion refemble the primitive Chriftians in principles and practice?" Blending farcafm with argument, he now feemed to indulge a fpirit of animofity againft the clergy. Declining at the fame time to refide at college, he was deprived of his fellowfhip in 1721. In his "Four Free Gifts to the Clergy," he denominated them "hireling priefts," and "minifters of the letter." Although he might be fufpected, he was not yet chargeable with hiftorical incredulity; for in 1726 he publifhed "A Defence of the Miracle of the Thundering Legion againft Mr. Moyle." At length he engaged in the controverfy between Anthony Collins and his opponents, and publifhed "The Moderator between an Infidel and an Apoftate," and "Two Supplements," in which he not only contended for myftical interpretations of the miracles of Chrift, but maintained that they were never actually wrought. Confidered as an avowed enemy to the Chriftian religion, a profecution was inftituted againft him by the attorney-general, but ftayed by the interpofition of Whifton, and fome other advocates of toleration. Notwithftanding this lenity, he proceeded in publifhing "Six Difcourfes on the Miracles," and two "Defences of the Difcourfes," in which, blending ridicule and buffoonery with argument, he maintained his offenfive opinions. This pertinacity and rudenefs prejudiced believers in the divine miffion of Chrift againft him; replies iffued from the prefs; but as he again became amenable to the law, he was tried at Guildhall before lord chief juftice Raymond, when, after many arguments for and againft him, he was found guilty, and fentenced to a year's imprifonment, and a fine of 100*l*. Unable to pay his fine, he refided within the rules of the King's Bench, and fubfifted by an annual allowance granted to him by his brother, and the contributions of fome learned and liberal friends, who vindicated his intentions, whilft they difapproved his enthufiafm and fanaticifm. Among thefe were fome, and particularly Dr. S. Clarke, who condemned every fpecies or femblance of religious perfecution, and who endeavoured to procure his releafe; but they could not prevail upon him to ftipulate that he would not perfevere in publifhing his peculiar opinions. But death gave him that releafe, which his friends could not obtain for him; as he was carried off by an epidemic difeafe, within four days after his feizure, in January 1732–3. Not long before he expired, he faid, "This is a ftruggle which all men muft go through, and which I bear, not only patiently, but willingly." His moral character is faid to have been unimpeachable, and his head was thought to have been more difordered than his heart. Biog. Brit.

WOOLWICH, in *Geography*, a market-town and parifh in the hundred of Blackheath, lathe of Sutton-at-Hone, and county of Kent, England, is fituated on the S. bank of the Thames, 8 miles E. from London. The etymology of Woolwich, a name very varioufly written at different periods, is uncertain: according to Hafted, in his "Hiftory of Kent," one of the ancient names, Hulviz, fignified the "dwelling on the creek." The parifh comprehends about

about 700 acres, of which above one-half, however, lie on the oppofite bank of the Thames, in the county of Effex, and confifts of marfh-land, on which ftood formerly a few houfes, and a chapel of eafe. The manor of Woolwich is fubordinate to the royal manor of Eltham. The town confifts chiefly of one narrow irregular ftreet, confined between the rifing land and the river; but feveral other ftreets, rows, and lanes, are connected with it. The church, a fpacious brick building, confifts of a nave, chancel, and aifles. It is fituated on an eminence overlooking the town and the dock-yard, and was completed in 1740. Befides this building, Woolwich contains feveral different diffenting meeting-houfes. The principal charitable eftablifhments are an alms-houfe and two fchools. Woolwich was originally but a fmall place, inhabited by fifhermen, and is indebted for its importance to the eftablifhment of a royal dock there in the reign of Henry VIII. Since that time, it has gradually arrived at its prefent augmented ftate; but particularly fince the eftablifhment there of the head-quarters of the artillery and the royal arfenal; by which means the population within the laft hundred years has increafed fix-fold. The precife period of the eftablifhment of the dock-yard is uncertain: it appears, however, that the Harry Grace de Dieu, of 1000 tons, was built there in 1512. This celebrated fhip is ftated to have been in length 128 feet, and in breadth 48 feet: fhe had three flufh decks, a forecaftle, half-deck, quarter-deck, and round-houfe, and carried 176 pieces of ordnance: fhe had eleven anchors, the largeft of which weighed 4400lbs. In its prefent enlarged ftate, the yard extends about five furlongs along the river by one furlong in breadth. It comprehends two dry docks, feveral flips, three maft-ponds, a fmith's-fhop and forges for making anchors, a model-loft, ftore-houfes, fheds, dwellings for various officers, and all other requifite buildings. The whole is under the immediate infpection of the navy board, but conducted by feveral refident officers. The number of artificers and labourers employed during peace is about 1500; but in war-time it rifes towards 4000. Between the dock-yard and the royal arfenal, formerly called the Warren, is the rope-walk, 400 yards in length. The military and civil branches of the office of ordnance have been eftablifhed at Woolwich fince the acceffion of George I. In the time of peace, this arfenal is the great repofitory of naval ordnance, where the guns of moft of the fhips of war are laid up there in order. The repofitory contains alfo an extenfive collection of military machines and models. The arfenal, comprehending about fixty acres of ground, contains, with other buildings, the foundery, and the late military academy, which was erected by fir John Vanbrugh. The foundery is provided with feveral furnaces, the largeft of which will melt about feventeen tons of metal at once. It contains alfo machinery for boring brafs cannon, as they are improperly called, for they are compofed of copper and tin inftead of zinc. In the adjoining laboratory, bombs, carcafes, cartridges, &c. for the navy and army, are prepared. The number of perfons employed in the arfenal during war is about 300, exclufive of the convicts belonging to the hulks or prifon-fhips lying in the river. The military academy, although founded in 1719, was not finally arranged till 1741, and has been fortunate in poffeffing, in the mathematical chairs, the eminent profeffors Derham, Simpfon, and Hutton. Befides the mathematical profeffors, here are mafters in chemiftry, fortification, arithmetic, French, drawing, fencing, &c. The number of pupils or cadets, deftined for the two corps of artillery and royal engineers, has been lately about 300. To provide neceffary accommodation, with offices, &c. a new edifice was conftructed and opened in 1806, about a mile S. from the town, on the upper part of the common. It is built in the caftellated form, from defigns by Mr. James Wyatt. The principal front facing the N. extends above 200 yards. The expence of the ftructure is eftimated at not lefs than 150,000*l.* The eftablifhment is appropriated to the fenior clafs of the cadets, the junior being for the prefent fixed at Black-Water in Hampfhire. Between this new academy and the town are extenfive ranges of barracks, &c. for the royal artillery, horfe and foot, which has increafed during the late war beyond all former example.

The population of Woolwich, in the return of 1800, was ftated at 9826, exclufive of the military, inhabiting 1362 houfes; but the number was probably under-rated; for in the return of 1811, the inhabitants are ftated to be 17,054, and the houfes 2487. Woolwich-common unites with the extenfive plain of Blackheath on the S., which gives name to the hundred. At its eaftern extremity rifes Shooter's-hill, which commands extenfive and interefting profpects in all directions. The view from it of London, the Thames, and the fhipping, is peculiarly impreffive. Over this hill paffed the great Roman road from the E. coaft of Kent, through *Durovernum*, now Canterbury, and *Durobriva*, Rochefter, to London. Its courfe is nearly purfued by the prefent road from Shooter's-hill, for eight miles, to a place beyond Dartford.—Beauties of England, Kent, by E. W. Brayley, 8vo. 1806.

Woolwich, a townfhip of New Jerfey, in the county of Gloucefter, with 3063 inhabitants; 10 miles S.E. of Philadelphia.—Alfo, a townfhip of the province of Maine, containing 1050 inhabitants, on the E. fide of the Kennebeck; 16 miles N.E. of Brunfwick.

WOOL-WINDERS are perfons employed in winding up fleeces or wool into bundles to be packed, and fold by weight. Perfons winding and felling deceitful wool, fhall forfeit for every fleece 6*d.* Thefe are fworn to do it truly between the owner and the merchant. 8 Hen. VI. cap. 22. 23 Hen. VIII. cap. 17.

WOORLA, in *Geography*, a town of Hindooftan, in Vifiapour; 16 miles N. of Merritch.

WOOTAMALLY, a town of Hindooftan, in Madura; 15 miles S.W. of Coilpetta.

WOOTTON, John, in *Biography*, an eminent, though not very able, painter of landfcape and animals, who flourifhed in England about 1720. He was a pupil of John Wyck, and was much employed in the portraits of horfes and dogs, and in painting the fports of the field, particularly fox-hunting; upon which fubject there are feven pictures of his engraved by Canot. Once at leaft he attempted (but he did not frequently repeat the attempt) to pourtray a battle, and his fubject was that of Culloden at the time of the rout of the rebel army. It has been engraved by Baron, though it is but an indifferent performance. He died in 1765. He had been fuccefsful in the purfuit of his art, for he was enabled by its proceeds to build a houfe in Cavendifh-fquare, where he lived, and had painted it with tafte, according to Walpole, who praifes his works ridiculoufly. His pieces, he fays, were high, forty guineas for a fingle horfe the fize of life, and twenty if fmaller.

WOOTTON-BASSET, in *Geography*, a borough and market-town of Wiltfhire, England, is fituated near the northern extremity of the county, at the diftance of 36 miles N. by W. from Salifbury, and 89 miles W. from London. It confifts chiefly of one principal ftreet, about half a mile in length. The houfes are moftly conftructed of brick with thatched roofs. Two reprefentatives have been regularly deputed from this town to ferve in parliament

ment fince the 25th of the reign of Henry VI. They are elected by the inhabitant houfeholders legally fettled there, and paying fcot and lot. The corporation is compofed of a mayor, two aldermen, and twelve burgeffes. The market-day is Tuefday, weekly; and there are alfo fix fairs annually. In the centre of the town are a market-houfe and fhambles; and near this is the town-hall, in which a machine, called a "cucking or ducking-ftool," formerly ufed for the punifhment of female fcolds, was lately preferved. The church is an old building dedicated to St. Bartholomew, but it is not remarkable for beauty of architecture, nor does it contain any monument or infcription worthy of notice.

According to the population returns of 1811, the borough and parifh contained 321 houfes, and 1390 inhabitants, who formerly carried on a confiderable trade in broad-cloths; but there is now no ftaple manufactory of any fort, though fome attempts have been lately made to introduce the bufinefs of rope-making and fack-making. In this parifh are two free-fchools and a Sunday fchool. The former were founded and endowed by the earl of Clarendon, one of them for twelve boys, and the other for twelve girls.

At the time of the Conqueft, this place was called fimply 'Wodeton.' It was then the property of Milo Crifpin; but in lefs than a century afterwards it was poffeffed by the Baffets of Wycomb, a branch of the noble family of the Baffets of Drayton. The prefent proprietor is the earl of Clarendon. The ancient manor-houfe, which ftands on the fummit of a confiderable eminence, is now converted into a farm-houfe, whence the eye furveys a very extenfive profpect into Somerfetfhire, Gloucefterfhire, &c. A variety of curious conical ftones, refembling fmall fir-apples, have been dug up in different fpots around the town, imbedded in a fort of blue marly ftone.

Liddiard-Tregooze, or Lydiard-Tregofe, is a village and parifh, fituated at the diftance of three miles north-eaft from Wootton-Baffet. According to the population returns of 1811, the parifh contains 95 houfes, and 613 inhabitants.

The church, an ancient ftructure, is divided into a nave, two fide aifles, and a chancel, with a fquare tower at the weft end, furmounted by an open baluftrade and angular pinnacles. The church contains feveral interefting monuments of the St. John family; alfo a very curious genealogical table with arms, &c.

Adjoining to the church is Liddiard-park, the feat of lord Bolingbroke. The attached grounds are extenfive, and contain many large clumps of trees, among which are a great number of old oaks.—Beauties of England and Wales, Wiltfhire, by J. Britton, 1815.

WOOTZ, in *Metallurgy*, a metal extracted from an ore of iron in the Eaft Indies, the nature of which is not known at prefent in Europe. Wootz is highly efteemed by the natives of India, and applied to various purpofes in the arts.

Dr. Scott gave the following account of its properties, in a letter to the prefident of Bombay:—"Wootz admits of a harder temper than any thing known in that part of India. It is employed for covering that part of gun-locks againft which the flint ftrikes. It is ufed for cutting iron on a lathe, for cutting ftones, and for chifels; alfo for making files and faws, and for every purpofe where exceffive hardnefs is neceffary: it cannot, however, bear any thing beyond a flight red heat, which makes it work very tedioufly in the hands of the fmith. It has a ftill greater inconvenience or defect, that of not being welded with iron or fteel, to which, therefore, it is only joined by fcrews and other contrivances." Dr. Scott obferves farther, that when wootz is heated above a light red heat, part of the mafs feems to run, and the whole is loft, as if it confifted of metals of different degrees of fufibility. The working with wootz is fo difficult, that it is a feparate art from that of forging iron. The magnetical power can only be imperfectly communicated to it. Specimens of wootz fent from India were examined by Dr. George Pearfon, who ftates in the Phil. Tranf. vol. xcv., that they were in the form of round cakes, about five inches in diameter and one thick, each of which weighed more than two pounds. The cake had almoft been cut through, fo as to divide it into two nearly equal parts. It was externally of a dull black colour, the furface was fmooth, the cut part was alfo fmooth, and, excepting a few fmall holes, the texture appeared to be uniform. No indentation could be made in it by blows with a heavy hammer, nor was it broken by blows that might have broken a like piece of fteel. Fire was elicited on collifion with flint. It poffeffed the hardnefs of fome kinds of crude iron, but did not effectually refift the file, like highly tempered fteel, and many kinds of crude iron. It admitted a polifh equal to the beft fteel. The wootz-filings were attracted by the magnet like common iron-filings. When broken, it exhibited the fracture and colour of a rather open-grained fteel. It was taftelefs and inodorous. Its fpecific gravity in different ftates, as given by Dr. Pearfon, ranges from 7.2 to about 7.7, which is nearly the fame as fteel. From the properties of this fubftance, Dr. Pearfon concludes, that wootz approaches nearer to the ftate of fteel than raw iron, although it poffeffes fome of the properties of this laft fubftance. It is not to be referred to that kind of fteel in which there is either an excefs or deficiency of carbon, but it contains fomething befides carbon and iron, otherwife it would be common fteel. The folution in nitrous and dilute fulphuric acid contained only oxyd of iron, and the refidue of carbonaceous matter, as in common fteel. Hence, fays Dr. Pearfon, it is obvious to fufpect, that wootz contains oxygen, either equally united with every part of the mafs, or united with a portion of iron to compofe oxyd, which is diffufed through the mafs. To this circumftance, Dr. Pearfon feems inclined to attribute the fmaller quantity of hydrogen gas given out during folution, than is afforded by common fteel, and to account for its partial fufibility and difficult malleability, and may be the reafon of its taking a fine edge or polifh. The oxyd is not perhaps equally diffufed; hence the wootz is not quite uniform in its texture and hardnefs until it has been remelted. The proportion of oxygen in wootz, fays Dr. Pearfon, muft, however, be very fmall, otherwife it would not poffefs fo much ftrength, and break with fo much difficulty. The oozing out of matter when fufed is analogous to what appears on refining raw iron. Although no account is given by Dr. Scott of the procefs for making wootz, we may without much rifk conclude, that it is made directly from the ore, and confequently that it has never been in the ftate of wrought iron, for the cake is evidently a mafs which has been fufed, and appears to have been cut almoft quite through while white hot at the place where wootz is manufactured. The particular ufes to which wootz may be applied are to be inferred from the preceding account of its properties and compofition; and may be proved by an extenfive trial of it in all the arts which require iron. See Phil. Tranf. vol. xcv.

WOPANKEN, in *Geography*, a town of Pruffia, in the province of Bartenland; 2 miles E. of Bartenftein.

WOPELBACH, a river of Ofnabruck, which runs into the Dalcke, 2 miles N. of Weidenbruck.

WORADA, a country of Africa, of an oval form, about 90 miles in circumference, S. of Konkadoo.

WORANY, a town of Lithuania; 28 miles S. of Troki.

WORBIS, or STADT WORBIS, a town of Weftphalia, in the territory of Eichsfeld, on the Wipper; 8 miles S.S.E. of Duderftadt.

WORBIS, *Breiten*, a town of Weftphalia, in the territory of Eichsfeld; 9 miles S.E. of Duderftadt.

WORBIS, *Kirch*, a town of Weftphalia, in the territory of Eichsfeld; 8 miles S.S.E. of Duderftadt.

WORBITZ, a town of Bohemia, in the circle of Czaflau; 10 miles S. of Czaflau.

WORBITZ *See*, a lake of the Ucker Mark of Brandenburg, near Joachimfthal; 28 miles N.N.E. of Berlin.

WORBSTADT, a town of France, in the department of Mont Tonnerre; 10 miles S.S.W. of Mentz.

WORCESTER, the capital city of a county of its own name, in the W. of England, fituated in N. lat. 52° 10′, and W. long. 2° 00′; diftant 26 miles N. from Gloucefter, 27 S.W. from Birmingham, 30 E. by N. from Hereford, and 111 W.N.W. from London. The inhabitants in 1811 were, according to the returns made to parliament, 5953 males, and 7861 females, in all 13,814, and the houfes 2527.

Hiftorical Events.—Worcefter is a place of high antiquity, as implied by the latter part of the name, indicating that the original town occupied the pofition of a Roman ftation: its proper name under thofe people, however, has not yet been afcertained. Camden indeed conceives it to be the *Branonium* of Antoninus' Itinerary, the fame with the *Branogenium* of Ptolemy; but that town is placed by Horfley at Ludlow, more to the N.W., on the S. border of Shropfhire. Nennius, who wrote in the beginning of the 7th century, points out Worcefter by the Britifh names *Caer-Guorangon* and *Caer-Guorcon*. By the Saxons it was called *Weogare-ceafter*, or *Wegeorna-ceafter*, from which came *Wigornia*, the Latin name ftill in ufe. In the Domefday-book it is called *Wireceftre*. The diocefe of Worcefter was founded by Ethelred, king of Mercia, about 680, the firft bifhop nominated being Tatfrith; but dying before confecration, the firft who filled the epifcopal chair was Bofel, a learned man from the celebrated monaftery of St. Hilda, at Whitby in Yorkfhire. St. Egwin, the third bifhop, who was appointed in 693, was the founder of the abbey at Evefham. Milred was nominated in 744. The 17th prelate was the famous St. Dunftan, who was appointed in 957. St. Wulftan II., appointed in 1062, was the founder of the prefent cathedral. Adam de Orleton, bifhop in 1327, is fuppofed to have prompted the murder of Edward II. by the equivocal anfwer he gave when confulted on the project: "*Edwardum occidere nolite timere bonum eft.*" The 69th bifhop, nominated to Worcefter in 1521, was the celebrated Julius de Medicis, a cardinal, and afterwards pope Clement VII. His fucceffor, Jerome de Ghinucci, alfo an Italian, was deprived at the Reformation, and, in 1535, was fucceeded by Hugh Latimer, who fuffered for his Proteftant profeffion, under queen Mary, in 1555. John Prideaux, the 84th prelate, appointed in 1641, was difmiffed during the interregnum, his bifhopric fequeftered, and himfelf allowed four fhillings and fixpence *per* week for his maintenance. The eminent fcholar Stillingfleet filled the fee from 1689 to 1699. In 1717, the fee was filled by John Hough. (See his biographical article.) The learned bifhop Hurd, appointed in 1781, was fucceeded in 1799 by the prefent prelate, bifhop Cornwall. The revenues of the fee were, in 1699, fixed at 1302*l.* 15*s.* 4½*d.*; but now fuppofed to exceed 3000*l.* The fee has poffeffed one pope, four faints, feven high-treafurers of England, eleven archbifhops, befides chancellors of the kingdom, and other great officers of the ftate. Few places, perhaps, have fuffered more than Worcefter by the inteftine broils of the country, and by cafual difafters. Ruined by the Danes about the year 894, it was rebuilt by Ethelred and Ethelfleda; but the inhabitants refufing to pay the tax called danegelt, the city was again laid wafte by Hardicanute. Again reftored, it fuffered feverely during the conteft between king Stephen and the emprefs Maud, as well as by a fire, from which the walls of the cathedral alone were preferved. Taking the part of Lewis, the dauphin of France, againft king John, the king's troops exercifed every tyrannical feverity on the inhabitants; the church was plundered, and a heavy fum exacted from the clergy. John was neverthelefs interred in the cathedral in 1216. It was in Worcefter that, previoufly to the battle of Evefham, young Edward raifed the ftandard of loyalty for his father, Henry III. After the acceffion of Henry VII. feveral citizens were beheaded, and a fine of 500 marks was levied on the city. In 1642 Worcefter witneffed the fanguinary conteft which terminated fo fatally for the affairs of Charles I. (See CHARLES.) In 1646, the city furrendered by capitulation to the parliament's army, having been the firft city in England to declare for the crown, and the laft which held out in its defence. In 1651 happened the fecond battle of Worcefter under Charles II.; a battle which decided the deftructive and vindictive controverfy between the royalifts and the parliamentary party, by which the latter obtained a complete afcendancy; and the king himfelf efcaped with difficulty out of the country. To preferve the memory of this fuccefs, "the lord-general Cromwell, on the 18th of September 1651," fays Leach, in his Diurnal, "with many officers of the army, was at Woollidge, at the launching of a gallant new frigot of the ftates, carrying three-fcore peeces of ordnance, and called her name Worcefter."

Prefent State.—Worcefter is diftinguifhed among the provincial towns of England for its refemblance, in various refpects, to the metropolis. It is defcribed to be well built, well paved, and well lighted. It confifts principally of one great ftreet running from N. to S., and terminating at the cathedral; alfo thirteen other collateral ftreets, befides lanes of inferior dimenfions. The circuit of the city exceeds three miles and a half. The Severn, bathing the weftern fide, and carrying veffels of confiderable burthen, is of great utility in facilitating the commerce to and from, as well as the requifite fupplies of the city. On it, paffage-boats fail up as far as Shrewfbury, and down to Gloucefter and Briftol. The buildings now extend beyond the ancient limits, which may, however, ftill be traced; the old wall, according to a plan made before the civil wars, was in extent 11,650 paces; but this wall, after the laft battle of Worcefter, was almoft wholly deftroyed. The caftle was erected by Urfo of Abitoth about 1088. The area, now called the College-green, was, in the Norman times, the outer ward of that caftle, behind which to the S. was the inner ward, or fortrefs itfelf. A gaol for the retention of the prifoners of the county is all that now remains of the caftle, on the fpot where the kings of England formerly kept their court. A fteep artificial mount, on which probably ftood the keep of the fortrefs, is a prominent object; the furrounding ditch and rampart may alfo be eafily traced.

Cathedral.—The original cathedral of Worcefter was founded in 680; but in 969 its revenues were transferred to to the monaſtery of St. Mary, an eſtabliſhment of the beginning of the eighth century. The church of this monaſtery being unſuitable to its novel application, another cathedral was erected and conſecrated by St. Oſwald, the biſhop, in 983. Being ruined by Hardicanute in 1041, the foundation of a new cathedral was laid in 1084, by biſhop Wulſtan II.; and in 1089 he finiſhed it, together with the monaſtery, and called the ſame *Monaſterium St. Mariæ in Cryptis*. The original plan of this church ſeems to have been a ſimple croſs, the entrance being at the weſt end of the preſent choir, which occupies the place of the ancient nave. This ancient ſtructure had probably a central or principal tower; as it is recorded that the *new* tower fell down in 1175, and two ſmaller ones were deſtroyed by a ſtorm in 1222. The antiquity of this part of the edifice is particularly apparent from the crypt or undercroft, which extends under the choir and its aiſles. This is a curious and intereſting part of the fabric. Twice ſeverely injured by fire, in 1113 and in 1202, the cathedral was re-conſecrated in 1218, by biſhop Silveſter, in the preſence of Henry III. and his court. Six years afterwards the foundation of an additional work, the preſent nave, was laid by biſhop William de Bloys, in which is diſplayed the ſkill of the architect, in adapting the new parts to the former ſtructure. The ſtone-vaulting of the edifice was begun by biſhop Cobham in 1327, and the whole was finiſhed in 1357. The beautiful central tower was conſtructed in 1374. Worceſter cathedral is in the exterior extremely plain, and its attractions conſiſt principally in the height, ſpace, and the lightneſs of its architecture, to which the lofty pinnacles, riſing from every termination of the building, as well as from the tower, not a little contribute. The external length, including buttreſſes, is 426 feet; the internal, 394: that of the nave, from the front to the weſt tranſept, 180; of the choir, including the organ-loft, 120; of the Lady-chapel, 60; of the weſt croſs or tranſept, 128; and of the eaſt tranſept, 120 feet. The nave is ſeparated from the aiſles by ten cluſtered columns on each ſide, ſupporting three ranges of pointed arches; an arrangement alſo carried on through the choir. A ſtone pulpit, originally placed near the weſt end of the nave, is now fixed at the north ſide of the choir. It is of an octagonal form, ornamented with emblematic ſculpture, and ſurmounted by a canopy.

Worceſter cathedral has, like many other edifices of the ſame nature, been a great ſufferer by the lapſe of time, and by the various modes of repair adopted at different periods. It now ſcarcely contains one arris or moulding, as originally conſtructed. Roman cornices now occupy the place of battlements; buttreſſes are pannelled in various heterogeneous ways; pinnacles have been reſtored after the Grecian ſchool; windows formed without ramifications or cuſps, and filled with modern ſtained glaſs, deſtitute of ſubject or deſign; Roman arches reſting on entablatures, to ſupport or ſtrengthen the tranſepts; Roman ſquares with leaves, inſtead of proper baſes to regular cluſtered pillars. Indeed this edifice affords a curious, but not a very pleaſing, diſplay of heterogeneous parts and ſtyles.

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Other places of worfhip belonging to the eftablifhment in Worcefter are, the churches of St. Peter the Great, St. Michael, St. Alban, St. Helen, St. Andrew, St. Clement, St. John Baptift, All Saints, St. Swithun, St. Martin, St. Nicholas, and Claines. Of thefe buildings, fome preferve their ancient appearance. St. Andrew's church is diftinguifhed by a fquare tower, 90 feet high, fupporting an octagonal fpire, in height 155 feet 6 inches; the whole height being 245 feet 6 inches. The church and tower are fuppofed to have been erected in the eleventh century, but the fpire was not added till 1751. Among the various monaftic inftitutions of Worcefter was that remarkable one, now called the *Commandery*, eftablifhed for the maintenance of two chaplains, five poor men, and two poor women, founded by St. Wulftan, who died in 1097: it became, after the diffolution, a part of the endowment of Chrift-church in Oxford. Commanderies were, among the knights-hofpitallers of Jerufalem, the fame with the preceptories among the knights-templars; being focieties placed on the country eftates of the order, under the controul of a commander, but accountable to the grand prior or mafter in London. Part of the ancient buildings ftill exift; but the whole, now in the poffeffion of a private individual, has of late years undergone great alteration.

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Municipal Government.—The city was incorporated by Henry I., but the firft charter was granted in the 45th year of Henry III. In 1621, the 19th year of James I., a mayor was eftablifhed. The corporation now confifts of a mayor, fix aldermen, 24 common-council-men, and 48 affiftants, by which laft two bodies the magiftrates are chofen. But the right of electing the members for parliament extends to upwards of 2000 citizens, the fheriff being the returning officer. Worcefter fent two reprefentatives to parliament in the 23d year of Edward I. Florence of Worcefter, the author of the Chronicon, a general hiftory of the world down to 1118, when he died, was a monk of the cathedral of this city. William of Worcefter was educated in Oxford in 1434, and drew up his "Polyandria Oxonienfis," a hiftory of the learned men bred in that univerfity. His Annals, at the end of the "Black Book" of the exchequer, contain notes on the affairs of his own times. The famous empyric and myftic philofopher, Edward Kelly, was born in Worcefter towards the middle of the 16th century. The relation of the impoftures of this perfon and his affociate Dr. Dee, furnifhed by Lilly, prefent a humiliating picture of the human mind and underftanding in thofe days, on the continent as well as in England. Worcefter produced, in 1650, the eminent lawyer lord Somers, who, by his knowledge and eloquence, defended the caufe of liberty and juftice in the latter part of the reign of Charles II., when but few warm and able advocates were found on their fide in Weftminfter-hall. See SOMERS, *Lord*.

Worcefter has long been rendered very interefting, from the circumftance of the *Royal Porcelain Works* being eftablifhed within its walls. It is, on our part, a moft pleafing duty, not only to trace its rife and progrefs, but to hold up its elegant and highly-finifhed productions to the attention of the liberal and fcientific. A very material difference exifts between this eftablifhment, and others of a fimilar kind on the continent; as the improvements made by expenfive experiments are *here* effected at the fole charge of the proprietors, while the *moft famed* manufactories on the continent are fupported and carried on at the coft of the government of the countries to which they belong. The Worcefter porcelain works were founded in the year 1751, by Dr. Wall and a company of proprietors, compofed of many gentlemen of fortune and confideration in the city and county; who continued to carry on the concern under thofe adverfe circumto the monaftery of St. Mary, an eftablifhment of the beginning of the eighth century. The church of this monaftery being unfuitable to its novel application, another cathedral was erected and confecrated by St. Ofwald, the bifhop, in 983. Being ruined by Hardicanute in 1041, the foundation of a new cathedral was laid in 1084, by bifhop Wulftan II.; and in 1089 he finifhed it, together with the monaftery, and called the fame *Monafterium St. Mariæ in Cryptis*. The original plan of this church feems to have been a fimple crofs, the entrance being at the weft end of the prefent choir, which occupies the place of the ancient nave. This ancient ftructure had probably a central or principal tower; as it is recorded that the *new* tower fell down in 1175, and two fmaller ones were deftroyed by a ftorm in 1222. The antiquity of this part of the edifice is particularly apparent from the crypt or undercroft, which extends under the choir and its aifles. This is a curious and interefting part of the fabric. Twice feverely injured by fire, in 1113 and in 1202, the cathedral was re-confecrated in 1218, by bifhop Silvefter, in the prefence of Henry III. and his court. Six years afterwards the foundation of an additional work, the prefent nave, was laid by bifhop William de Bloys, in which is difplayed the fkill of the architect, in adapting the new parts to the former ftructure. The ftone-vaulting of the edifice was begun by bifhop Cobham in 1327, and the whole was finifhed in 1357. The beautiful central tower was conftructed in 1374. Worcefter cathedral is in the exterior extremely plain, and its attractions confift principally in the height, fpace, and the lightnefs of its architecture, to which the lofty pinnacles, rifing from every termination of the building, as well as from the tower, not a little contribute. The external length, including buttreffes, is 426 feet; the internal, 394: that of the nave, from the front to the weft tranfept, 180; of the choir, including the organ-loft, 120; of the Lady-chapel, 60; of the weft crofs or tranfept, 128; and of the eaft tranfept, 120 feet. The nave is feparated from the aifles by ten cluftered columns on each fide, fupporting three ranges of pointed arches; an arrangement alfo carried on through the choir. A ftone pulpit, originally placed near the weft end of the nave, is now fixed at the north fide of the choir. It is of an octagonal form, ornamented with emblematic fculpture, and furmounted by a canopy.

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Charitable Inftitutions.—The chief of thefe is the houfe of induftry, completed in 1794, a handfome building on the eaft fide of the city, advantageoufly fituated on an eminence, and calculated to accommodate 150 perfons belonging to the different parifhes of the city. The infirmary, fituated in an airy pofition, overlooking the race-ground, the river, and the north-weft parts of the county, was commenced in 1767: it receives about 58 patients on an average annually. A number of hofpitals and alms-houfes, fome of ancient foundation, provide fupport for age, and education for youth. A free-fchool on the Lancafterian plan was eftablifhed fome years ago. The old county-gaol is fituated in the caftle-yard; but a new one has been lately erected in the neighbourhood of the infirmary, on the Howardian plan. The city-gaol is an ancient building in a crowded fituation, having been originally a Francifcan convent, founded in the 13th century, but granted to the city at the diffolution.

Public Amufements.—Worcefter has long maintained its claim to be one of the moft fafhionable cities in the weftern parts of the kingdom: it is confequently the winter-refidence of a number of confiderable families from the furrounding counties of England and Wales. The theatre, affemblies, concerts, races, the various public walks, clubs, the public library, &c. render Worcefter a bufy, gay, and much-frequented city.

Municipal Government.—The city was incorporated by Henry I., but the firft charter was granted in the 45th year of Henry III. In 1621, the 19th year of James I., a mayor was eftablifhed. The corporation now confifts of a mayor, fix aldermen, 24 common-council-men, and 48 affiftants, by which laft two bodies the magiftrates are chofen. But the right of electing the members for parliament extends to upwards of 2000 citizens, the fheriff being the returning officer. Worcefter fent two reprefentatives to parliament in the 23d year of Edward I. Florence of Worcefter, the author of the Chronicon, a general hiftory of the world down to 1118, when he died, was a monk of the cathedral of this city. William of Worcefter was educated in Oxford in 1434, and drew up his "Polyandria Oxonienfis," a hiftory of the learned men bred in that univerfity. His Annals, at the end of the "Black Book" of the exchequer, contain notes on the affairs of his own times. The famous empyric and myftic philofopher, Edward Kelly, was born in Worcefter towards the middle of the 16th century. The relation of the impoftures of this perfon and his affociate Dr. Dee, furnifhed by Lilly, prefent a humiliating picture of the human mind and underftanding in thofe days, on the continent as well as in England. Worcefter produced, in 1650, the eminent lawyer lord Somers, who, by his knowledge and eloquence, defended the caufe of liberty and juftice in the latter part of the reign of Charles II., when but few warm and able advocates were found on their fide in Weftminfter-hall. See Somers, *Lord.*

Worcefter has long been rendered very interefting, from the circumftance of the *Royal Porcelain Works* being eftablifhed within its walls. It is, on our part, a moft pleafing duty, not only to trace its rife and progrefs, but to hold up its elegant and highly-finifhed productions to the attention of the liberal and fcientific. A very material difference exifts between this eftablifhment, and others of a fimilar kind on the continent; as the improvements made by expenfive experiments are *here* effected at the fole charge of the proprietors, while the *moft famed* manufactories on the continent are fupported and carried on at the coft of the government of the countries to which they belong. The Worcefter porcelain works were founded in the year 1751, by Dr. Wall and a company of proprietors, compofed of many gentlemen of fortune and confideration in the city and county; who continued to carry on the concern under thofe adverfe circum-

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ftances generally attending the introduction of *a new fpecies* of manufacture: for at that time little was known of porcelain in England, except by the imports from foreign nations. The Worcefter porcelain company had the merit of difcovering the method of transferring impreffions from *engraved copper-plates* to the furface of the porcelain. The invention, after a lapfe of feveral years, was conveyed into Staffordfhire, and now forms a grand branch of the extenfive foreign and home trade carried on in the potteries, giving employment to many thoufands. The *founders* of this manufactory, befides the printing, produced neat enamelled defigns, but not very fuperior either in defign or execution. Thefe extenfive premifes, fituate on the banks of the Severn, were fubfequently purchafed by Meffrs. Jofeph Flight and Martin Barr, and by a liberal policy, and great exertion and expence in a long feries of experiments, the productions of thefe works have rifen rapidly in the public eftimation. His prefent majefty, the queen, and princeffes, in the year 1788, honoured the manufactory by minutely infpecting its various proceffes; and at this time the king gracioufly granted his patent, when thefe works were ftyled 'Royal,' being the firft that enjoyed this diftinction. His majefty condefcended to fuggeft the eftablifhment of a warehoufe in London, and one was immediately opened in Coventry-ftreet. The proprietors have fince had the honour of receiving a patent and every encouragement from his royal highhefs the prince regent, the enlightened patron of the arts; and from the late princefs Charlotte, as well as from other members of the royal family, and even from foreign courts; but our limits forbid our entering into detail. On the demife of Martin Barr, efq. in the year 1813, he was fucceeded by his fons; and the works are now carried on under the firm of Flight, Barr, and Barr. It is not a little remarkable, that a confiderable part of the export trade of the Worcefter porcelain works is to our fettlements in the Eaft Indies, and even to Canton. We cannot but obferve the fingular change in our commercial relations *in this manufacture;* for the Chinefe, who feventy years fince furnifhed this country and nearly all Europe with porcelain, are now excluded from our markets, and thrown into the back-ground, and their extenfive manufactories nearly ruined. What Wedgwood did in his coarfer clays, in his beautiful imitations of the Etrufcan vafes, and in antique defigns on jafper, will long live in the recollection of his country. The fame fpirit feems to actuate the proprietors of the Royal Worcefter Porcelain Works, as they have fpared no expence *in their finer materials*, and highly-finifhed models and paintings, to excel the manufactories on the continent. In thefe works, the utmoft attention is paid to the ftudy of hiftorical compofitions, landfcapes, flowers, &c.; and the fuccefs which has attended the new method is moft evident, as the productions now fairly rival the beft foreign fpecimens. It is with peculiar pleafure we can at length announce, that we have feen a *fabric*, recently made by the prefent proprietors of thefe works, which in its colour, fracture, and tranfparency, is equal to the porcelain made at Sevre or Drefden. This fabric is compofed *entirely of Britifh materials*, and the fact muft be the ground of triumph, after all that has been faid of the impoffibility of finding in this country proper materials *for a true porcelain*. The *procefs* is moft curious and elaborate, of which we can but give a flight defcription, as its details are fo numerous. It may be viewed by tickets, granted by order of the proprietors to any refpectable individuals leaving their names. The materials, feveral of which are procured from the county of Cornwall, are firft felected with great care, and fome undergo a fevere calcination previous to their being compofed in proper proportions; they are then weighed and mixed, and burnt in a kiln to a very intenfe degree of heat, and form what is termed a 'frit.' This is ground under a maffive iron roller previous to an admixture of a certain proportion of the pureft argil, or working clay, which is ground with the frit in a mill, the bottom of which is laid with ftone, over which large ftones of about fifteen hundred or a ton weight are driven by upright 'drivers,' fixed in wooden arms attached to the centre fhafts; thefe, with water, reduce the fubftance to a thick white liquid, which is afterwards paffed through an extremely fine lawn fieve, and is run from cifterns into large brick pans, warmed by flues underneath; the heat being fufficient to drive off, by evaporation, the water that cannot be collected on the furface, fo that the refiduum is a moift clay, which is afterwards tempered in ftone vaults, and rendered fit for the ufe of the potter. The man who firft brings the rude mafs of clay into form, on a circular block, moved horizontally by a boy, who drives a vertical wheel, is called a 'thrower.' The dexterity and rapidity with which the clay appears to fpring into the fhape required feems like magic, as it is performed filently, and almoft unperceived, by the preffure of the fingers and thumb. This mode of 'throwing' differs from the Chinefe method, and that practifed on the continent, where the thrower moves his block by the action of his feet: in the one he has the advantage of an undivided attention, and the clay is literally obedient to his touch; while in the foreign method, the thrower is diftracted with two diftinct operations, and at the beft it can be but a clumfy exhibition. By this mode all *round* veffels derive their firft formation; any article of an oval, fquare, or other fhape, muft be made off a mould formed of alabafter, prepared in a powder, and with water brought into a liquid form, when it is run on the model, and fets quite hard, prefenting a cafe the precife reverfe of the model, on which layers of clay, cut to a proper thicknefs, are preffed with a fponge and the hand, and the artift from this is termed 'a preffer.' Great care is requifite in drying the different articles in a ftove after they come from the thrower, to render them fufficiently firm to hang on a lathe, where they are reduced to a proper thicknefs, and a more accurate form, by a turner, who works his wheel on the fame principle as one for wood or ivory. It is again committed to the ftove, where it is rendered quite dry and crifp; and the furface is afterwards fponged, and then rubbed with paper perfectly fmooth. In pieces which have any particular marks or decorations in the clay, they are preffed from moulds, and the handles are attached to the veffel fimply by the clay reduced to a liquid form. When burnt, the union is fo complete, that it appears to have been made altogether, and is perfectly as firm. We cannot trace the operations in this ftage any farther, but are furprifed to fee how many hands the moft fimple article paffes through, while the rifk and labour in thefe and more elaborate fpecimens are very great in this tender ftate of the clay. From the potter's-ftove the ware is carried to what is termed the bifcuit-kiln, and placed in cafes of fire-clay, called feggars, in which each piece requires particular fupports to prevent its yielding to the fire, and lofing its proper fhape. Here the porcelain is burnt to an intenfe degree of heat, and is rendered quite white and tranfparent, but has a flight roughnefs on its furface. From hence it is carried to the warehoufe, examined, freed from duft and other imperfections, and then dipped in a liquid termed the glaze, dried in a ftove, and afterwards every piece is carefully examined and 'trimmed;' which confifts in rendering the furface quite even, and fcraping the glaze from the feet, which, if not removed, would *melt* and adhere to the cafes in which they are burnt.

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From the glazing-room the articles are carried to the fecond kiln, and here they undergo another fevere fire, which fluxes the glaze, and gives to the porcelain a beautiful gloffy furface. In this kiln the loffes are great, as the porcelain can have no fupport. It is again warehoufed, examined, and delivered to the painters, who decorate it with gold, reduced by a chemical procefs, fo that it may be worked in a liquid form. In paintings of various defigns, the outline is made with a black-lead pencil, on the glazed furface, corrected with Indian ink; and the colours, all of which are prepared from mineral fubftances, worked in oil and fpirits of turpentine, are laid on with fine camel's-hair pencils. The colours in this ftate are difficult for ftrangers to underftand, as their tints are fo furprifingly changed by the action of the fire; while their opaque and obfcure appearance is increafed at every ftage of drying at a common fire, previous to their being burnt in the kiln. The finer kinds of paintings in figures, landfcapes, flowers, &c. require repeated burnings, in order to give them fufficient depth and richnefs by working one tint over another. The enamelling kiln, in which they are fired, is rendered fufficiently hot to fufe the glaze, without occafioning it to run; while the colours, by the aid of their fluxes, are melted into the glaze, fo as to render their union perfect, and give them their rich tranfparent effect.

The *durability* of thefe colours, which cannot be acted on by any atmofphere, renders good painting in this ftyle very defirable. It has long been a defideratum with the greateft mafters to procure colours for painting on canvas, on which *time* can have no injurious effect; but in this they have hitherto unfortunately not fucceeded, and it was the regret of an eminent artift, that his paintings had not *the permanency of porcelain colours*. A method of printing, entirely different from the original mode invented by the founders of the works, is now carried on here. (For a defcription, fee PRINTING *on Porcelain*, in the *Addenda*.) The laft operation is the burnifhing of the gold, which is executed with a ftone, black in its external appearance, and remarkable for its hardnefs and the high polifh it takes. This work is performed by women, who render the gold extremely brilliant by rubbing its furface with great care and fkill. The emboffed gold, for which this manufactory is celebrated, is burnifhed with a fine agate, which is alfo ufed in chafing and in finifhing the handles of vafes, &c. We have now fketched the procefs, but we fhould not omit to mention that in *every ftage* the porcelain is very liable to accident and imperfections; and if not totally fpoiled, it may require a repetition of firings, which much increafes the rifk and expence. The moft coftly articles are expofed in the fire from 150 to 200 hours, in their different ftages collectively. An important colour ufed in porcelain manufactories is the rich dark blue, generally called 'royal.' It is prepared from cobalt, and the oxyd of this ore is fo powerful as to require the heat of the glaze-kiln to bring out its beautiful tint. It is not, like other colours, worked on a glazed furface, but laid on the porcelain after the firft burning, when in the rough or 'bifcuit' ftate, then fired, and afterwards dipped in the glaze, and paffed through the glaze-kiln, frequently requiring two or three fuch ordeals of heat to perfect its colour. We were formerly fupplied with this mineral from the mines of Saxony, but have now the pleafure to learn that the proprietors of thefe works made fome fuccefsful experiments for a company of gentlemen, who difcovered cobalt-ore in Cornwall; which by a particular preparation produces *as fine a blue as the Saxon cobalt*, and it is now ufed in preference to the foreign, which can only be imported in the adulterated form of a zaffer. The reflection, that by fcience and labour the rude materials of the earth are raifed and converted into elegant and ufeful forms, and embellifhed with claffical and tafteful defigns, is highly pleafing; while it affords the means of maintenance to fo many induftrious workmen and ingenious artifts. All the perfons employed in thefe interefting works are *Britifh*, and this manufacture ftands as one proof of the increafed civilization of England. —The Hiftory and Antiquities of Worcefter, by Valentine Green, 2 vols. 4to. 1796. Beauties of England and Wales, Worcefterfhire; by F. C. Laird, 8vo. 1813. Graphic and Hiftorical Defcription of the Cathedrals of Great Britain, Worcefter, 8vo. 1815. Hiftory, &c. of Worcefter, by J. Chambers, 8vo. 1818.

WORCESTER, the fouth-eafterly county of the ftate of Maryland, with 16,971 inhabitants, including 4427 flaves. Snowhill is the chief town.—Alfo, a county of Maffachufetts, large and populous, with 50 townfhips, 53 congregational churches, and 64,910 inhabitants; 50 miles long from N. to S. and 40 broad.—Alfo, a town of the ftate of Maffachufetts, containing 2577 inhabitants. This is the chief town of a county of the fame name, and one of the largeft inland towns in the ftate. It contains two churches, a town-houfe, and a gaol; 34 miles W. of Bofton. N. lat. 42° 10′. W. long. 71° 46′.—Alfo, a townfhip of Vermont, in the county of Chittenden, with 41 inhabitants; 30 miles N. of New Haven.—Alfo, a townfhip of Pennfylvania, in the county of Montgomery, with 868 inhabitants; 18 miles N.W. of Philadelphia.—Alfo, a town of Ohio, in the county of Wafhington, with 385 inhabitants.

WORCESTERSHIRE, an inland county in the weftern part of England, bounded by Herefordfhire, which feparates it from Wales, on the S.W., by Shropfhire on the N.W., by Staffordfhire on the N., by Warwickfhire on the E., and by Gloucefterfhire on the S. The form of the county is very irregular, having on every fide detached parts furrounded by other counties, and comprehending within its bounds parts belonging to the neighbouring fhires. The mean length may be eftimated at about 30 miles, and the mean breadth at 25 miles, giving a furface of 750 fquare miles, or 480,000 acres; but according to the official report laid before parliament, the contents are reduced to 431,360 acres: about two-thirds of the county lie on the E. and one-third on the W. fide of the river Severn. Worcefterfhire comprehends one city, eleven market-towns, three of them parliamentary boroughs, and in all 152 parifhes; the whole is diftributed into five hundreds. The inhabitants amounted, in 1811, to 160,546, of whom 78,033 were males, and 82,513 females, and the inhabited houfes were 30,206.

Hiftorical Events.—Worcefterfhire is fuppofed to have formed a part of the territory of the *Cornavii*, who alfo inhabited the contiguous diftricts of Warwickfhire, Staffordfhire, Shropfhire, and Chefhire. That numerous tribe appear from the *Notitia Imperii* to have furnifhed bodies of troops to the Roman armies; but no trace of their name is now to be difcovered in the tracts they are believed to have occupied. The county was called by the Saxons *Wireceafter-fcire*, and in Domefday-book *Wirecefre-fcire*, and the inhabitants in Bede's time were named *Wicci*; a term which, in the opinion of Camden, may have been derived from *Wich*, fignifying, in the old Englifh language, a falt-pit, in allufion to the mines of that fubftance found in the county. Of the Roman hiftory of Worcefterfhire but little is known. Ptolemy feems to take no notice of it; nor does it appear to be traverfed by any of the roads traced out in the Itineraries of Antoninus. It is highly probable, however, that Worcefterfhire muft have been the theatre of parts

parts of the exploits of Oſtorius, when proprætor in Britain; becauſe he was certainly poſted on the *Sabrina*, now the Severn. The other river mentioned by the hiſtorians of his operations, the *Antona*, has been by ſome writers conjectured to be the Avon, which falls into the Severn in the S. part of the county, while others ſuppoſe it to ſignify the Nen of Northamptonſhire. The Roman roads, of which veſtiges are diſcovered in different parts of Worceſterſhire, although not known to be laid down in the Itineraries, ſufficiently prove the county to have profited by the arts and the policy of the conquerors, in the opening of communications; one of the earlieſt and moſt effectual means of promoting civilization, as well as of eſtabliſhing dominion, among a rude and vanquiſhed people. One of theſe ancient or Roman roads is the Runed-way, or Ridgeway, on the E. ſide of the county, running between Worceſter and Alceſter, in Warwickſhire: another is a paved way from Kencheſter, in Herefordſhire, pointing N.E. towards Worceſter. The great Ikening-ſtreet enters the county from Staffordſhire, and paſſes near Bromſgrove: another great road, ſuppoſed by Naſh to be the ancient Portway, but now called the King's head-land, paſſes over Hagley common. According to Dr. Stukeley, a Roman road extended from Worceſter down the bank of the Severn to Upton, and thence to Tewkeſbury on the N. border of Glouceſterſhire, where it joined Ricning-ſtreetway. Worceſterſhire formed a part of the Saxon kingdom of Myrcnaric, or Mearc-lond, in Latin changed into Merkia. This, by much the largeſt kingdom of that people in England, was founded by Crida about the year 586, and enlarged by Penda, under whom the Chriſtian religion was introduced among the Merkians. During the ſtruggles between the native Britons and their invaders, this part of the country muſt have ſuffered ſeverely; but at laſt the Britons, driven from the plains, retired behind the Severn into the mountainous tracts of Wales. The ravages of the Danes in the 9th and 10th centuries were not unknown in Worceſterſhire; and to that people tradition aſcribes various ſepulchral and military antiquities diſcovered in it.

During the heptarchy, the greater part of Worceſterſhire, Glouceſterſhire on the E. of the Severn, and a portion of Warwickſhire, were inhabited by the *Wiccii*, and under the juriſdiction of the biſhop of Worceſter: but on the acceſſion of William of Normandy, the epiſcopal government was ſuperſeded, and the civil power entruſted to the ſheriffs of Worceſter. The firſt of theſe was Urſo of Abitoth, as he is ſtyled in Domeſday-book, ſon of the lord of that place, in Normandy, and brother of Robert Le Deſpenſer, anceſtor of the preſent families of that name in England. Urſo is alſo ſtyled *Vice-comes*, having received from the king the hereditary ſhrievalty, with the conſtableſhip of the caſtle of Worceſter. He ſat in the great councils held in London in the 15th, and in Weſtminſter in the 18th years of William I. During the conſpiracy of Roger, earl of Hereford, and Ralph, earl of Norfolk, he prevented the former from paſſing over the Severn to form a junction with the inſurgents: His daughter and heireſs, Emmeline, married Walter, the progenitor of Beauchamp, whoſe family afterwards became earls of Warwick. The firſt earl of Worceſter was Walleran de Mellent, a relation of the royal family. He held alſo the paternal honours in Normandy; but ſiding with the barons againſt Henry I., his eſtates were laid waſte, himſelf long held a priſoner, and even when enlarged not entruſted with the keeping of any of his own caſtles. Taking part with Stephen againſt the empreſs Maud, his city of Worceſter was carried by aſſault, and reduced to aſhes. Dying a priſoner in Normandy, his ſon inherited the Norman but not the Engliſh honours. All this happened in the 12th century; and the title of earl of Worceſter ſeems to have lain dormant until 1397, when it was conferred on Thomas Percy, ſon of Henry, lord Percy, by his firſt wife Mary, daughter of Henry Plantagenet, earl of Lancaſter, and brother of Henry I. earl of Northumberland. This gallant earl of Worceſter, accompanying the Black Prince to France, &c. diſtinguiſhed himſelf under the command of John of Gaunt, duke of Lancaſter. The title in 1420 was beſtowed on Richard Beauchamp, of the houſe of Warwick, deſcended from the firſt Norman ſheriff or earl. He ſerved with great reputation in France; but dying in 1449 without male iſſue, the title was granted to John Tibetot or Tiptoft, baron of Powis. Under Henry VI. he was charged with the guard of the narrow ſeas, and appointed lord-deputy of Ireland; and by Edward IV. juſtice of North Wales, conſtable of the Tower of London, and treaſurer of the exchequer. Soon after he became chancellor of the kingdom, ſtill, however, retaining his command at ſea. It was not in military and ſtate affairs alone that this nobleman diſtinguiſhed himſelf. Educated at Oxford in all the learning of thoſe days, he afterwards viſited Jeruſalem for devotion; alſo Padua, Venice, and Rome, to conſult the libraries and the learned ſocieties of thoſe places; and was the author of ſeveral works. On the temporary reſtoration of Henry VI. by Neville, earl of Warwick, the earl of Worceſter was apprehended and beheaded at London in 1471. His ſon was afterwards replaced in the family honours and eſtates by Edward IV.; but dying without iſſue in 1485, the title was, by Henry VIII., conferred on Charles, natural ſon of Henry, duke of Somerſet. His grandſon, Henry, was created marquis of Worceſter by Charles I.; and his grandſon, Henry, was, in 1682, by Charles II. created duke of Beaufort, the title of marquis of Worceſter being by courteſy attached to the eldeſt ſon of that family to the preſent time.

State of Property.—Prior to the Norman Conqueſt, great part of the lands of Worceſterſhire belonged to the church; but on that event much was beſtowed on the favourites and followers of the Conqueror. Very little is now poſſeſſed by the deſcendants of the ancient proprietors; for in the various revolutions of the kingdom, the adherents of the loſing ſovereign were in general deprived of their property. William Beauchamp, baron of Elmſley, poſſeſſed great eſtates by deſcent from the firſt earl of Worceſter; but loſt them by adhering to the empreſs Maud againſt Stephen. They were reſtored however by Henry II. In the conteſts between king John and the barons, the grandſon of William Beauchamp was a material ſufferer; for having taken the ſide of the nobles, the church of Worceſter, on the re-eſtabliſhment of John's power, laid hold of the opportunity to enlarge their precincts, abridging the accommodations of the caſtle, ſo that it was no longer fit for the habitation of the ſheriff and his retinue; and from that time it began to fall into decay. The whole county was then the property of, or poſſeſſed by eccleſiaſtics, and by a few barons; nor was it until a much later period that a more general diviſion of lands, from various cauſes, took place. In the reign of Richard II., the Beauchamps, earls of Warwick, were again deprived of their lands: under Henry VII. other large poſſeſſors of land, who had borne arms in Boſworth-field, were ſtripped of their property. But the greateſt forfeiture of lands in Worceſterſhire took place in conſequence of the attainder and execution of Edward, earl of Warwick, who had taken the part of Perkin Warbeck againſt Henry VII. Conſiderable changes were alſo occaſioned by the transfer under Henry VIII. of the

the lands of the diffolved religious eftablifhments, to his favourites and the nobles who co-operated in his fchemes. In the unhappy reign and life of Charles I., Worcefterfhire was often the theatre of warfare; many eftates were dilapidated or ruined, and but few really acquired; for the prices fet on the church-lands by the parliamentary furveyors were fo enormous, that though fold at nominally a few years value, the purchafers generally loft by the acquifition. In later times, the changes of property in this county have been numerous and frequent; but the caufes of thofe changes depending on private motives and not on public interefts, as in former days, they do not come within the fcope of this article. It is, however, worthy of remark, that out of the great number of families who recorded their armorial bearings, on the firft vifitation of the county by the Clarencieux, king at arms, in 1533, only fix or feven now remain, and of thefe only two refide on the ancient family eftates. Of thofe named in the laft vifitation (1683) but few defcendants now exift. By thefe changes, however, it has happened in Worcefterfhire, as in other diftricts where manufactures and commercial enterprize prevail, that the landed property is now diftributed amongft a much greater number of proprietors, and that the country is incomparably better peopled and cultivated than in former times.

General Afpect, Soil, and Climate.—When viewed from any of the numerous furrounding eminences, Worcefterfhire affumes the afpect of a plain, the gentle flopes and rifings on the eaft and weft of the capital being then fcarcely defcernible. From thofe eminences alfo the cultivation of the plains is viewed to great advantage, as there are no tracts of confiderable extent fo barren or fo neglected as not to prefent an agreeable as well as profitable verdure. On a nearer view, from a hill in the centre of the county, to the eaftward of the capital, a moft beautiful landfcape prefents itfelf; the whole back-ground, diftant from eight to twelve miles, appears to be the continuation of one range of hills, enclofing rich and beautiful plains, in which the flourifhing hop-grounds and plentiful orchards conftitute very interefting and gratifying objects.

The foil of the county is various; but it chiefly confifts of rich loamy fand, mixed with a fmall proportion of gravel, in the central parts on the north of Worcefter. Towards the eaft the foil is a very light fand, containing a few fpots of clay, and fome peat-earth; but the eaftern diftrict of the county is, in general, a ftrong clay, the wafte lands being principally a deep black peat-earth. Between Worcefter and the vale of Evefham, in the fouth-eaft part of the county, the foil is partly red marle, and partly ftrong clay, whilft the fubfoil in fome places is compofed of lime-ftone. In the celebrated vale of Evefham, watered by the river Avon, the foil is particularly deep, of a darkifh earth, refting on clay, and in parts on gravel. Farther fouth limeftone prevails, in the upper lands, on the fkirts of the Cotfwold hills, and a rich loam in the lower lands. In the fouth-weft divifion of the county, between the Severn and the Malvern hills, the foil is in general clay, mixed with fand or gravel; but farther to the northward the gravel increafes, until it terminates in the light fands of the northern border of the county. In all of thefe diftricts, however, fome rocky and ftony foil is found; but according to Mr. Pomeroy, in his Agricultural Survey, no traces of chalk or flint any where occur; nor have any been found, it is faid, in the lime-quarries. The vale of Severn is defcribed by Mr. Pitt, in his fubfequent furvey of the county, to contain probably ten thoufand acres of a deep rich fediment, depofited in the courfe of ages by the river and its tributary ftreams. In fome parts, this fediment confifts of a pure water-clay, fit for brick-making, but generally of a rich mud, fertile and favourable to vegetation. The county has been lately diftributed in the following manner:

	Acres.
Common fields of arable land eftimated at	20,000
Inclofed ditto - - - - - -	340,000
Permanent grafs-land - - - -	100,000
Kitchen-gardens, &c. - - -	5,000
Woods, waftes, rivers, roads, &c. -	35,000
Whole county about - -	500,000

Refpecting the corn-produce of the county, it is thus eftimated in Pitt's furvey: In 360,000 acres of arable land, 43,500 are fuppofed to be laid down in wheat, yielding from 20 to 32 bufhels *per* acre, or 1,200,000 bufhels on an average. From this quantity deducting 108,750 bufhels, at $2\frac{1}{2}$ *per* acre, the remaining neat produce is 1,091,250 bufhels.

The climate of Worcefterfhire, particularly in the middle, fouthern, and weftern parts, is ftated to be remarkably mild, foft, and healthy. The vale of the Severn rifes but little above the fea, and the valleys of the Avon and Teme are nearly on the fame level; and the adjoining uplands, feldom rifing at the moft 150 feet higher, poffefs a warmth and foftnefs which ripen the grain and bring to perfection the fruits of the earth, from a fortnight to a month earlier than in more elevated counties, even enjoying a fimilar foil and furface. The principal bleak and inclement parts are the Bredon and Broadway hills on the fouth border of the county, and the Lickey range on the north: for the Malvern hills on the weft, although only fheep-pafture, poffefs a moft falubrious climate.

Hills.—The higheft hills are certain points of the Lickey range, which, rifing to the north-eaft of Bromfgrove, runs north towards Hagley, and diverges to the eaftward. Some of thofe points are eftimated to be elevated 800 or 900 feet above the general level of the country. On this range is a fmall fpring producing two ftreams, one of which flows northward to the Rea, which falls into the Trent, and with it is difcharged into the German ocean on the eaft fide of the ifland; the other, falling into the Stour, is carried by the Severn into the Briftol Channel on the weft. Bredon-hill, in the fouth-eaft corner of the county, is of about equal elevation. The higheft point of the Malvern range of hills, called the Herefordfhire beacon, rifes, according to the great ordnance furvey of England, 1444 feet above the level of the fea: the Worcefterfhire beacon, barometrically meafured, rifes 1298 feet; and North-hill 1211 feet above the Severn.

Rivers.—Thefe are, the Severn, the Avon, the Teme, and the Stour; the fmaller ftreams are, the Salwarp, Arrowe, Ledden, Rea, &c. The Severn, called by the Romans *Sabrina*, is fuppofed to be fo named from the Britifh terms *fabr*, fand, or *fabrin*, fandy, becaufe it is often turbid, efpecially when heavy rains fall on the Welfh mountains. See SEVERN.

The river Avon is faid to have been originally fo named by the Britons, on account of the gentlenefs of its courfe. It is commonly diftinguifhed from a number of other rivers in Britain of the fame name, as the Warwickfhire-Avon, and will be ever memorable while the name of Shakfpeare remains. Entering Warwickfhire towards the fouth-eaft corner, the Avon, by a winding courfe, waters the vale of Evefham, paffes by Perfhore, and unites with the Severn in the neighbourhood of Tewkefbury. It is navigable for barges

barges through the whole extent of the county, by means of locks in different places. See Avon.

The Teme, rifing in Radnorfhire, enters Worcefterfhire a little above Tenbury, and thence purfuing a winding but rapid courfe, through a fucceffion of beautiful and romantic fcenery, along the woods and dales of Stanford, the feat of fir Edward Winnington, bart., it is loft in the Severn below Worcefter. From the declivity of its bed, and confequent rapidity, it is navigable for barges only up to Powick bridge, a mile and a half from the Severn. But although on this account the Teme be of little commercial ufe, it is peculiarly ornamental to the county, no part of which furpaffes the banks of this ftream in variety of ground, wood, and open lawn. A ramble along its various windings, extending upwards of twenty miles, through a fucceffion of orchards, hop-grounds, corn and pafture land, is, in autumn, peculiarly agreeable. The Stour, an inconfiderable ftream, has rifen into notice fince the opening along its courfe of the important canal by Kidderminfter, uniting the Severn and the Merfey. The Salwarp purfues its fhort courfe to the Severn by Bromfgrove and Droitwich, where it formerly received the overflowings of the falt-fprings, but thefe are now turned into the new canal from that town to the Severn. The other little ftreams of Worcefterfhire merit no particular notice.

Canals.—Connected with the natural rivers are the artificial canals opened throughout the county. Thefe are, the Trent-and-Severn, or the Staffordfhire and Worcefterfhire canal, more commonly called the Stourport canal, from the place where it falls into the Severn, eleven miles north from Worcefter; the Droitwich canal, for the conveyance of the produce of the falt-fprings to the Severn; the Worcefter and Birmingham canal; the Dudley extenfion canal; and the Leominfter canal, near Tenbury. See Canals.

Woods and Forefts.—About the time of the Norman Conqueft, Worcefterfhire was confidered to poffefs five forefts; namely, thofe of Feckenham, Omberfley, Horewell, Malvern, and Wyre; but of the laft only a fmall portion lies within the county. Feckenham foreft, once very extenfive, has now almoft difappeared, owing to the continual demand for fuel to the falt-works at Droitwich, until of late years a fufficient fupply of pit-coal has been obtained. Omberfley foreft, on the north of Worcefter, and Horewell foreft on the fouth, have long been difafforefted. Malvern foreft or chafe extended between the Severn and the fummit of the hills of the fame name, where may ftill be traced the trench which divided the foreft and the county from Herefordfhire on the weft. Wyre foreft, on the north border of the county, now more properly belongs to Shropfhire and Staffordfhire. Befides the veftiges of thefe forefts, the county contains feveral tracts of woodland, of oak, elm, and beech: but from the demand for young trees to make hop-poles, and for trees to be converted into charcoal for the iron-works in the neighbouring counties, much timber of fuperior fize cannot now well be expected in Worcefterfhire.

Mineralogy.—The minerals of this county are neither numerous nor peculiarly valuable. Clay and lime-ftone are abundant; but coal, to render the latter ufeful in agriculture as well as building, is not eafily procured where the ftone is found. Some coal is indeed raifed in the northweft diftrict, about Mamble, where is a rail-way leading to the Leominfter canal. Coal is alfo found at Penfax, and the Whitley-hills, in the fame quarter, and is much ufed for coke for the hop-kilns and lime-pits; but the vein is too thin to promife much advantage to the county at large, which is principally fupplied from the Staffordfhire mines, by means of the Severn. In the vale of Evefham, and many other parts of the county, fuel is particularly fcarce and dear. The lime-ftone quarries about Dudley are very extenfive, and extremely curious excavations: but although the town ftands in a detached part of the county, inclofed by Staffordfhire, thofe quarries actually belong to the latter county. Building-ftone of different forts is alfo found in feveral parts. But the principal mineral riches of Worcefterfhire arife from the falt-mines of Droitwich, a parliamentary borough, fituated fix miles north-eaft from Worcefter, on the road to Birmingham. Thefe falt-works are of great antiquity, having been granted by Kenulph, king of Mercia, to the church of Worcefter, in 816; and it appears from Domefday-book, that fhares in them were annexed to many eftates at even a confiderable diftance, on account probably of the wood they yielded for the manufacture of the falt. The principal brine-pits, however, belonged to the crown, but were granted by king John to the burgeffes of Droitwich. The general fubftratum of the environs of the town is fuppofed to be a falt-rock, lying ufually from 150 to 200 feet below the furface. On boring in any part, the falt-fprings are met with about 110 feet below the furface: the boring-machine then paffes through about 130 feet of gypfum to the brine-river, in depth about 22 inches, beyond which is a bed of falt-rock hitherto unexplored. In fearching for this brine-river fome years ago, the miners paffed through four feet of mould, 32 of marle, 40 of gypfum, a brine-river of 22 inches, and 75 feet of another ftratum of gypfum, below which they came to the falt-rock. (See Droitwich and Salt.) For an account of the mineral waters of *Malvern*, fee that article; and more particularly the paper of Mr. Horner, in the firft volume of the Geological Society of London. Befides thefe, Worcefterfhire has fome chalybeate fprings at Sandbourne and the Round-hill, in the parifh of Kidderminfter.

Manufactures and Commerce.—The commerce of Worcefterfhire is confiderable, from its own productions, and from the depofit and tranfit of thofe of the neighbouring mining and manufacturing diftricts. Of its own products may be noticed the hops, fruit, cyder, and perry, which render the capital the principal mart for thofe articles in the weftern part of the kingdom. The county alfo exports a confiderable furplus of its own manufactures, confifting of Kidderminfter ftuffs and carpets; of Worcefter gloves, china and glafs-ware, and of nails, bar and fheet iron. Great quantities of falt are annually fent from Droitwich; Evefham furnifhes oil and oil-cake; timber, grafs-feeds, corn, flour, malt, falmon, cattle and fheep, and other agricultural productions are furnifhed by the county in general.

Civil and Ecclefiaftical Divifions.—Worcefterfhire is divided into five hundreds; *viz.* Ofwaldeflow, Halffhire, Doddington, Perfhore, and Blackenhurft: the firft containing the capital and the centre of the county, with feveral detached portions in other quarters; the fecond occupying the northweft parts; the third, the north-eaft; the fourth, the fouth; and the fifth, the fouth-eaft quarter, around Evefham. In ecclefiaftical matters, the county is under the government of the bifhop of Worcefter, and contains 152 parifhes. The diocefe was formerly of great extent; but in 1541 the fee of Gloucefter, and in 1542 that of Briftol, being erected, a confiderable part of the epifcopal jurifdiction of Worcefter was withdrawn. At prefent the bifhopric comprehends all the county, with the exception of 15 parifhes and 8 chapelries belonging to Hereford; about one-third part of Warwickfhire, together with the parifhes of Brome and Clent in Staffordfhire, and Hales-Owen in Shropfhire. The diocefe thus contains 116 rectories, 79 vicarages, 26 curacies, and 41 chapelries, all diftributed into 9 deaneries.

Parliamentary

Parliamentary History.—Worcestershire has been represented in parliament ever since the third year of Edward III., and at and ever since the revolution has maintained a respectable character for independence in the choice of its representatives. In the early part of the last century, sir John Pakynton accused the bishop of interfering in the election, of forbidding the clergy to vote for sir John, of threatening the tenantry of the see not to renew their leases if they voted for him, and even of desiring the baronet to withdraw his pretensions. The charges were established; and after a long contest between the two houses of parliament, on an address to queen Anne, the bishop was dismissed from his office of almoner. Worcestershire, which is included in the Oxford circuit, sends nine members to parliament; *viz.* two for the county, two for the city of Worcester, two for each of the boroughs of Droitwich and Evesham, and one for the borough of Bewdley.

Mansions and Country-seats.—Of these, Worcestershire contains a very considerable number, some of which are highly deserving of notice. Hagley-park, the "British Tempe" of Thomson, the favourite seat of the ingenious and amiable lord Lyttelton, the historian of Henry II., is situated toward the northern frontier of the county. The grounds have long been celebrated for variety and beauty of scenery. Croome-court, the handsome seat of the earl of Coventry, eight miles to the south of Worcester, is more indebted to modern art and skill for its beauties than to the natural features of the ground. The agricultural improvements, chiefly carried on by the late earl, are both extensive and important. Six miles north from Worcester is Omberfley, the residence of the marchioness of Downshire, in the midst of spacious grounds. The house has been lately modernized. Grafton-hall, about a mile west from Bromsgrove, the property of the earl of Shrewsbury, was in ancient times a capital mansion; but being burned down in 1710, the porch and a part of the hall alone remain as specimens of its original magnificence. The latter has been converted into a chapel for a modern building annexed. Madresfield, six miles south-west from Worcester, the residence of viscount Beauchamp, is an ancient baronial castle, greatly altered in the modern style. Whitley-court, the seat of lord Foley, eight miles north-west from Worcester, is a highly improved and spacious mansion, in the midst of an extensive park. The parish-church, closely adjoining to the house, is one of the most elegant in the kingdom. Annexed to the see of Worcester is the ancient castle of Hartlebury, the residence of the bishops from the time of Henry III., situated between nine and ten miles north from Worcester. The principal part of the buildings, as they now stand, is the work of bishop Hough. Much of the improvements, however, are due to the late bishop Hurd, who furnished the palace with a valuable library, for the use of his successors in the see, in which are the principal books from the libraries of Mr. Pope and bishop Warburton.—Collections for the History of Worcestershire, by the Rev. Tredway Nash, D.D. 2 vols. fol. Lond. 1781–2. Supplement to ditto, ditto, 1799. General View of the Agriculture of the County of Worcester, by William Thomas Pomeroy, 4to. Lond. 1794. General View of the Agriculture of the County of Worcester, by W. Pitt, 8vo. Lond. 1813. Beauties of England and Wales, Worcestershire, by F. C. Laird, 8vo. Lond. 1816.

WORCUM, or Woudrichem, or *Wodercum*, a town of Holland, situated on the south side of the Wahal, first surrounded with walls in 1460, and defended with four bastions; 13 miles E.N.E. of Dort.

Worcum, a sea-port town of Frieseland, situated in a fertile country, but subject to inundations of the sea, especially when the wind blows from the east. The harbour is blocked up with sand, but it carries on a considerable trade by means of its canals; 18 miles S.W. of Lewarden. N. lat. 53°. E. long. 5° 35′.

WORD, in *Language*, is an articulate sound, designed to represent some idea.

Word, in *Writing*, is an assemblage of several letters, forming one or more syllables, and signifying some thing.

The Port-royalists define words to be distinct articulate sounds, agreed on by mankind for conveying their thoughts and sentiments.

The proper character of a word, according to the ingenious Mr. Harris, is that of its being a sound significant, of which no part is of itself significant; and hence he infers, that words are the smallest parts of speech.

The first and most obvious distinction of words is into such as are significant absolutely or by themselves, and such as are significant by relation: the former may be called principals, and the latter accessories. Moreover, all words whatever, significant as principals, are either *substantives* or *attributives;* and those, which are significant as accessories, acquire a signification either from being associated to *one word*, in which case they only define and determine, and may justly be called *definitives*, or to *many words at once*, in which case they serve to no other purpose than to connect, whence they are called *connectives*. Accordingly, Mr. Harris refers all words to these four species. Hermes, p. 20, &c. See Speech.

Grammarians divide words into eight classes, called *parts of speech;* which are, the *noun*, *pronoun*, *verb*, *participle*, *adverb*, *conjunction*, *preposition*, and *interjection;* to one or other of which, all the words and terms in all languages, which have been, or may be invented to express our ideas, are reducible. See each.

Words, again, are divided into *primitives* and *derivatives*, *negative* and *positive*, *simple* and *complex*, *common* and *proper*, *abstract* and *concrete*, *synonymous* and *equivocal*.

With regard to their syllables, words are farther divided into *monosyllables* and *polysyllables*.

The grammatical figures of words, which occasion changes in the form, &c. thereof, are, *syncope*, *apocope*, *apostrophe*, *diæresis*, *aphæresis*, *prosthesis*, *epenthesis*, *paragoge*, *metathesis*, &c. See Syncope, Apocope, &c. See also Figure.

The use of words, we have observed, is to serve as sensible signs of our ideas; and the ideas they stand for in the mind of the person that speaks, are their proper significations.

Simple and *primitive* words have no natural connection with the words they signify; whence there is no rationale to be given of them: it is by a mere arbitrary institution and agreement of men, that they come to signify any thing. Certain words have no natural propriety or aptitude to express certain thoughts, more than others: were that the case, there could have been but one language.

But in derivative and compound words the case is somewhat different. In the forming of these, we see a regard is to be had to agreement, relation, and analogy: thus most words that have the same ending, have one common and general way of denoting or signifying things; and those compounded with the same prepositions, have a similar manner of expressing and signifying similar ideas in all the learned languages where they occur.

For the perfection of language, it is not enough, Mr. Locke observes, that sounds can be made signs of ideas; unless these can be made use of, so as to comprehend several particular

particular things; for the multiplication of words would have perplexed their ufe, had every particular thing needed a diftinct name to be fignified by.

To remedy this inconvenience, language had a farther improvement in the ufe of general terms, by which one word was made to mark a multitude of particular exiftences; which advantageous ufe of founds was obtained only by the difference of the ideas they were made figns of: thofe names becoming general, which are made to ftand for general ideas; and thofe remaining particular, where the ideas they are ufed for are particular.

Some of our philofophers have complained much of the great ufe, or rather abufe, of vague and general terms, which have no precife definite fignification. To diftinguifh thefe, F. Malebranche obferves, that every thing that is, and confequently every thing that is intelligible, is either a being, or a mode and manner of being. Hence it is evident, that every term which does not fignify either of thefe, fignifies nothing, and is an obfcure and confufed term. In metaphyfics, the ufe of fuch terms, he fays, is fometimes neceffary and allowable, as in fpeaking of the divine perfections, &c. But in phyfics it is always mifchievous, however common.

It is obfervable, that the words which ftand for actions, and notions quite removed from fenfe, are borrowed from fenfible ideas; as, to imagine, apprehend, comprehend, underftand, adhere, conceive, inftil, difguft, difturbance, tranquillity, &c. which are all taken from the operations of things fenfible, and applied to modes of thinking. *Spirit*, in its primary fignification, is no more than breath; *angel*, a meffenger. By which we may guefs what kind of notions thofe were, and whence derived, which filled the minds of the firft beginners of languages; and how nature, even in the naming of things, unawares, fuggefted to men the originals of all their knowledge: whilft, to give names that might make known to others any operations they felt in themfelves, or any other ideas that came not under their fenfes, they were forced to borrow words from the ordinary and known ideas of fenfation.

The ends of language, in our difcourfe with others, are chiefly three: firft, to make our thoughts or ideas known one to another. This we fail in, 1. When we ufe names without clear and diftinct ideas in our minds. 2. When we apply received names to ideas, to which the common ufe of that language doth not apply them. 3. When we apply them unfteadily, making them ftand now for one, and anon for another idea.

Secondly, to make known our thoughts with as much eafe and quicknefs as is poffible. This men fail in, when they have complex ideas, without having diftinct names for them; which may happen either through the defect of a language, which has none; or the fault of the man, who has not yet learned them.

Thirdly, to convey the knowledge of things. This cannot be done, but when our ideas agree to the reality of things. He that has names without ideas wants meaning in his words, and fpeaks only empty founds. He that has complex ideas without names for them, wants difpatch in his expreffion. He that ufes his words loofely and unfteadily, will either not be minded, or not underftood. He that applies names to his ideas, different from the common ufe, wants propriety in his language, and fpeaks gibberifh; and he that has ideas of fubftances, difagreeing with the real exiftence of things, fo far wants the materials of true knowledge.

Words, *Divifion of*. See Division.

Words, *General*. See General.

Words *of Command*. See Exercise.

Word, *Watch-Word*, in an *Army* or *Garrifon*, is fome peculiar word or fentence, by which the foldiers are to know and diftinguifh one another in the night, &c. and by which fpies and defigning perfons are difcovered.

It is ufed alfo to prevent furprizes. The word is given out in an army every night by the general, to the lieutenant, or major-general of the day, who gives it to the major of the brigades, and they to the adjutants; who give it firft to the field-officers, and afterwards to a ferjeant of each company, who carry it to the fubalterns.

In garrifons it is given, after the gate is fhut, to the town-major, who gives it to the adjutants, and they to the ferjeants.

Word, in *Heraldry*, &c. See Motto.

Words, *Defamatory*, *Treafonable*, &c., in *Law*. See Defamation, Scandal, and Treason.

WORDEN, in *Geography*, a town of the duchy of Holftein, on the right fide of the Elbe; 10 miles N.W. of Gluckftadt.

Worden, *Groffen*, a town of the duchy of Bremen; 10 miles N.N.W. of Stade.

WORDERNBERG, a mountain of the duchy of Stiria; 6 miles S.S.E. of Eifenhartz.

WORDINGBERG, a fea-port of Denmark, fituated on the fouth coaft of the ifland of Zealand, oppofite the ifland of Falfter. In the year 1066, Waldemar I. built a ftrong caftle here, which is now gone to decay. Waldemar III., who was exceedingly fond of this place, refided here for the moft part; and in derifion of the Hanfe towns, built the well-known tower, which, from a golden goofe erected on the top of it, he called *Gans*, that is, *The Goofe*. In this tower, he purpofed to confine the prifoners of the Hanfe towns that fhould fall into his hands in the war he intended to carry on againft them. As the old caftle gradually fell to decay, prince George, who was brother to Chriftian V., and married to Anne, queen of England, built here an entire new caftle, which Frederick IV. afterwards enlarged; but that edifice has been pulled down. The ufual paffage to the iflands Falfter and Laaland is from this place. In 1240, at a famous diet held here, the Old Juftifche Low-buck, or Codex Legum Juricarum, was compiled and promulged: this body of laws is ftill in force in South Jutland. In 1256 another diet was held here; and in 1658, preliminaries for a peace between Denmark and Sweden were treated of in this town; 43 miles S.W. of Copenhagen. N. lat. 55° 3′. E. long. 11° 58′.

WORE. See Wyre.

WORENZUTTE, a town of Pruffia, in Ermeland; 8 miles S. of Heilfberg.

WORGAN, Dr. John, in *Biography*, a mufical graduate of Oxford, organift of St. Mary-Axe, Bedford chapel, and many years a diftinguifhed performer on the organ at Vauxhall, and Dr. Arne's fucceffor there in the compofition of cantatas, fongs, and ballads.

He learned the rudiments of mufic of his elder brother, who had likewife an organift's place in the city, and played the violoncello in the Vauxhall band. Their fcholars on the harpfichord were very numerous, particularly within Temple-bar; and John, as an organift and opener of new organs, rivalled Stanley. He was a very ftudious man, and dipt very early into the old ecclefiaftical compofers of Italy. He fucceeded Gladwin in playing the organ at Vauxhall. His firft ftudy in compofition and organ-playing was directed by Rofeingrave, who pointed his attention to the pure harmony and modulation of Paleftrina, and organ-fugues of Handel. His conftant ufe of the organ at Vauxhall, during the fummer, ſummer, ranked him with Stanley and Keeble; and his enthuſiaſm for Scarlatti's leſſons, with which he was impreſſed by Roſeingrave, rendered him equal to Kelway in their execution.

With an extempore prelude, *alla Paleſtrina*, and one of Handel's organ-fugues, he uſed to preface his concerto every night.

At length he got acquainted with Geminiani, ſwore by no other divinity, and on conſulting him on the ſubject of compoſition, he was told that he would never be acquainted with all the arcana of the ſcience, without reading "El Porque della Muſica," a book written in Spaniſh per Andres Lorente, en Alcala, 1672. But where was this book to be had? Geminiani told him, and told him truly, that the tract was very ſcarce. He had, indeed, a copy of it himſelf; but he would not part with it under twenty guineas. Worgan, on fire to be in poſſeſſion of this oracular author, immediately purchaſed the book at the price mentioned; not underſtanding a word of Spaniſh, he went to work in learning it as eagerly as Rowe the poet, when lord Oxford had expreſſed a wiſh that he underſtood that language, which Rowe thought would qualify him for a good place under government. But after hard drudgery, when he haſtened to acquaint the miniſter of ſtate that he thought himſelf a tolerable maſter of the Spaniſh tongue, "I give you joy (ſays lord Oxford); you are now able to read Don Quixote in the original."

The knowledge of Spaniſh and ſtudy of Lorente ſeem to have had no other effect on Worgan's compoſitions, than to ſpoil his Vauxhall ſongs; which though ſung into popularity by dint of repetition, had no attractive grace, or pleaſing caſt of melody.

He compoſed ſeveral oratorios, in which the choruſſes are learned, and the accompaniments to his ſongs ingenious. The *cantilena* was original, it is true, but it was original awkwardneſs, and attempts at novelty without nature for his guide.

His organ-playing, though more in the ſtyle of Handel than of any other ſchool, is indeed learned and maſterly, in a way quite his own. In his youth, he was impreſſed with a reverence for Domenico Scarlatti by old Roſeingrave's account of his wonderful performance on the harpſichord, as well as by his leſſons; and afterwards he became a great collector of his pieces, ſome of which he had been honoured with from Madrid by the author himſelf. He was the editor of twelve at one time, and ſix at another, that are admirable, though few have now perſeverance ſufficient to vanquiſh their peculiar difficulties of execution. He is ſtill in poſſeſſion of many more, which he has always locked up as Sybil's leaves.

He had the misfortune to labour under two dreadful calamities; a bad wife, and the ſtone. He got rid of the former, after great mortifications and expence, by divorce; but in too early wiſhing to abridge his ſufferings from the latter, he loſt his life in the torture of an operation, Auguſt 20, 1790.

WORGAUM, in *Geography*, a town of Hindooſtan, in the country of the Mahrattas; 20 miles W. of Poonah.

WORK, in the *Manege*. To work a horſe, is to exerciſe him at pace, trot, or gallop, and ride him at the manege.

To work a horſe upon volts, or head and haunches in or between two heels, is to paſſage him, or make him go ſideways upon parallel lines.

To Work, in *Sea Language*, is to direct the movements of a ſhip, by adapting the ſails to the force and direction of the wind. A ſhip is alſo ſaid to work when ſhe ſtrains and labours heavily in a tempeſtuous ſea, ſo as to looſen her joints or timbers. See Rolling.

Work, *Carpenter's*, *Clock*, *Crown*, *Field*, *Fire*, *Fret*, *Groteſque*, *Horn*, *Moſaic*, *Out*, *Regimen of the*, *Ruſtic*, *Scratch*, *Stream*, *Vermicular*, and *Wax*. See the ſeveral articles.

Work, *Diſcharge*, in *Calico-Printing*, &c. a peculiar kind of proceſs, in which the cloth is firſt dyed of ſome uniform colour, by means of a mixture of iron-liquor and ſome one or more of the common vegetable dyeing ſubſtances; and calicoes thus prepared are ſaid to be dyed of ſelf-colours. They are then waſhed and dried, and when properly preſſed or calendered, they are fit for receiving any pattern, according to the views of the artiſt. This operation is generally effected by means of the mineral acids, previouſly fitted for the purpoſe by diſſolving in them a portion of one or more of the metals, according to the nature of the dye which is intended to be *diſcharged*, or of the colour to be produced. In doing this, the diſcharging liquor ſhould be ſo made as to be capable of diſſolving the iron which is contained in the dye, and which is always uſed in quantity ſufficient for covering, or at leaſt diſguiſing in a great meaſure, the other colour or colours which had been employed with it, and at the ſame time for acting as a mordant in beautifying and fixing thoſe colours. Thus a piece treated with a decoction of Braſil-wood, and dyed black by being *padded* with iron-liquor, if when dried it be printed with a peculiar ſolution of tin, the ferruginous portion of the dye will be diſſolved, and the printed part will be inſtantly converted from a deep black to a brilliant crimſon. The term *padding* denotes the operation of paſſing the pieces from a roller through a trough containing a ſolution of iron, or any other mordant, and is ſynonymous with *blotching*. In the ſame way, an olive-coloured calico, dyed in a ſolution of iron and a decoction of weld, will be as ſpeedily changed to a bright pale yellow; and the various drabs and ſlates of every ſhade which have been in their compoſition, will undergo as ſudden a change by the ſame treatment; though the colour of the figures produced upon them will depend on the materials with which the cloths were originally dyed. Even the deepeſt gold colours, or ſtrongeſt buffs, if produced by iron only, may, by a peculiar preparation of tin, be diſcharged; and thoſe parts of the cloth which have been treated with this metallic ſolution, will be reſtored to their former whiteneſs. Calicoes alſo, dyed of a light blue in the indigo-vat, then paſſed through ſumach and copperas, and finiſhed in a bath of quercitron bark and alum, may have figures of a bright green imparted to them. In this caſe, the green is originally formed by means of the indigo-vat and the bark, though it is enveloped by the iron of the copperas, which overcomes the other colours, till the ſolution of the tin is applied, which removes the iron from thoſe particular parts, and gives a brilliancy to the remaining colour, which they would not otherwiſe have poſſeſſed; the tin being a powerful mordant for the bark, by which the yellow of the green is procured. A good ſelf-colour may likewiſe be given to calicoes, merely by dyeing them in ſumach and copperas, and then running them through an alkaline ſolution of annotto; and here the figures produced by the application of a colourleſs ſolution of tin will be of a bright orange.

In the inſtances above cited from Mr. Parkes's Eſſays, vol. ii., he refers only to that branch of diſcharge-work in which all the purpoſes are attained by diſſolving the iron that makes a part of the colour intended to be diſcharged; whereas the finer and more expenſive work is done by a different proceſs. The particular kind of chemical diſcharge-work above-defcribed is fubject to the imperfection of not being perfectly faft; that is, the goods thus produced will not bear frequent wafhing like thofe which are done by the bath of madder or bark. In this connection with permanent colours, Mr. Parkes is led to mention a very valuable *green*, not long ago invented by a Mr. Iflet of London, fecured to him by patent, which was produced by printing ground indigo, mixed with a peculiar kind of folution of tin, and then faftening the indigo within the fibres of the calico, by means of that procefs denominated *china-blue dipping*. (See DIPPING.) After this, the goods are to be dyed in a copper of bark or weld, which converts the blue into a green, and the whites are to be cleanfed by croft-bleaching, &c.

In another kind of difcharge-work, the agent that is employed is the citric acid, in various degrees of concentration, according to the purpofe to which it is to be applied, or the ftrength of the ground intended to be difcharged. This is employed chiefly for the production of white figures upon felf-coloured grounds produced by madder and fundry other dyes. The acid for this purpofe is mixed with either gum or pafte to a proper confiftency for the black, the plate, or the cylinder, and from thence it is transferred to the piece; and wherever it attacks, the mordant, whether iron or alumine, is difcharged, and a delicate white appears in its ftead. In ufing citric acid for this purpofe, a portion of one of the mineral acids is fometimes mixed with it. There is another fpecies of difcharge, on which the agent employed by the printers is the nitrous, and fometimes the nitro-muriatic acid. See DISCHARGING *of Colour* and COLOUR.

WORKALLEN, in *Geography*, a town of Pruffia, in Oberland; 4 miles S.W. of Liebftadt.

WORK-HOUSE, a place where indigent, vagrant, and idle people are fet to work, and maintained with clothing, diet, &c. See HOUSE *of Correction*.

Such are the Bridewells, and feveral other places about the city of London, or fuburbs; fuch alfo was the foundation of that in Bifhopfgate-ftreet, for employing the poor children of the city and liberties, who have no fettlement; and that for the parifh of St. Margaret's, Weftminfter, called the Grey-coat hofpital.

By 43 Eliz. cap. 2. the church-wardens and overfeers, with the confent of two juftices, are empowered to fet to work the children of the poor and other deftitute perfons, and to provide for the relief of the lame, old, blind, and fuch as are poor, but not able to work; and they may erect, with the leave of the lord of the manor, on any wafte or common, of which the parifh is parcel, convenient houfes of dwelling for the poor. (See POOR.) By 3 Car. IV. they may fet up and ufe any trade, merely for the employment and relief of the poor. By 9 Geo. cap. 7. they may contract for the maintenance and employment of the poor in houfes purchafed or hired; and poor perfons refufing to be lodged and maintained in fuch houfes, fhall be put out of the parifh-books, and not entitled to receive relief from the church-wardens and overfeers; and two or more parifhes are allowed to unite in lodging their refpective poor in one houfe; and the officers of one parifh are allowed to contract with thofe of another for the maintenance, &c. of their poor. Moreover, by 8 & 9 Will. cap. 30. parifh poor that are relieved are required to wear on the fhoulder of the right fleeve of the uppermoft garment, in red or blue cloth, a large Roman P, together with the firft letter of the name of the parifh or place to which they belong. By 24 Geo. II. cap. 43. no fpirituous liquor fhall be fold or ufed in any work-houfe, or houfe of entertainment for parifh poor. The ftatute 22 Geo. III. cap. 83. eftablifhes many new regulations with regard to the maintenance of the poor; but leaves it optional in any parifh or place whether they will adopt thefe, or retain the prefent mode. At Amfterdam they have a famous work-houfe, or houfe of correction, called the *Rafphuyfe*, (which fee,) which, by a privilege granted in 1602, has alone the right of fhaving and cutting the dyer's woods, as brafil, fantal, campechy, faffafras, &c. Each perfon, tolerably ftrong, kept in the houfe, is obliged to furnifh two hundred and fifty pounds of rafped wood *per* day; and the weaker, a certain proportionable quantity of chips.

WORKING *to Windward*, in *Sea Language*, denotes the operation by which a fhip endeavours to make a progrefs againft the wind. See BEATING, PLYING, TACKING, and TURNING.

WORKING *Furnace*. See FURNACE.

WORKING *of Glafs*. See GLASS.

WORKINGTON, in *Geography*, a confiderable market and fea-port town in the ward of Allerdale-above-Derwent, county of Cumberland, England, is fituated on the borders of the river Derwent, at the diftance of 34 miles S.W. by W. from Carlifle, and 310 miles N.W. by N. from London. The manor was anciently poffeffed by the Culwens, now Curwens, a family of great confequence in the county, of whom eight out of ten, in fucceffive defcent, were knights of the fhire. The prefent importance of the town has originated from the working of the collieries fince the reign of queen Elizabeth, at which period the entire maritime ftrength of the county confifted of only twelve veffels, though the number now belonging to this port alone is more than 160, and many of them are from one to three hundred tons burthen. Thefe are principally engaged in the exportation of coals to Ireland, and fome few to the Baltic. The river is navigable to the town for fhips of four hundred tons; and on each bank, near the mouth, are piers. The harbour is one of the fafeft on the coaft; and many improvements have been recently made in the fituation and conftruction of the quays. The appearance of the town is diverfified: feveral of the ancient ftreets are narrow and irregular; thofe of modern erection are better formed; the public buildings are all of late date. The houfes are principally difpofed in two clufters: in that called the Upper Town a new fquare has been erected, in the area of which is the corn-market; at a little diftance are the butchers' fhambles. The church, a neat edifice, contains the monument of fir Patrick Curwen, baronet, who died in 1661. In the town are meeting-houfes for Prefbyterians and Methodifts, and a Catholic chapel; alfo a theatre and an affembly-room. Two large weekly markets are held on Wednefdays and Saturdays for meat and other provifions. Corn is fold only on the Wednefdays, which is the principal market-day. Here are alfo two annual fairs for cattle, but of no great note. The principal manufactures are thofe of fail-cloth and cordage, and every thing connected with fhipping. Veffels of from four to five hundred tons, copper-bottomed, are built here, and fold to the merchants of Liverpool, Cork, &c. In the population return of the year 1811, the town of Workington is ftated to contain 1059 houfes, and 5807 inhabitants. The parifh includes the townfhips of Great Clifton, Little Clifton, Stainburn, and Winfcales, making an addition of 726 to the population, and of 161 to the number of houfes.

On an eminence, near the eaft end of the town, overlooking the river Derwent, is Workington-hall, the feat of John Chriftian Curwen, efq., who has nearly rebuilt it, from the defigns of Mr. Carr of York, and greatly extended and improved the park and pleafure-grounds. The old manfion, manſion, of which there are ſcarcely any remains, was caſtellated, purſuant to a licence granted by Richard II. to ſir Gilbert de Culwen in 1379. Mr. Gough obſerves, that the walls were ſo remarkably thick, that in making ſome recent improvements; a paſſage was excavated through one of them lengthways, leaving ſufficient thickneſs on each ſide to anſwer every purpoſe of ſtrength. In this manſion, Mary, queen of Scots, when ſhe landed in England in 1568, was hoſpitably entertained by ſir Henry Curwen, till he was required by queen Elizabeth to reſign his royal gueſt, who was removed to Cockermouth caſtle, and afterwards to that of Carliſle.—Beauties of England and Wales, vol. ii. Cumberland, by J. Britton and E. W. Brayley, 1802. Lyſons's Magna Britannia, vol. iv. 4to. Cumberland, 1816.

WORKS, Opera, in *Fortification*, the ſeveral lines, trenches, ditches, &c. made round a place, an army, or the like, to fortify and defend it. See Line, Parallel, and Trench.

The principal works in a fortreſs, or fortified place, ſee under Fortified *Place*, Fortification, &c.

Works, *Covenant of*, in *Theology*. See Covenant.

WORKSBORN, in *Geography*, a river of Northumberland, which runs into the North Tine.

WORKSOP, a market-town in the hundred of Baſſetlaw, and county of Nottingham, England, is ſituated 22 miles N. from Nottingham, the ſame diſtance N.W. from Newark, and 146 N. by W. from London. The town is ſmall, but neat and pleaſantly ſeated in a valley, near the ſource of the river Ryton. According to the population returns of 1811, the houſes were then 759, and the inhabitants 3702. A market, noted for malt, is held on Wedneſday, and fairs on the 20th of March, 20th of May, 21ſt of June, and 3d of October. Workſop, anciently Wirkenſop, was, before the Norman Conqueſt, the property of a Saxon nobleman. Long afterwards it belonged ſucceſſively to the families of Furnival, Nevill, and Talbot, earls of Shrewſbury. The Talbot eſtates deſcending to co-heireſſes, a part was conveyed to the Howards, earls of Arundel, afterwards dukes of Norfolk, by whom the lands of Workſop are ſtill poſſeſſed, and who, on this account, enjoy the privileges of furniſhing a glove for the king's right-hand at his coronation, and of ſupporting that hand while he holds the ſceptre. Workſop was in former times defended by a caſtle, long ago deſtroyed : but its ſcite is ſtill pointed out on a circular hill, encompaſſed with a trench, at the W. ſide of the town.

Workſop was formerly noted for its monaſtery, founded by William de Lovetot, in the reign of Henry I., for canons regular of the order of St. Auguſtine. The inſtitution was ſubſequently enriched by the gifts of various proprietors of the town ; but at the general diſſolution its poſſeſſions were ſeized by Henry VIII. Few veſtiges of the monaſtery now remain ; but the church ſtill partly ſubſiſts, and is a noble ſpecimen of ancient architecture. What now remains is but the W. end of the original church, with two lofty towers. The W. entrance conſiſts of an arch with zigzag ornaments, whilſt the towers have the windows in a gradation of different ſtyles of architecture. The interior of the church, in length about 135 feet, conſiſts of a nave and two aiſles ; the roof is ſupported by eight pillars, alternately octangular and cylindrical : the ancient pulpit is ſtill preſerved. On the N. ſide of the church are fragments of walls ; and foundations are diſcovered in the adjoining meadows : but the moſt curious veſtige of the ancient buildings is a ruinous chapel, at the S.E. corner of the church, now uſed as a place of burial, of which the windows, ſtill well preſerved, furniſh examples of the lancet form. The gate of the monaſtery is nearly entire, and retains a few of the ſtatues with which it was formerly furniſhed. The church and church-yard contain ſome monuments for eminent perſons of former times : one is the tomb of John, brother of Ralph Nevill, the firſt earl of Weſtmoreland, and treaſurer of England. The trade of Workſop, and its appendage Radford, has been much promoted by the Cheſterfield canal, which paſſes cloſe by the N. end of the town. The ſale of liquorice, formerly conſiderable, has been for ſome years at an end, none being now raiſed in the neighbourhood. On the S.W. of the town ſtands the noble manſion of the duke of Norfolk, ſtyled *Workſop-manor*, in the midſt of a park, eight miles in circuit, containing a great variety of ground, and much ancient timber of a fine growth, having once been a part of the great foreſt of Sherwood. The original manſion was erected by the renowned Talbot, the firſt earl of Shrewſbury, on a ſcale of extent and magnificence ſuited to his character and fortune : but in 1761 the whole was unfortunately burnt down ; by which accident, the loſs ſuſtained was very great, not only in the furniture, but in the library, the paintings, and the antique ſtatues, part of the celebrated Arundelian collection. Soon after this misfortune, the duke of Norfolk commenced a new manſion, on a plan of great magnificence, compriſing a quadrangle incloſing two courts ; but the execution of the ſcheme was interrupted by the unexpected death of the heir of the family. One ſide, however, which is the front, has been finiſhed, and is 318 feet in length, of great elegance and grandeur. In the centre is a portico of ſix Corinthian columns, on a ruſtic baſement. In the tympanum of the pediment is an emblematic repreſentation of the high alliances of the houſe of Norfolk ; and on the points are placed three ſtatues. The body of the building is crowned with an open baluſtrade. The interior contains many valuable paintings and portraits of anceſtors and connections of the family. The chapel is adapted to the Roman Catholic ſervice, to which the dukes of Norfolk have always, with the exception of the late duke, been ſteadily attached : it ſerves as a place of worſhip for a number of perſons of the ſame perſuaſion reſiding in the neighbourhood.

At no great diſtance to the S. of Workſop-manor is Welbeck abbey, the ſeat of the duke of Portland. This place belonged to Sweyn the Dane before the Conqueſt. A monaſtery is ſuppoſed to have been founded in the reign of Stephen, by Thomas de Cukeney, for Premonſtratenſian canons, who were removed from Newhouſe in Leiceſterſhire. In the reign of Edward III., the manor of Cukeney was purchaſed by the biſhop of Ely, and beſtowed on the monaſtery. At the diſſolution it was purchaſed by a perſon named Whalley, from whom it came to ſir Charles Cavendiſh, youngeſt ſon of ſir William, who married the celebrated counteſs of Shrewſbury. The ſon of ſir Charles, afterwards duke of Newcaſtle, was the author of a well-known treatiſe on horſemanſhip. His grand-daughter, marrying John Hollis, duke of Newcaſtle, left an only daughter and child, who by marriage conveyed the eſtates to the earl of Oxford ; and their only child and daughter by marriage transferred Welbeck to the anceſtor of the preſent proprietor. The manſion is a large irregular ſtructure, erected at different periods, containing, particularly within, portions of the ancient monaſtic buildings. The greater part of what is now ſeen was conſtructed about 1604. The interior contains many ſpacious and elegant apartments, which are decorated with a number of portraits of perſons important in Engliſh hiſtory.

The

The grand riding-houfe and ftables were erected by the noted duke in 1623 and 1625: having been long neglected they have been of late years reftored, and are now among the moft remarkable in the kingdom. Welbeck-park is about eight miles in circuit, and contains noble woods of venerable oaks, fome of very great age and extraordinary fize. One in particular, noticed in Evelyn's Silva, was in his time thirty-three feet round at the bottom, and is conceived to be 700 years old: it is now much decayed. But the moft remarkable tree is "the duke's walking-ftick," in height about 112 feet; the folid contents are eftimated at 440 feet. Near the gate leading to Workfop is a group of trees, called the "feven fifters," there having been formerly feven ftems fpringing from one root, but one has lately been broken off. The late duke formed an extenfive piece of water in the park, and raifed a bridge of three fpacious arches over it, but which fell down juft as it was completed.

About two miles to the eaftward of the parks of Workfop and Welbeck is that of Clumber, a feat of the duke of Newcaftle. The manfion is a magnificent ftone ftructure of three fronts, one of which is ornamented with a light Ionic colonnade. The apartments are fpacious, particularly the ftate dining-room, fixty feet in length, thirty-four in breadth, and thirty in height, which is fitted up with great magnificence. In the various rooms are feveral very valuable paintings. The arrangements for the domeftic accommodation of the family are well worthy of notice. The park, now eleven miles in compafs, was not long ago a wide tract of foreft-land. It is in a manner wholly the creation of the late duke of Newcaftle. It now contains about 4000 acres; but half a century ago the ground was little better than a black heath, interfperfed with bogs and marfhes, through which ran a fmall ftream. The park comprehends, however, two woods of ancient oaks, from one of which the manfion takes its name.

Adjoining to Clumber-park, on the fouth, is that of Thorefby, the feat of earl Manvers. The old houfe was deftroyed by fire in 1745, after which it was rebuilt by the proprietor, the laft duke of Kingfton, grandfather of the prefent poffeffor. The manfion, which is rather a comfortable refidence than a magnificent feat, confifts of brick, on a ruftic ftone bafement, with an Ionic portico of four columns in the principal front. The great ftair-cafe, fingle at the bottom, but divided into two at the firft landing, opens into a dome fupported by columns, on which refts a gallery, which communicates with the upper chambers. The apartments contain fome valuable portraits and paintings. The park is about thirteen miles in circumference, and contains feveral pieces of water, of which one, near the houfe, affumes the appearance of an extenfive river.—Thoroton's Hiftory of Nottinghamfhire, by Throfby, 3 vols. 4to. London, 1790. Beauties of England and Wales, Nottinghamfhire, by F. C. Laird, 8vo. London, 1812.

WORLD, Mundus, the affemblage of parts which compofe the univerfe.

The *duration* of the world is a fubject which has been greatly difputed. Plato, after Ocellus Lucanus, held it to be eternal, and to have flowed from God, as rays flow from the fun. Ariftotle was much of the fame mind: he afferts, that the world was not generated, fo as to begin to be a world, which before was none; and, in effect, his whole eighth book of Phyf. and firft book de Cœlo, are fpent in proving the eternity of the world.

He lays down a pre-exifting and eternal matter, as a principle; and thence argues the world eternal. His argument amounts to this; that it is impoffible an eternal agent, having an eternal paffive fubject, fhould continue long without action.

His opinion was long generally followed; as feeming to be the fitteft to end the difpute among fo many fects about the firft caufe.

Epicurus, however, though he makes matter eternal, yet fhews the world to be but a new thing, and fays it was formed out of a fortuitous concourfe of atoms. See Lucretius, lib. v.

Some of the modern philofophers refute the imaginary eternity of the world, by this argument: that, if it be *ab æterno*, there muft have been a generation of individuals, in a continual fucceffion from all eternity; fince no caufe can be affigned why they fhould not be generated, *viz.* one from another. Therefore, to confider the origin of things, and the feries of caufes, we muft go back in infinitum, *i. e.* there muft have been an infinite number of men, and other individuals, already generated; which fubverts the very notion of number. And if the caufe which now generates have been produced by an infinite feries of caufes, how fhall an infinite feries be finite, to give room for new generations? See God.

Dr. Halley fuggefts a new method of finding the age of the world, from the degree of faltnefs of the *ocean*; which fee.

It is another popular topic of controverfy, whether the world be finite, or infinite? See the arguments on both fides, under Universe.

It is likewife difputed, whether the plurality of worlds be poffible? See Plurality.

Some hold the affirmative, from an opinion of the infinite power of the Deity; it being a fetting bounds to omnipotence to fay, that he created fo many bodies at firft, and that he could not create more.

The Cartefians maintain the negative, upon thefe principles: that it is a contradiction to fay, there are feveral worlds exifting at the fame time, fince this implies feveral univerfes of created beings, the world being the το παν. That if there were feveral worlds, they muft either be at a diftance from one another, or contiguous; but neither can be faid: for were they contiguous, they would only conftitute one; and were they diftant, there muft be fomething between. But what can be between? If it be extended, it is corporeal; and, inftead of feparating the feveral worlds, it will connect them all into one.

The *exiftence* of an external world has been much controverted. The arguments on either fide, fee under Abstraction, Body, and Existence.

The world is fometimes divided into *upper* and *lower*: the *lower*, or *fublunary*, is the globe of our *earth* (which fee); and the *upper* includes the heavens, and heavenly bodies.

World, *Axis of the.* See Axis.

World, *Map of the.* See Map.

World, *Soul of the.* See Anima *Mundi.*

World, *Syftem of the.* See System.

WORLITZ, in *Geography*, a town of Saxony, in the principality of Anhalt; 5 miles E. of Deffau.

WORM, a river of Norway, which flows from the lake Miofs into the Glom, or Glomen.

WORMDIT. See Warmstadt.

WORMHOUT, a town of France, in the department of the North; 5 miles S. of Bergues.

WORMIA, in *Botany*, a genus of plants firft eftablifhed by Rottböll, was named by him in memory of the famous Danifh phyfician and naturalift, Olaus Wormius, fucceffor of of Caſpar Bartholin in the profeſſorſhip of medicine at Copenhagen. He died rector of that univerſity in 1654. His Latin writings, on the hiſtory and antiquities of Denmark and Norway, are valued for their accuracy. His ſon William publiſhed, in 1655, the *Muſæum Wormianum*, a handſome work in folio, the ſecond book of which, according to Haller, conſiſts entirely of botanical ſubjects. Olaus Wormius herein deſcribes and figures ſeveral rare plants, or monſtrous varieties, with a detail of their anatomy. His letters, not publiſhed till 1751, are ſaid to contain many things relating to Botany. — " Rottb. Nov. Act. Hafn. for 1783. v. 2. 522. t. 3." Saliſb. Parad. at p. 73. De Cand. Syſt. v. 1. 433. — Claſs and order, *Polyandria Pentagynia*. Nat. Ord. *Magnoliæ*, Juſſ. *Dilleniaceæ*, De Candolle.

Gen. Ch. *Cal.* Perianth inferior, of five roundiſh, concave, very obtuſe, coriaceous, permanent leaves. *Cor.* Petals five, roundiſh, concave, larger than the calyx, tapering at the baſe, deciduous. *Stam.* Filaments very numerous, crowded, ſhort, equal; anthers terminal, linear, longer than the filaments, ſhorter than the petals, recurved, burſting by a double orifice at the ſummit. *Piſt.* Germens five, or more, ſuperior, diſtinct, ovate, compreſſed, crowded; ſtyles terminal, tapering, recurved, longer than the germens; ſtigmas notched. *Peric.* Capſules as many as the germens, and of the ſame form, each of one cell and one valve, burſting at the inner edge, crowned with one of the permanent ſtyles. *Seeds* ſeveral, from 8 to 12, roundiſh, "each with a pulpy tunic at the baſe." *Saliſb.*

Eſſ. Ch. Calyx inferior, of five coriaceous, permanent leaves. Petals five. Anthers with two terminal pores. Capſules five, compreſſed, diſtinct, many-ſeeded. Styles thread-ſhaped. Stigmas notched. A genus of trees or ſhrubs, with rather twining *ſtems*, and round ſmooth *branches*. *Leaves* alternate, ſtalked, ſimple, oval, coriaceous, with a ſingle mid-rib, and many tranſverſe parallel partial ribs. *Stipulas* large, oblong, pointed, deciduous; the young ones convoluted, forming a terminal point, as in the *Magnolia* tribe. *Flower-ſtalks* about the ends of the branches, oppoſite to the leaves, angular, either racemoſe or panicled; often unilateral. *Flowers* white or yellow. *Calyx* remaining coriaceous and dry, not becoming pulpy, in which, as well as the ſeparate *ſtigmas*, and elongated *ſtyles*, this genus differs abundantly from *Dillenia*. (See that article.) M. De Candolle notices the two terminal pores of the *anthers* in *W. alata*, which he thought might afford a character for dividing the genus, if the ſame were not found in all the ſpecies. We find this character in *W. dentata*, as well as in our new *W. ſericea*, and therefore venture to make it a part of the generic diſtinction.

1. W. *madagaſcarienſis*. Madagaſcar Wormia. De Cand. n. 1.—" Leaves oval, bluntly ſinuated. Cluſters panicled."—Gathered by Commerſon in Madagaſcar. An elegant tree, with thick round *branches*. *Stipulas* ſolitary, large, long, leafy, externally villous, deciduous, each leaving an annular ſcar on the branch. *Leaves* oval or orbicular, ſmooth, with broad, obtuſe, ſhallow, marginal notches. *Footſtalks* long, channelled above, and marked with tranſverſe wrinkles. *Flower-ſtalks* nearly oppoſite to the leaves, erect. *Partial-ſtalks* ſingle-flowered, without *bracteas*. *Petals* undulated, thrice as long as the calyx. *Seeds* roundiſh. *De Candolle.*

2. W. *dentata*. Toothed Wormia. De Cand. n. 2. (Dillenia dentata; Thunb. Tr. of Linn. Soc. v. 1. 201. t. 20. Willd. Sp. Pl. v. 2. 1253, excluding Rottböll's ſynonym. Poiret in Lam. Dict. v. 7. 151.)—Leaves ovate, abrupt, coarſely and rather ſharply toothed. Footſtalks ſimple, triangular, ſmooth. Flower-ſtalks triangular, from three to ſix-flowered.—Gathered by Thunberg in Ceylon. We received a ſpecimen, preciſely anſwering to the above plate, in 1786, from profeſſor David Van Royen, marked *Dillenia indica*; *Reaumuria* of Koenig, by whom it was gathered; and *Ghodaparra* of the Cinghaleſe. This is a *tree*, with round branches. *Leaves* four inches long, of a broad, elliptic-ovate figure, very abrupt, coriaceous; paler beneath; entire at the baſe; wavy at the ſides; moſt toothed at the end; tranſverſe ribs very ſtraight. Convoluted *ſtipula*, at the end of the branch, acute, two-edged, ſmooth. *Footſtalks* linear, narrow, near two inches long, acutely triangular, not bordered, ſmooth. *Cluſter* ſimple, on a long, ſmooth, angular ſtalk, not quite oppoſite to the uppermoſt leaf, in our ſpecimen conſiſting of ſix *flowers*, whoſe partial ſtalks are about an inch long. Thunberg repreſents three *flowers* only, whoſe *petals* are obovate, about an inch in length.

3. W. *triquetra*. Triangular Wormia. " Rottb. Nov. Act. Hafn. v. 2. 532. t. 3." De Cand. n. 3.—Leaves ovate, bluntiſh, bluntly and ſlightly ſinuated. Footſtalks ſimple, triangular. Flower-ſtalks triangular, racemoſe.—Native of Ceylon. *Van Royen.* Deſcribed by De Candolle from a dried ſpecimen. "*Branches* round, brown, ſmooth, with an elevated ring round the origin of each leaf. *Footſtalks* ſtraight, two inches long. *Leaves* oval, or oblong; rather tapering at the baſe; obtuſe, or ſomewhat pointed, at the end; either entire, or very bluntly and ſlightly waved; the ribs pinnate, (as in the reſt,) having about eight or ten lateral ribs at each ſide. *Flower-ſtalks* ſimple, nearly oppoſite to the leaves. Two outer *calyx-leaves* rather the largeſt. *Petals* concave. *Stamens* very ſhort. *Germens* triangular, crowded. *Styles* reflexed." Such is De Candolle's deſcription, but he doubts whether this be a diſtinct ſpecies from the laſt. We have ſeen neither ſpecimen nor figure, but the plant having been received from profeſſor Van Royen, like our ſpecimen of the preceding, rather confirms the doubt than removes it.

4. W. *alata*. Wing-ſtalked Wormia. De Cand. n. 4. (Dillenia alata; Banks Ic. unpubliſhed, communicated with ſpecimens, in flower and fruit, to Linnæus.)—Leaves oval, entire. Footſtalks ſmooth, winged.—Gathered by ſir Joſeph Banks, in New Holland, near Endeavour river. The *branches* are round, ſmooth, except the annular ſcars left by the *ſtipulas*. *Leaves* three or four inches long, and above half as broad, ſmooth, obtuſe, with diſtant tranſverſe ribs, and copious reticulated veins; their under ſurface ruſty-coloured, but poliſhed. *Footſtalks* an inch or an inch and a half long, winged at each ſide with an entire leafy border, contracted at the apex, and quite ſmooth. *Flower-ſtalk* oppoſite to the upper leaf of the branch, ſolitary, racemoſe, triangular, ſmooth, ſhorter than the leaves, bearing two or three yellow *flowers*, larger than thoſe of *W. dentata*. *Petals* undulated. *Anthers* long, linear, with two pores at the end, like *W. dentata*. *Styles* ſometimes nine or ten, recurved. *Capſules* coriaceous, gaping, apparently real *follicles*, with a number of round *ſeeds*, inſerted into the margins, deſtitute, as far as we can ſee, of any pulpy tunic.

5. W. *ſericea*. Silky-ſtalked Wormia.—Leaves oval, bluntly ſerrated. Footſtalks depreſſed, ſilky, as well as the flower-ſtalks and calyx.—Native of the Eaſt Indies. A ſpecimen in the herbarium of the younger Linnæus, which he ſuppoſed to be *Dillenia indica*, is marked "*Mallei Mangatſokeri*, a tree with ſnow-white *flowers*." We cannot refer this to any thing in profeſſor De Candolle's work. It undoubtedly belongs to the genus before us. The *branches*

branches are round, ſtrongly ſcarred; when young, finely downy. *Leaves* crowded about the extremity of each branch, apparently deciduous, being found on young ſhoots only, ſhaped like the laſt, and nearly as large, but ſomewhat ſerrated, and, in a young ſtate at leaſt, finely downy; their tranſverſe ribs much more copious, ſtraight, and parallel, than in that. *Footſtalks* half an inch long, ſtout, broad, and depreſſed, blunt-edged, not bordered, denſely clothed with fine, white, ſilky, permanent down. *Stalks* ſimple, ſingle-flowered, ſilky, about the length of the footſtalks, each oppoſite to a leaf. *Calyx-leaves* obovate, concave, an inch long; ſmooth within; ſilky at the back. The *petals* we have not ſeen. *Filaments* ſhort. *Anthers* long, compreſſed, two-edged, each opening by two terminal orifices. *Germens* crowded together. *Styles* five, recurved at the extremity. *Stigmas* ſmall, abrupt.

We have at the end of the article DILLENIA, hazarded an opinion, that the *D. elliptica*, *integra*, and *retuſa* of Thunberg, as well as his *dentata*, above-deſcribed, belong to this genus of *Wormia*, to which profeſſor De Candolle ſeems, by a remark under *D. integra*, in his Syſt. v. 1. 437, diſpoſed to agree. Probably he thought it beſt, having examined no ſpecimens, to leave theſe plants where he found them, but we cannot omit the following, on the authority of Thunberg's figure.

6. W. *retuſa*. Abrupt Wormia. (Dillenia retuſa; Thunb. Tr. of Linn. Soc. v. 1. 200. t. 19. De Cand. Syſt. v. 1. 437. Willd. Sp. Pl. v. 2. 1253.)—Leaves obovate, abrupt, diſtantly toothed, ſmooth. Footſtalks hairy at the baſe. Stalks ſingle-flowered, ſmooth.—Native of woods in Ceylon. *Thunberg*. A *tree*, apparently nearly related to *W. dentata*, but the flowers are ſolitary, and rather ſmaller, each on a ſimple ſtalk, oppoſite to the uppermoſt leaf. *Styles* five, evidently thoſe of a *Wormia*, not a *Dillenia*.

WORMING, in *Ship-Building*, windling a rope cloſe along the cuntlines of larger ropes to ſtrengthen them, and make a fair ſurface for the ſervice. See *Plate* I. *fig*. 46. *Rigging*.

WORMING, in *Animals*, an operation which is ſometimes performed on the young of the dog and ſome other kinds. Young puppies are thus cut, in ſome caſes, under an ignorant ſuppoſition that it prevents their going mad; but in reality to cure them, as it generally does, of the diſpoſition to gnaw every thing in their way. It conſiſts in the removal of a ſmall worm-like ligament, ſituated beneath the tongue; and the part being afterwards ſore for ſome days, the animal is thus weaned of his miſchievous habits. See *Diſeaſes of* DOGS.

WORMIUS, OLAUS, in *Biography*, a Daniſh phyſician, deſcended from a family which fled from Arnheim, in Guelderland, to Denmark, from the perſecution of the duke of Alva, was born at Aarhuus, in Jutland, in 1588, and finiſhed his education at the univerſity of Marpurg; afterwards availing himſelf of the lectures which he attended in the principal German academies, and in his tour through France, Italy, Switzerland, and Holland. He then returned to Denmark in 1610, and having in the following year taken the degree of doctor in medicine at Baſle, he paſſed through the Netherlands to England, and in 1613 returned to his native country, where by ſucceſſive preferments he became profeſſor of medicine in 1624, in conſequence of the reſignation of Caſpar Bartholin. Although he obtained in 1636 a canonicate in the chapter of Lund, he continued his profeſſional practice, and was often conſulted by Chriſtian IV. and Chriſtian V. His knowledge of antiquities, medicine, and anatomy, was profound; and in 1628 he diſcovered bones in the human ſkull, called after his name "ſex officula Wormiana in futura cranii lamdoidea." His collection of curioſities was, after his death, lodged in the royal muſeum. He was thrice married, and had 18 children. He died in 1654. His writings were very numerous; and the principal of them are enumerated in the General Biography, to which we refer.

WORMS, in the *Linnæan Syſtem of Nature*. See VERMES.

WORMS, in *Huſbandry*, are very prejudicial to corn-fields, eating up the roots of the young corn, and deſtroying great quantities of the crop.

Sea-ſalt is the beſt of all things for deſtroying them. Sea-water is proper to ſprinkle on the land where it can be had; where the ſalt-ſprings are, their water does as well; and where neither are at hand, a little common or bay ſalt melted in water does as well.

Soot will deſtroy them in ſome lands, but it is not to be depended upon, for it does not always ſucceed. Some farmers ſtrew on their land a mixture of chalk and lime; and others truſt wholly to their winter-fallowing to do it; if this is done in a wet ſeaſon, when they come up to the ſurface of the ground, and ſome nails with ſharp heads be driven into the bottom of the plough.

If they are troubleſome in gardens, the refuſe brine of ſalted meat will ſerve the purpoſe, or ſome walnut leaves, ſteeped in a ciſtern of water for a fortnight or three weeks, will give it ſuch a bitterneſs that it will be certain poiſon to them.

A decoction of wood-aſhes, ſprinkled on the ground, will anſwer the ſame purpoſe; and any particular plant may be ſecured both from worms and ſnails by ſtrewing a mixture of lime and aſhes about its roots. It is a general caution among the farmers to ſow their corn as ſhallow as they can, where the field is very ſubject to worms. Mortimer's Huſbandry, p. 328.

In the roots of ſome ſorts of garden crops, ſuch as the carrot, onion, ſhallot, cauliflower, broccoli, and ſome others, worms and maggots are not unfrequently very injurious and hurtful, unleſs they be deſtroyed in ſufficient time to prevent ſuch effects. In the firſt, much advantage is ſuppoſed to have been gained by the full uſe of pigeon dung in preventing the worm.

And in this and the other ſorts of garden crops it is found, that much benefit in removing ſuch evils may be produced by a proper ſucceſſion of cropping, as that of following ſtrawberries which have been four or five years planted with onions, and artichokes that have ſtood the ſame length of time with carrots; as theſe ſorts of vermin do not attack either the ſtrawberry or the artichoke. In ſome caſes, it is ſuppoſed that it may be ſafe to crop two or three times with onions or carrots on the ſame ſpot, but not oftener, as ſome appearances of the worm and maggot are generally diſplayed in the ſecond or third year; but that from the ground being four or five years under ſtrawberries or artichokes, plants on which thoſe vermin cannot ſubſiſt, they ſoon periſh, and the land where the rows ſtood has all the advantage of a new ſoil.

Soot when applied as a manure is ſaid to be a good preventive of the maggot in onion crops; and that ſhallots, as requiring only a ſmall ſpot, may be much improved in growth, and entirely preſerved from the maggot, by the application of old hot-bed dung as manure, in the bottoms of the drills, well-mixed with ſoot; planting the ſhallots on this mixed manure, and covering them in to a proper depth. The ſoot in this caſe prevents the appearance of the maggot, and at the ſame time greatly improves the ſtrength of of the ſhallot plants: it is a method which has never been found to fail in preventing worms and maggots in ſuch crops.

Cauliflowers, broccoli, and the roots of other ſuch plants, may be preſerved from the effects of worms, by watering the drills of them well with ſoap-ſuds before planting them out, and afterwards occaſionally: this not only, it is ſaid, prevents the worm, but encourages the growth of the plants, and in ſome meaſure prepares the ground for other vegetables that are liable to the ſame ſort of attacks.

The maggot is conſidered by ſome as peculiar to the onion and ſhallot, and that whenever the former becomes diſeaſed, it is moſt liable to its attacks; and that as it could never be detected in the ſoil, it is highly probable that the ova or eggs of it are depoſited in the root, and may be hatched in the greateſt numbers when the plants are in a ſickly ſtate. It is not ſuppoſed, that the maggot ever paſſes from one onion to another; but that any remedy which is ſufficiently powerful to deſtroy the inſect muſt inevitably deſtroy the onion itſelf; that all that can be done is, therefore, to ſelect proper ſoils and ſituations for the onion crops.

It is remarked, however, that the maggot which attacks the carrot is unqueſtionably to be found in the ſoil, and that it viſibly enters from without.

It is concluded on the whole, that worms and inſects of theſe kinds in general are driven from their retreats under ground, by pouring bitter or acrid water upon it, as ſuch in which green walnuts have been ſteeped, or of which a ley has been made by diſſolving potaſh. See ſeveral papers in the firſt volume of the "Memoirs of the Caledonian Horticultural Society."

Worms, in *Medicine*. Three ſpecies of worms infeſt the human body; namely, the Ascaris, Lumbricus, and the *Tænia* or Tape-*Worm*; which ſee reſpectively.

Worms were formerly ſuppoſed to be a common cauſe of a ſeries of morbid ſymptoms, eſpecially in children; but it is now well underſtood, that the diſeaſe aſcribed to their influence is a maraſmus depending upon other morbid conditions of the alimentary canal. The ſymptoms of this diſeaſe have been already detailed, under the head of *Diſeaſes of* Infants, to which we refer.

Tin is often recommended as a good remedy againſt worms, particularly of the flat kind. Dr. Alſton, in the Med. Eſſ. Edinb. vol. v. art. 7. directs an ounce and a half of the powder of pewter-metal to be mixed in half a Scotch mutchkin, or about half a pint Engliſh meaſure of treacle, for children; but to grown perſons, he gives two ounces of the powder of pure tin, paſſed through the fineſt hair-ſieve, and mixed with eight ounces of treacle. As to the adminiſtration of this medicine, the original receipt directs half of it to be taken the Friday before the change of the moon; the day after, half the remainder, and the reſt on Sunday. On the Monday, a purge is to be taken. The doctor thinks there is probably nothing in the particularities of the day; but ſays, the medicine ſucceeds well in ſeveral ſpecies of worms.

The efficacy of fern-root againſt worms was known in the time of Dioſcorides; and towards the beginning of this century, Meſſieurs Andry and Marchant publiſhed accounts of ſucceſsful modes of exhibiting it in theſe caſes. But it has been principally celebrated of late as a ſpecific in the cure of the tænia, or tape-worm.

Dr. Prieſtley, conſidering how fatal nitrous air is to inſects, and likewiſe its great antiſeptic power, conceived that conſiderable uſe might be made of it in medicine, in the form of clyſters; and he apprehends, that if nitrous air was diluted with common air, or fixed air, the bowels might bear it better, and that it might ſtill be deſtructive to worms of all kinds, and be of uſe to check or correct putrefaction in the inteſtinal canal, or other parts of the ſyſtem. Prieſtley's Obſ. on Air, vol. i. p. 227.

Worms, in *Animals*, a troubleſome ſort of vermin often found in the inteſtines of the horſe, and ſome other animals, cauſing diſeaſe. See Botts, Earth-*Worms*, Ascarides, Tænia, and Teretes.

With reſpect to the cauſe of worms in horſes, it is imagined, that, as in the human ſubject, ſome conſtitutions are more inclinable to breed worms than others. Gibſon ſays, the moſt uſual cauſe of worms is foul or high feeding, which occaſion crudities and ſlimy indigeſted matter in the ſtomach and bowels, (eſpecially in horſes that have been pampered for ſale,) forming a proper nidus for worms. This indeed may be the caſe, but the primary cauſe of worms is that which occaſions theſe crudities, to wit, a want of energy in the functions of the ſtomach and bowels, as worms are never found in animals perfectly healthy in theſe reſpects.

According to Gibſon, the ſigns of worms in horſes are various, according to their different kinds. The botts that many horſes are troubled with in the beginning of ſummer are always found ſticking to the rectum, and are often thruſt out with the dung, along with a yellowiſh-coloured matter, like melted ſulphur. They are no way dangerous there, but they are apt to make a horſe reſtleſs and uneaſy, and rub his breech againſt the poſts. The ſeaſon of their coming is uſually in the months of May and June, after which they are ſeldom to be ſeen, and rarely continue in any one horſe above a fortnight or three weeks. Thoſe that take poſſeſſion of the membranous portion of the ſtomach are extremely dangerous in cauſing convulſions, and are ſeldom diſcovered by any previous ſigns before they bring a horſe into violent agonies. See Botts.

But the teretes or earth-worms give little diſturbance to a horſe, and would hardly be diſcovered, unleſs they were ſeen now and then to come away with the dung. Frequently horſes void one or two, and no more; and ſometimes they will void pretty large quantities of the young brood, not much larger than the aſcarides, only of a red colour, and not white, as the latter generally are. They are moſt uſual in autumn, or the beginning of winter, though a horſe may now and then void one or two of theſe at other times of the year.

However, the aſcarides, or ſmall needle-like worms, are very troubleſome to horſes, breed at all times of the year, and often when one brood is deſtroyed another ſucceeds. Theſe are not at all dangerous, yet when a horſe is peſtered in this ſort of way, though he will go through his buſineſs tolerably well, and ſometimes feed heartily, yet he always looks lean and jaded; his hair ſtares as if he was ſickly, and nothing that he eats makes him thrive. That he feels pain, too, is plain, for he often ſtrikes his hind foot againſt his belly, which ſhews where his grievance lies, and is ſometimes griped, but yet without the very violent ſymptoms that attend a colic or ſtrangury. He never rolls or tumbles, but only ſhews uneaſineſs, and generally lays himſelf down quietly on his belly for a little while, and then gets up, and begins to feed; but the ſureſt ſign is, when a horſe voids theſe worms with his dung.

In regard to the cure, if a horſe be troubled with botts, Gibſon ſays, he may be relieved without much expence or trouble, only by giving him a ſpoonful of ſavin, cut very ſmall, once or twice every day, in oats or bran moiſtened; and if three or four cloves of chopped garlic be mixed with

with the favin, it will do better, for garlic is of great fervice in thefe complaints. Horfes that are troubled with botts ought to be purged with calomel and aloetic purges before the weather grows too hot; and if they be kept to a clean diet after this, it will be a great chance if ever they are troubled with them any more. As the botts generally happen about the grafs feafon, thofe horfes that are turned out to grafs often get rid of them there, by the firft fortnight's purging; and, therefore, thofe that have the convenience of a good pafture for their horfes need not be very folicitous about giving them medicines.

And the earth-worms, which fome writers call teretes, rotundi, or lumbrici, are alfo beft conquered by calomel and occafional aloetic purges, for worms often come away in purging, when, till then, it has not been known that the horfe was troubled with them; and it has been obferved, after thefe have been voided, that the animal has thriven better, grown more lively, and fhewn more alertnefs at his bufinefs. There can fcarcely be a better plan of treatment than is fupplied in the following *formulæ*, recommended by Mr. Denny in his ufeful work: — Take of calomel, one drachm; anifeeds, in powder, half an ounce; treacle, enough to make a ball. This is directed to be given in the evening; and the next morning the following:—Take of fuccotrine aloes, in powder, one ounce; ginger, in powder, two drachms; treacle, enough to make a ball: and the above bolus and purgative ball muft be repeated, with an interval of nine days, until the horfe has taken three dofes. Then it is advifed to give the following alterative powder, daily for about a month; this procefs does not require any change of diet, or involve any hazard from the effects of cold:—Take of Ethiops mineral, crude antimony, prepared, and anifeeds in powder, each half an ounce; mix them. The management of the horfe during this courfe of worm medicines is that in common cafes of phyfic; but fome prefer giving Barbadoes aloes for the removal of worms, thinking it the more efficacious, becaufe its operation is very rough: and Gibfon thinks it may be given to hackneys, and other horfes of fmall value; but he never found it more efficacious than the fuccotrine, at the fame time that it expofes a horfe more to gripes and other dangerous diforders, unlefs it be properly managed. The following he gives as a cheap well-corrected purge of this kind:—Take of Barbadoes aloes, one ounce; falt of tartar, two drachms; ginger, grated, a drachm and a half; oil of amber, a middling fpoonful; fyrup of buckthorn, fufficient to make a ball. The only objection to this is the quantity of aloes, which would be too confiderable even if of a milder fort for fome horfes.

It may be obferved, that the fort of worms called afcarides fometimes come away from a horfe in great numbers, with the help of a purge, and fome get quite clear of them with purges only; but this does not very often happen, for the horfes that breed afcarides, above all others, are fubject to flime and foulnefs in their inteftines. In the human body, afcarides are thought to be bred in the rectum, near to the fundament; but in horfes no other kind than botts ufually adhere to that gut. On the contrary, thefe worms in them feem to be lodged about the beginning of the fmall inteftines near the ftomach, where they feed on the alimentary parts of the chyle. The botts in a horfe are often feen fticking near the fphincter ani, and are continually dropping away with the dung; but the afcarides are feldom feen there, except when the animal has had a purge given him, or when he falls into a natural purging, which often happens from the irritation of the bowels, and then they come away in very great numbers, accompanied with much flime and mucus. Botts feldom alter a horfe's looks, but thefe not only make a horfe grow lean, and look emaciated, but on opening his mouth one may perceive a more than ordinary languid whitenefs, and a fickly fmell, inftead of that livelinefs of colour that is always perceivable in the mouth of a found and vigorous horfe; fo that, whatever be the primary caufe, thefe worms feem in a great meafure to proceed from a vitiated appetite and a weak digeftion, which renders them the more difficult to be removed; for which purpofe recourfe muft be firft had to the foregoing remedies, and after them, fuch medicines as are proper to ftrengthen the ftomach, promote digeftion, and give tone to the folids.

The treatment advifed by Gibfon for thefe worms is chiefly the following: — Take of calomel, prepared, two drachms; diapente, half an ounce; make thefe into a ball, with a fufficient quantity of conferve of rofes, and give it in the morning, keeping the horfe from meat an hour or two before and after the dofe; and the next morning adminifter a moderate aloetic purge, taking great care to keep the horfe from wet, or from any thing that may expofe him to take cold. The above calomel ball and the purge may be repeated in fix or eight days, and again in fix or eight days more. Or the following mercurial purge may be given, which will be lefs troublefome, though not lefs efficacious:—Take of crude quickfilver, two drachms; Venice turpentine, half an ounce. Rub the quickfilver with the turpentine in a mortar till no particle of the former appear; then add, oil of favin, thirty or forty drops; fuccotrine aloes, in powder, half an ounce; ginger, grated, one drachm; fyrup of buckthorn, enough to make it up into a ball.

One of thefe mercurial purges may be given in the foregoing manner, *viz.* one in fix or eight days, with all the fame precautions: it will work mildly, and with little or no griping or ficknefs. And another mercurial purge, which is proper to deftroy worms and to cleanfe the firft paffages, is this:—Take of diagridium, calx of antimony, and calomel, of each two drachms; fuccotrine aloes, fix drachms; ginger, grated, one drachm; oil of favin, cloves, or anifeeds, thirty or forty drops; fyrup of buckthorn, enough to form the ball. To be given as the preceding.

When a horfe has gone through a courfe of thefe mercurial purges, fome advife the following drink to be given two or three times a-week, or till the horfe begins to thrive and look healthy:—Take of rue, camomile flowers, horehound, of each a handful; galangals, bruifed in a mortar, three drachms; liquorice-root, fliced, an ounce. Boil thefe in a quart or three pints of forge-water fifteen or fixteen minutes in a covered veffel, and keep it covered till cold; then ftrain it through a piece of coarfe canvas, and give it in the morning upon an empty ftomach.

Powdered tin has likewife been advifed with the intention of deftroying worms; and alfo moft of the preparations of antimony: fulphur is alfo good in all fuch cafes; and even crude antimony in fine powder, given with equal parts of fulphur, often fucceeds in the proportion of an ounce in the morning and another at night.

The worms which infeft the bodies of other animals of different domeftic kinds may be deftroyed, expelled, or got rid of, by the fame remedies and modes of treatment, only proportioning their quantities to the nature and ftrength of the animals to which they may be given, and regulating the manner of exhibiting and continuing them, to that of the ftates in which they may be at the time, from the effects of the worms and other caufes.

There is alfo a kind of worms which are frequently fatal to the gallinaceous birds, of which a curious account has been given by Mr. Weinſenthal, in the Medical and Phyſical Journal. The inconvenience produced by theſe creatures is at firſt but ſlight: however, it gradually becomes more and more oppreſſive, until it ultimately deſtroys the birds. Very few indeed recover; they languiſh, grow diſpirited, droop, and die. It is found, on diſſection, that theſe ſymptoms are occaſioned by worms in the trachea. The writer has ſeen the whole of it completely filled with theſe worms, and has been aſtoniſhed at the animal's being capable of reſpiration at all under ſuch circumſtances.

They are of a reddiſh colour, and at firſt view reſemble the human lumbricus; but when examined are materially different. When expoſed to the microſcope, they are found to have an orifice or mouth at one end, formed for ſuction; the other end, as far as it can be aſcertained, is imperforated. The inteſtinal tube is much convoluted, like that of the lumbricus.

It does not appear that any effectual remedy has been yet diſcovered for removing theſe moſt deſtructive animals. They have been drawn out of the trachea by means of a feather, ſtripped from near its end, which is paſſed into the larynx and twiſted round, till it engages one or two of the worms, which are extracted, but without any relief to the animal, after the operation has been performed.

Worm, in *Timber*, a diſeaſe in growing fir, and perhaps other timber-trees, produced by a worm. For which it is ſuppoſed by Mr. Nicol, in his "Practical Planter," that there can be no remedy except in the draining and improvement of the ſoil. Indeed, this diſeaſe is not known on ſoils congenial to the nature of the plant; nor does it ever appear until the tree becomes ſickly, by its roots having touched a cankering bottom.

It has been ſuppoſed this worm is the ſame with that which is found in deal, and ſome other ſorts of wood.

Worms, *Aquatic*. See *Water*-Worms *infra*.

Worm, *Aſcaris*, in the *Linnæan Syſtem*, a genus of the order of *inteſtina*, and claſs of *vermes;* the characters of which are, that the body is round and filiform, and attenuated towards both ends. There are two ſpecies. See Ascarides.

Worm, *Bee*. See *Generation of* Bees.

Worm, *Butterfly*. See Aurelia, and Caterpillar.

Worm, *Canker*. See Scarabæus.

Worm, *Chur*. See Gryllus.

Worm, *Cochineal*. See Coccus.

Worm, *Connough*, or *Connaught*, in *Natural Hiſtory*, a name given by the common people of Ireland to a kind of caterpillar found in many parts of that kingdom; and, from its ugly aſpect, reputed to be poiſonous.

It is ſaid to be the only poiſonous creature of that kingdom, and many miſchievous effects are attributed to its ſting, and to its poiſonous quality, when eaten by cattle. As to the firſt of theſe opinions, it is evidently erroneous; the creature having no power to ſting at all. The other is not ſo eaſily proved falſe, but is much to be ſuſpected. The reaſons on which it is founded are theſe: the cattle in Ireland are ſubject to a very terrible diſeaſe, which is moſt frequent in autumn; about the time when theſe animals are in the greateſt plenty.

It is moſt frequent alſo among thoſe cattle which feed in low and marſhy grounds, where this creature lives and feeds; cows and hogs, which feed in theſe places, are the only creatures ſubject to the diſtemper, and this is imputed to the cow's eating by large mouthfuls, becauſe ſhe chews the cud a ſecond time; and the hogs feeding ſo foul and greedily, as to eat things which other creatures refuſe. Finally, the great cauſe of aſſigning this diſeaſe to this creature is, that the worm only appears in great numbers about once in ſeven years; and in theſe, and theſe years only it is, that the diſtemper among the cattle is common.

The ſymptoms by which this diſeaſe is diſtinguiſhed from all others are, great ſwelling of the head, and a falling down of the anus; the gut often hanging out to the length of ſix or ſeven inches. The common cure among the more intelligent people is a ſtrong decoction of the plant called bear's-foot, or great black hellebore, with ſome rue and garlic given with butter and beer; this is found to have great ſucceſs with the cows. The hogs are cured only by mixing reddle, or the common red ochre powdered, with butter-milk, and making them eat a large quantity of it.

The Iriſh peaſants have recourſe to many idle remedies; but theſe are found often of real ſervice. The caterpillar, ſuppoſed to occaſion this diſeaſe, feeds on the common ragwort, and is larger than moſt other creatures of this kind, being of the length and thickneſs of a man's finger; it is marked with two large ſpots behind the head, which are ſuppoſed by the vulgar to be the eyes, but are only round variegations, of the nature of thoſe common on other caterpillars; and what they take to be a ſting in the tail, is no other than a horn in that part, which is not peculiar to this caterpillar, but found on many others. That the common people are deceived in regard to the external parts of this creature is evident; but experiments are required yet to prove whether or not they are ſo, in regard to its poiſonous quality.

One trial is remarked by Mr. Molyneux to have been made on a dog, who eating the ſkin of only one of the creatures was found dead about three days after; another dog, which drank the juices expreſſed from that ſkin, received no hurt. The inſect is deſcribed in Liſter's edition, under the name of the elephant caterpillar. Phil. Tranſ. N° 168. p. 880.

Worm, *Earth*, *lumbricus*, a genus of the order of *inteſtina*, including two ſpecies. See Earth-*Worm* and Lumbricus.

Worm, *Flower-root*. See Flower.

Worm, *Fly*, in *Natural Hiſtory*, the worm or maggot produced of the egg of a fly, and afterwards to be tranſformed into one.

Theſe worms are to the fly, what the caterpillar is to the butterfly it produces. The cuſtom of the world has appropriated the term caterpillar to that one ſpecies of the flying inſects' firſt ſtate; but we have unfortunately no term of diſtinction yet eſtabliſhed for any of the firſt ſtate of any of the other flying inſects, the creature produced by the egg of the fly ſcarce being indeterminately called worm. Till more expreſſive names ſhall be invented for theſe, it may not be improper to diſtinguiſh thoſe of the different claſſes by the additional name of the inſect they are to be changed into, and to call that which is to become a beetle, the *ſcarab-worm;* that which is to be hereafter a fly, the *fly-worm;* and ſo of the reſt.

Thoſe which are to be hereafter winged creatures of the fly-claſs are extremely different one from another in form and figure, and may very properly be arranged into ſeveral claſſes.

The moſt remarkable and ſtriking differences between the claſſes of thoſe creatures, are thoſe of the form and ſhape of their heads. Many of them have heads which it is not eaſy to diſtinguiſh to be ſuch, as they carry no one mark of the head of an animal viſibly about them. There are many whoſe heads are variable at the pleaſure of the creature, and which at times are ſeen to be more or leſs long, more or leſs thick, more or leſs flat, more or leſs ſhortened at pleaſure

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by the animal, and eafily bent and turned about in any direction. The heads of thefe creatures are compofed of a very foft and flexible flefh.

There are others whofe heads are hard, and which always retain the fame regular figure. The firft general arrangement of thefe worms may be into thofe which have a variable, and thofe which have an invariable head. The fubordinate diftinctions may be deduced from the number, difpofition, ftructure, and form of the other parts. Some worms of this kind have no legs; thofe of others are membranous or fcaly; and others have them both membranous and fcaly. Some worms have the power of altering the figures of their bodies at pleafure, both as to length and bulk: the bodies of others are rigid, and incapable of thefe changes. Some, again, have a thin membranous coat; whereas that of others is firm and fcaly, or cruftaceous. Moreover, confiderable differences are obfervable with regard to the pofition, number, and figure, of their organs of refpiration.

Among the fly-worms of variable heads, the difpofition of the ftigmata, or air-holes, at which the tracheæ of thefe animals terminate, will afford feveral diftinctions of genera: *e. gr.* the worms of the common flefh-fly has in its ftigmata fix apertures, three in each, refembling button-holes; but the worms of many other flies have only one fmall eminence in each: others have them cylindric and hollow, and projecting like horns, of which fome have two, and others three, differently fituated and difpofed. The number and figure of the hooks, which ferve thefe creatures for teeth, may alfo ferve for matter of diftinction. The common worm of the flefh-fly has two hooks, with a dart between them; others have hooks without a dart; fome have one hook, and others none. The figure of the body, and the differences of fize and colour, may furnifh farther diftinctions with regard to the genera of the firft clafs.

Thofe of the fecond clafs, which have variable heads, and differ from the former in having legs like thofe of the caterpillar clafs, have often a fort of hooks faftened to them: they have alfo a long flefhy tail, capable of being lengthened or contracted at pleafure, and refembling the tail of a rat; whence thefe are called *rat-tailed worms*. In thefe worms, the tail is the principal organ of refpiration; its end being always open, and fupplying the office of the ftigmata of the other genera.

The fly-worms of the third clafs, which have invariable heads, and have nothing analogous to the organization of moveable jaws, have pointed heads, or fuch as feem truncated, and no fcaly legs: thefe form a very numerous family both in the terreftrial and aquatic kingdom, and all of them furnifh two-winged flies. Under this clafs Reaumur enumerates and defcribes eight genera. This ingenious writer mentions worms of another clafs, which ufually produce four-winged flies, having heads of an invariable figure, and two teeth or moveable jaws near the aperture of the mouth, without fcaly legs, and with the ftigmata placed on the fides of their bodies. The flies produced from thefe are, the bees, wafps, ichneumons, gall-flies, &c. There is another clafs of the hexapode, or fix-legged worms, which are transformed into fome fpecies of the libellæ; which have no mouth, but two openings at the top of their antennæ, through which their aliment may pafs. The formica leo, and the puceron eaters, belong to this clafs. There is another clafs, which have bodies like thofe of the caterpillar clafs, and fix legs, befides two other fhorter legs or hooks near their hinder part, which ferve for motion and for fixing themfelves. The water-worms, which make for themfelves cafes of different materials, and are transformed into papilionaceous flies, are of this clafs. There is alfo a clafs of worms, called falfe or baftard caterpillars. See Fausse *Chenille*. See the more particular defcription of thefe claffes, and their fubordinate genera, in Reaumur's Hift. Inf. tom. iv. p. 161, &c.

Worm, *Gourd*, the name of a fpecies of *tænia*, or tapeworm; the body of which is of an oblong form, flat on the belly, and rounded on the back; its fkin is foft, and its mouth large, horizontal, and emarginated, or dented in the middle. It refembles the common gourd in figure, and from thence has got this name of *vermis cucurbitinus*, or the gourd-worm. It is frequently found in the inteftines of animals.

Worm, *Golden*. See Aphrodita.

Worm, *Guinea*, or *Hair*-Worm. See Chætia, Amphisbæna, and Dracunculi.

Worm, *Gally*, *Glow*, *Gnat*, *Goofeberry*, *Hay*, *Horfe*, *Lyfimachia*, *Mufhroom*, *Oyfter*, *Pile*, *Sheep-nofe*, *Silk*, *Solitary*, and *Truffle*. See the refpective articles.

Worms, *Meal*. There are two very different infects found in our meal or flour; the one is fo fmall, that it is only to be feen by the microfcope; all that the naked eye can difcover of it is, that fomething is alive in the place, from the whole fubftance of the flour being in motion. See Flour.

The other meal-worm is larger, and more frequently offers itfelf to our obfervation: it confifts of eleven rings, and has three pair of legs. The mouth of this worm is made into a kind of forceps, and from this arife, on each fide, a great number of fmall fpinulæ; thefe ferve inftead of teeth, and the animal feeds by means of them. They are found fometimes very foft and tender, fometimes hard and firm; at fome feafons they are very brifk and lively, at others they have fcarce any life in them.

The moft remarkable thing in regard to thefe worms is, that they are always exactly of the colour of the flour which they live among. Ray has obferved, that the white flour breeds white ones; the coarfer flour breeds larger and greyer ones; and that flour which has the bran among it, breeds brown ones of the fame colour with that of itfelf. This is a provifion of nature for the fafety of the animal, fince were it of a colour different from that of the flour, it muft be eafily difcovered among it, and would be picked out and thrown away. The caterpillar tribe are thus preferved, by being of the colour of the leaves they feed on; their green ufually fuiting itfelf exactly to that of the tree or plant. Deflandes, Trait. Phyf.

Worms *of the Sea*. The fea-worms are of the number of thofe animals which, with the oyfter and feveral other fhell-fifh, furnifh us an inftance of animals which remain all their lives fixed in the manner of plants to one fpot, whence there is no probability of their moving themfelves.

Thefe worms are included in a fort of cafes or pipes, and may be divided into two claffes, according to the nature of thofe cafes. In the one fpecies thefe only are made of grains of fand, fragments of fhells, and the like, faftened together by a vifcous humour; and in the other they are compofed of a true fhelly matter.

Thofe worms which have fhelly cafes are fixed fometimes to the fand at the bottom of the fea, fometimes to ftones, or fea fubftances, and fometimes to the fhells of other fifhes; their fhells are rounded, and, in fome degree, conic, as they always gradually grow wider from their point or apex to the mouth; as to the reft, their fhape is different in almoft every individual, forming divers irregular curves, and often refembling the fhapes into which a common earth-worm curls and twifts itfelf in its various motions.

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When we confider the effects of the glutinous juice iffuing from the body of this animal, in faftening together any loofe fubftances it meets with, fo as to form a cafe for it, it may be eafily fuppofed that the adhefion of the balani-marini, and other the like fhells, which remain all their lives fixed to fome one fpot, is performed in the fame manner. Mem. Acad. Par. 1711. See VERMICULUS.

WORMS, *Water*. Of thefe there are fome which transform themfelves by a fingular procefs, without any vifible change in its exterior form, into flies, and belong to the third clafs of fly-worms. They are particularly defcribed by M. Reaumur, Hift. Inf. tom. iv. p. 310, &c.

There is a fingular fpecies of thefe creatures, which is found to be capable of reproduction or multiplication from cuttings, in the manner of the polype.

The difcovery Mr. Trembley made of this ftrange property in the polype, gave occafion to the trying of the experiment in regard to fome other infects. Worms were the moft natural objects of thefe experiments; and though they failed in many fpecies, they yet fucceeded in fome, and proved, that nature has not given that amazing property of reproduction of its moft effential parts, to only one fpecies of animals.

Mr. Bonet tried the experiment on a very nimble kind of water-worm, by cutting it into two in the middle, and the fuccefs perfectly anfwered the expectation; for the two pieces continued alive and vigorous, and in a little time became two complete worms. The ftructure of thefe worms, though it appear fimple to the naked eye, is very worthy the examination of the microfcope, and when viewed with this affiftance, there are difcovered in it parts extremely deferving our attention. Phil. Tranf. N° 469. p. 470.

Dr. Hales, in his Vegetable Statics, relates a curious experiment, by which it is proved that the bones of animals, when they are offified to a certain degree, do not grow any longer, except at their extremities; and the cafe is the fame in regard to thefe worms; for the old piece, which is the middle of the animal, never lengthens itfelf, but the addition of new rings to each end makes the increafe of length in the worm.

In all thefe pieces the liquor, which ferves as blood to the animal, is found circulating from the tail-part towards the head, in the ufual way; and by this motion of the blood it is always eafy to know, even in the fmalleft pieces, which is the head and which the tail-end, and the new head and tail are always feen to come regularly from the proper ends. Phil. Tranf. N° 469. p. 470, &c. See REPRODUCTION.

WORM, in *Chemiftry*, denotes a long, winding pewter-pipe, which diftillers and apothecaries place in a tub of water, to cool and condenfe the vapour in the diftillation of fpirits.

This the chemifts alfo call a *ferpentine*. Formerly, this worm, or fomething like it, was placed above the head of the ftill, with a refrigeratory at the upper end of it, which is ufeful enough in the diftilling of fpirit of wine.

WORM, in *Gunnery*, is a fingle or double-wired iron fcrew, mounted on a wooden handle by means of a focket, or fixed on the end of a rammer, to pull out the wad of a cannon, firelock, carabine, or piftol; it is the fame with the *wad-hook*, only the one is more proper for fmall fire-arms, and the other for cannon.

This inftrument ferves to draw out the wadding, or pieces of cartridges, which remain in the gun after frequent firing, and which would otherwife accumulate fo much, that other cartridges could not be rammed home enough to reach the priming, whereby the gun would mifs fire.

To WORM *a Cable* or *Hawfer*, in *Sea Language*, fignifies to ftrengthen it, by winding a fmall line, or rope, all along between the ftrands.

WORM-*Powders*. See POWDER.

WORM-*Seed*, *Semen Contra*, *Semen Sanctum*, or *Semen Santonicum*, is a hot, bitter, drying kind of feed, proper to deftroy worms generated in a human body, and particularly in children.

This feed is light, fmall, oval, compofed of a number of thin membranous coats, of a yellowifh-green or brownifh colour, eafily friable on being rubbed between the fingers into a fine chaffy kind of fubftance, a bitter tafte, and a ftrong fmell. It muft be chofen new, greenifh, of a fharp, bitter, aromatic tafte, not a little difagreeable.

The place where it is produced is Perfia, about the frontiers of Mufcovy. It is brought to us from Aleppo, &c. Naturalifts have not been agreed about the plant that produces it.

J. Bauhine has a large differtation on the fubject. Some will have it the fpecies of abfinthium, or wormwood, called *fantonicum*, or *marinum abfinthium;* others will have it the *tanacetum;* others the *abrotanum;* but it is now fuppofed to be the produce of a fpecies of *artemifia*, refembling in its general appearance our fine-leaved mugwort, called by Linnæus *artemifia fantonica*, and the *artemifia auftriaca* of Jacquin.

M. Tournefort gives us the following account of this notable drug, in the fecond volume of his Travels. The fementine, or worm-powder, is not gathered like our feeds. The plant grows in the meadows, and muft be let ripen; and the mifchief is, that as it grows near to maturity, the wind fcatters a good part of it among the grafs, where it is loft; and this makes it fo dear.

As they dare not touch it with the hand, for fear of making it fpoil the fooner, when they would gather what is left in the ear, they have recourfe to this expedient. They take two hand-bafkets, and, walking along the meadows, fweep the bafkets, the one from right to left, the other from left to right, as if they were mowing; by this means the feed is fhaken out into the bafkets.

Thefe feeds have been chiefly recommended as anthelmintics, and commonly taken, in this intention, either along with molaffes, or candied with fugar. For other purpofes they appear to be a ftrong bitter. They give out their virtue both to water and fpirit. The extract made by rectified fpirits, appears to be the moft eligible preparation of the fantonicum for the purpofes of an anthelmintic; and the watery extract, or a tincture drawn from it, for the more general intentions of bitter medicines.

Some have afcribed their quality of deftroying worms folely to their bitternefs; but it appears from Baglini, that worms (lumbrici) immerfed in a ftrong infufion of thefe feeds were killed in five, and according to Redi feven or eight hours; while in the infufion of wormwood, and in that of agaric, the worms continued to live more than thirty hours; and hence it has been inferred, that their vermifuge effects would not wholly depend upon the bitternefs of this feed. To adults, the dofe in fubftance is from one to two drachms in a day. (Woodville's Med. Bot.) The worm-feeds of former pharmacopœias are now properly rejected, as their place is fupplied by anthelmintics of more certain efficacy.

WORM-*Tincture*, in *Chemiftry*, a name given by many to a medicine prepared by Hoffmann from earth-worms; and in many parts of Germany efteemed one of the moft noted medicines in the world, though lefs known in other places.

The preparation is this: the worms are to be collected in the spring or summer months, and the larger sort are the best. They are to be carefully dried, and reduced to a fine powder; this powder is to be mixed up into the consistence of a poultice, with oil of tartar *per deliquium*, and this is to stand twenty-four hours; then spirit of wine is to be poured on it, so as to reach three fingers-breadth above it, and a drachm of saffron, and half a drachm of castor, are to be added, and the whole is to stand three days in infusion, and after this be filtered off for use. Some add a small quantity of opium to the tincture, but as it is often wanted in cases where opium is not proper, it is better to keep it separate thus made; and when there is occasion to have it opiated, to add as many drops of laudanum as is judged necessary.

The oil of tartar in this case penetrates the very innermost structure of the worms, and is a means of extracting such a tincture from them, as no art could otherwise contrive to make; and the medicine becomes, according to Hoffmann, much more than an anodyne, from the admixture of the salt of tartar in the tincture.

When it is intended to be made with opium, it is always proper to add also some of the hound's-tongue root, which is found as an anodyne to emulate the virtues of opium.

This tincture, whichever way prepared, is excellent in abating the pains of diseases that do not admit a cure. The fits of the gout are rendered easier by every dose of it; and even in cancers, the pain is quieted in a wonderful manner by it, and life rendered much more supportable. Hoffmann's Act. Laborator. Chym.

Worms, in *Geography*, late a bishopric of Germany, in the circle of the Upper Rhine, surrounded by the Lower Palatinate, the county of Katzenelnbogen, and the electorate of Mentz; about ten miles in length along the borders of the Rhine. In ancient times, the Vangiones inhabited this district. In the middle ages it was called "Wormbsveld," "Wormatzfeld," or "Wormsergau;" and one of the bishops, named Victor, is said to have assisted at a council at Cologn, in the year 347. Of the ancient bishops here, however, we have little certainty. The series of the prelates of Worms, which may be most depended on, begins with Erembert, who was appointed bishop thereof about the year 770. The bishop of Worms was subject to the archbishopric of Mentz. In the circle of the Upper Rhine, he was the summoning prince and director. In the council of the princes of the empire, he exchanged place on the spiritual bench with the elector of Wurzburg. The whole of the bishopric situated on the left side of the Rhine is annexed to France, and included in the department of Mont Tonnerre.

Worms, a town of France, in the department of Mont Tonnerre, late an imperial city of Germany, in the circle of the Upper Rhine, and capital of a bishopric of the same name, anciently the capital of the Vangiones. It was situated nearly in the centre of the diocese to which it gave name, not far from the Rhine, and near the place where the Eisbach and Giessenbach fall into it. This city was accounted one of the free Lutheran imperial cities, with toleration and freedom of worship to the Catholics. The Calvinists had also a church here. To the Catholics belonged not only the cathedral, but likewise four collegiate and the like number of parish churches in or near the city, a college, a gymnasium, three convents, and three nunneries. The bishop's palace here was built quite new, in 1719, at the expence of bishop Francis Louis. The kings of the Francs appointed counts and dukes over it. From time immemorial it has been termed a free imperial city, and is so styled in some records of the emperor Charles IV., bearing date in 1355 and 1356, and in the register of the cities of 1386, and was also acknowledged such in 1479, in the diet at Nuremberg; and by the emperor Maximilian I., in formal instruments of 1507 and 1508. In 1495, 1521, 1545, and 1578, diets were held here, and this was the place in which the reformation began in 1525. In 1743, a treaty was concluded here betwixt his Britannic majesty, the queen of Hungary, and the king of Sardinia. In the beginning of the revolution, Worms surrendered to a detachment of the French republican army, and was laid under a heavy contribution by Custine, but evacuated after the loss of Mentz. It was again taken in 1794; 25 miles S. of Mentz. N. lat. 49° 36′. E. long. 8° 22′.

Worms. See Bormio.

Worms's *Head*, or *Penrhyn Gwyr*, a rock on the south coast of Wales, in the county of Glamorgan. N. lat. 51° 36′. W. long. 4° 17′.

WORMSDORF, a town of Saxony, in the circle of Leipsic; 20 miles E. of Leipsic. N. lat. 51° 16′. E. long. 12° 53′.

WORMSER Joch, a mountain of the Tyrolese, between the sources of the Adige and the Adda; 8 miles S. of Glurentz.

WORMVILLE, a town of United America, in the Mississippi territory.

WORMWOOD, Absinthium, in *Botany*. See Artemisia *Absinthium*.

The common wormwood, *artemisia absinthium* of Linnæus, grows wild about dunghills, and on dry waste grounds, flowers in June or July, and may be propagated by slips in March or October, or raised from seeds sown soon after they are ripe. The leaves have a strong offensive smell, and a very bitter nauseous taste; the flowers are equally bitter, but less nauseous; the roots are warm and aromatic, without the bitterness and offensiveness of the other parts: the leaves lose part of their ill smell by being dried and kept for some time. The active parts of this plant seem to be extractive, essential oil, and a small portion of resin.

Wormwood leaves give out nearly the whole of their smell and taste both to aqueous and spirituous menstrua; the former, prepared without heat, being the least ungrateful. Rectified spirit elevates little from this plant in distillation; water brings over nearly the whole of its smell and flavour Along with the aqueous fluid there arises an essential oil, which smells strongly, and tastes nauseously of the wormwood, though not bitter. The oil drawn from the fresh herb is commonly of a dark green; from the dry, of a deep yellowish-brown colour. The quantity of oil varies according to the season and soil in which the wormwood is produced: in some years, ten pounds have afforded upwards of two ounces; in others, twenty pounds have yielded little more than one ounce. Geoffroy observes (Mem. Acad. Par. 1721), that in rainy seasons and moist soils, it yields the most oil; that in dry years the oil is accompanied with a resinous matter, and proves of a fine green colour; and that in wet seasons it is less resinous, and not green. A decoction of wormwood in water, long boiled, and inspissated to the consistence of an extract, loses the smell and flavour of the plant, but retains its bitterness. An extract, made with rectified spirit, contains, along with the bitter, nearly the whole of the nauseous part; the watery extract gives out its simple bitterness, not only to water again, but to rectified spirit.

Wormwood is a moderately warm stomachic and corroborant: for these intentions it was formerly in common use, but it has now given place to bitters of a less ungrateful kind. An infusion of the leaves, with the addition of fixed alkaline

alkaline falt, is a powerful diuretic in dropfical cafes. The effential oil is fometimes given, in dofes of a drop or two, properly diluted by folution in fpirit of wine, as a mild antifpafmodic. Its more frequent ufe is a vermifuge; for which purpofe it is both applied to the belly, and taken in pills made with crumb of bread. Dr. Lewis, however, fays, that the fpirituous extract promifes to be, in this intention, preferable to the pure oil; as it contains, along with the oil, all the bitter matter of the wormwood. This plant very powerfully refifts putrefaction, and is made a principal ingredient in antifeptic fomentations. Boerhaave commends, in tertian agues, a medicated liquor, prepared by grinding about feven grains of the oil with a drachm of fugar, and two drachms of the alkaline falt extracted from the afhes of wormwood, and afterwards diffolving the compound in fix ounces of the diftilled water of the plant. Two hours before the fit is expected, the patient is to bathe his feet and legs in warm water, and then drink half an ounce of the liquor every quarter of an hour, till the two hours are expired: by this means, he fays, cafes of this kind are generally cured with eafe and fafety, provided there is no fcirrhofity or fuppuration.

Dr. Lewis obferves, that this medicine is a very ferviceable aperient, where obftructions of the vifcera prohibit the immediate ufe of the bark, and in fuch obftructions as the imprudent ufe of the bark may have occafioned. Its virtues, he fays, might be improved by an addition of the bitter watery extract; though the compound, thus laborioufly prepared, would not be at all fuperior to a fimple infufion of the plant in pure water, impregnated with a due proportion of fixed alkaline falt.

The roots of wormwood, fays Dr. Lewis, promife to be applicable to fome ufeful purpofes: their virtue refides chiefly in the cortical part; and rectified fpirit extracts their flavour more perfectly than watery liquors. The Edinburgh college directs a tincture of the dried flowering tops of wormwood, in the proportion of fix ounces to a quart of rectified fpirit, under the title of *tinctura abfinthii.* This, in the opinion of Dr. Cullen, is a light and agreeable bitter, and at the fame time a ftrong impregnation of the wormwood. Dr. Cullen concurs with Bergius and Gladitfch in afcribing to the odour of wormwood a quality of occafioning fome confufion of the head; and formerly, he fays, when it was the fafhion with fome people in the country to drink purl, that is, ale in which wormwood is infufed, it was commonly alleged to be more intoxicating than other ales. This effect he inclines to attribute to its narcotic power; and he is of opinion, that there is in every bitter, when largely employed, a power of deftroying the fenfibility and irritability of the nervous power. The dofe in fubftance may be ℈j to ℈ij, and of the infufion, made by macerating ʒvj of the plant in f℥xij of water, f℥j to fʒxij three or four times a day. Lewis's Mat. Med. Woodville's Med. Bot.

The afhes of wormwood afford a more pure alkaline falt than moft other vegetables, excepting bean-ftalks, broom, and the larger trees. In the Amœn. Acad. vol. ii. p. 160. Linnæus mentions two cafes, in which an effence, prepared from this plant, and taken for a confiderable time, prevented the formation of ftones in the kidneys or bladder; the patients forbearing the ufe of wine and acids.

Many naufeous infects are deftroyed or driven away by the fmell of this plant; and it is no uncommon practice among the good women in the country, to preferve their clothes from moths, by laying bundles of dried wormwood among them.

Some of our brewers have a method of ufing wormwood inftead of the hops, to give the bitter tafte to their malt-liquors, and to preferve them. It is found to anfwer the latter purpofe very well; but the tafte is fo difagreeable, that it is much complained of. The reafon of this is, that the people who ufe it do not underftand the time of gathering it.

All plants are fulleft of juice while in the fhoot, but fulleft of virtue when they have their feeds on them. This is the cafe with wormwood, as well as a thoufand others; and though, in the feeding-time, it produces much more flavour than when younger, yet it is without that naufeous bitter of the crude juice, which gives us the diftafte to the plant.

Some people have found the proper way of managing wormwood, and have given a flavour with it to their malt-liquors, even preferable, in the opinion of all palates, to that given in the common way by hops.

The method is this: the plant is to be gathered when fully ripe, and the feeds upon it, and in this ftate hung up in fmall bunches to dry. When thoroughly dried, a certain quantity of good ftrong malt-liquor is to be impregnated with it, to the utmoft ftrength that it can poffibly give it. This is to be fet by for ufe, to add to all the reft.

When the hops fhould in the common way be added to the beer, this liquor is to be added in a proper quantity, making the tafte the judge when there is enough of it.

By this means juft what degree of bitter is required may be given to the liquor, and the bitter of this common plant, thus managed, is as perfectly agreeable as that of any vegetable in the world.

The wormwood, for this purpofe, fhould have its feeds carefully preferved in the drying, and it is beft if not ufed till the year after it was gathered. Phil. Tranf. N° 124.

The effential falt of wormwood is afforded in great quantity, and poffeffes in many refpects the virtues of the plant. It does not differ from other vegetable fixed alkalies, provided they be equally pure.

Wormwood fhares with all other bitters the virtues of an abfterfive deobftruent, and is in fome degree purgative, as all bitters are. Wormwood is one of thofe plants which the chemifts have generally chofen for their proceffes of the refufcitation of plants from their afhes; and though the pretended principles of this art are falfe, yet there have been fome of the artifts fo cunning as to form reprefentations of this plant, that have deceived and puzzled the greateft unbelievers, though they have not convinced them. Phil. Tranf. N° 74.

Wormwood, *Sea*, *artemifia maritima* of Linnæus, falfely called in our markets *Roman wormwood*, and fubftituted for it: it is a native of Britain, and grows plentifully about our falt-marfhes, and in feveral parts on the fea-coaft, flowering in Auguft and September. In tafte and fmell it is lefs unpleafant than the common wormwood; and hence is preferred by the college as an ingredient in fome of the diftilled waters; the effential oil is lefs ungrateful, and the watery extract lefs bitter than thofe of the common fort. The virtues are the fame, differing only in degree. It is lefs effectual as an antifeptic and anthelmintic, but more eligible as a ftomachic. A conferve of the tops, made by beating them with thrice their weight of fine fugar, is kept in the fhops; but it is now fcarcely ever ufed.

Wormwood, *Roman*, *artemifia pontica* of Linnæus, has more numerous, more finely divided, and darker coloured leaves than the former, and is hoary only underneath, whereas that is hoary all over. This is a foreign fpecies, but as hardy and as eafily raifed as the others. It is confiderably

fiderably lefs ungrateful than either of the former fpecies; its fmell is weaker, and its bitternefs is mixed with a kind of aromatic flavour. This appears to be the moft eligible of the three, as a ftomachic and corroborant; in which intention a conferve of the tops has been greatly recommended.

WORMWOOD, *Mountain*, *artemifia glacialis* of Linnæus, is fine-leaved, and covered with a gloffy filk-like down. The mountain wormwood of Valais, or *abfinthium feriphium montanum candidum* C. B. is covered with a cotton-like down, and the leaves are curled about the edges. Haller informs us, that the firft of thefe plants is frequent in ftony grounds on the Alps; and the fecond by the fides of fandy roads in the territory of Valais, in Switzerland; that the former is bitterifh and aromatic, of great eftimation among the inhabitants of the Alps, and the common remedy againft the intermittent fevers which often rage there, and for exciting the menftrual difcharges, checked by the cold; and that the latter has an acrid aromatic fmell and tafte, without bitternefs, and promifes, from its fenfible qualities, to be a plant of great virtues. They have not yet been introduced into practice in this country. Lewis. See ARTEMISIA.

WORMWOOD-*Tree*, in *Gardening*. See ARTEMISIA.

WORMWOOD-*Fly*, in *Natural Hiftory*, a very fmall black fly, found on the ftalks of the common wormwood in June and July.

WORMWOOD-*Wine*, *Vinum Abfinthites*. See VINUM, and ABSINTHITES.

WOROFIDOW, in *Geography*, a town of Poland, in the palatinate of Braclaw; 26 miles N.E. of Braclaw.

WORONETZ, a town of Ruffia, in the government of Orlof, fituated upon a river of the fame name, near the fpot where it falls into the Don, and thus poffeffing an eafy intercourfe with the Black fea. It is qualified for becoming a great capital, being placed fo as to enjoy the advantages of both warm and cold climates, and holding an intercourfe with all parts of the empire. The ftreets are wide, but not paved. Tallow is a great article of trade here, and alfo iron. Here is alfo the moft confiderable cloth manufactory in Ruffia, firft eftablifhed by Peter the Great: the gypfy tribe is very prevalent here.

WORPE, a river of Germany, which runs into the Wumme, 7 miles N.E. of Bremen.

WORRAL, in *Zoology*, an animal of the lizard kind, of about four feet long, and eight inches broad, with a forked tongue, which it puts out like a ferpent, but without teeth.

It is a harmlefs animal, and feeds only on large flies, and the fmaller fpecies of lizards. It is found in Egypt only during the hotteft months, and principally frequents the grottos and caverns in the mountains on the weft of the Nile, where it fleeps during the winter feafon.

It is faid to be greatly affected by mufic; but experiment fhews this to be an erroneous opinion. Pococke's Egypt, vol. i. p. 208.

WORSBOROUGH, in *Geography*, a village of England, in the county of York, with a medicinal fpring; 3 miles S. of Barnefley.

WORSE, a river of England, which runs into the Severn, near Bridgenorth.

WORSHIP *of God*, *Cultus Dei*, amounts to the fame with what we otherwife call *religion*.

This worfhip confifts in paying a due refpect, veneration, and homage to the Deity, under a certain expectation of reward. And this internal refpect, &c. is to be fhewn and teftified by external acts; as prayers, facrifices, thankfgivings, &c.

The Quietifts, and fome other myftic divines, fet afide not only all ufe of external worfhip, but even the confideration of rewards and punifhments. Yet, even the heathens had a notion, that God did not require us to ferve him for nought: "Dii quamobrem colendi fint," fays Cicero, "non intelligo, nullo nec accepto ab illis nec fperato bono."

The fchool divines divide worfhip into divers kinds, *viz.* *latria*, that rendered to God; and *idolatria*, that rendered to idols, or images. To which the Romanifts add, *dulia*, that rendered to faints; and *hyperdulia*, that to the Virgin.

Some theological writers have obferved, that the Greek word προσκυνειν, *to worfhip*, is not defcriptive only of the honour which is appropriated to God, but is indifferently ufed to fignify the honour and refpect which are paid to fuperiors of all kinds, in heaven or on earth. Accordingly, they have diftinguifhed between *civil* and *religious* worfhip.

The general principles upon which the worfhip of God is confidered as an exercife or act of religion, to which its meaning is commonly appropriated, have been already ftated under the articles PRAYER and SUNDAY; and it has been illuftrated in three different views of it, as private, domeftic, and public. To this article we have referred the more particular confideration of public worfhip, as a duty of indifpenfable obligation, and of indifputable importance and utility. If the worfhip of God, fays archdeacon Paley, be a duty of religion, public worfhip is a neceffary inftitution; becaufe without it, the greater part of mankind would exercife no religious worfhip at all. Befides, affemblies appointed for this purpofe afford regularly recurring opportunities for moral and religious inftruction to thofe who would otherwife receive no fuch inftruction. If we advert to fact, it will be found that the general diffufion of religious knowledge among all orders of Chriftians, in all Proteftant, and in moft Chriftian countries, compared with the intellectual condition of barbarous nations, can be afcribed to no other caufe than the regular eftablifhment of affemblies for divine worfhip; in which portions of Scripture are recited and explained, or the principles of Chriftian erudition are fo conftantly taught in fermons, incorporated with liturgies, or expreffed in extempore prayer, as to imprint, by the very repetition, fome knowledge and memory of thefe fubjects upon the moft unqualified and carelefs hearer. If this practice were not obferved even by thofe members of the community who do not fo much need the affiftance that is indifpenfable with regard to others, and fanctioned by their prefence and example, we may eafily forefee how foon religious affemblies would fink into contempt and difufe. This argument meets the only ferious apology that can be made for abfence from public worfhip. But even this is a very infufficient apology in another point of view, becaufe public worfhip is a duty, independently of the effect of example, of univerfal obligation. Man is a focial being; and as fuch enjoys many bleffings which demand public acknowledgment, and is chargeable with many errors and tranfgreffions which he ought publicly to unite with others in confeffing, and is expofed to many evils which he fhould deprecate in common with others who are in the fame fallible or mutable ftate with himfelf.

"Surely, fome will fay," as Paley ftates another objection againft public worfhip, "I may be excufed from going to church fo long as I pray at home, and have no reafon to doubt but that my prayers are as acceptable and efficacious in my closet as in a cathedral; still less can I think myself obliged to sit out a tedious sermon, in order to hear what is known already, what is better learnt from books, or suggested by meditation." They, whose qualifications and habits best supply to themselves all the effect of public ordinances, will be the last to prefer this excuse, when they advert to the general consequence of setting up such an exemption, as well as when they consider the turn which is sure to be given in the neighbourhood to their absence from public worship. You stay from church, to employ the sabbath at home in exercises and studies suited to its proper business: your next neighbour stays from church, to spend the seventh day less religiously than he passed any of the six, in a sleepy, stupid rest, or at some rendezvous of drunkenness and debauchery, and yet thinks that he is only imitating you, because you both agree in not going to church. The same consideration should over-rule many small scruples concerning the rigorous propriety of some things, which may be contained in the forms, or admitted into the administration of the public worship of our communion; for it seems impossible, that even "two or three should be gathered together" in any act of social worship, if each one require from the rest an implicit submission to his objections; and if no man will attend upon a religious service, which in any point contradicts his opinion of truth, or falls short of his ideas of perfection.

We may add, that there are other valuable advantages resulting from religious assemblies, that are not immediately designed in the institution, or contemplated by the individuals who compose them; *e.g.* 1. Joining in prayer and praises to their common Creator and governor has a sensible tendency to unite mankind together, and to cherish and enlarge the generous affections. 2. Assemblies for the purpose of divine worship, placing men under impressions, by which they are taught to consider their relation to the Deity, and to contemplate those around them with a view to that relation, force upon their thoughts the natural equality of the human species, and thereby promote humility and condescension in the highest orders of the community, and inspire the lowest with a sense of their rights. Thus, things are made to appear little, by being placed beside what is great. In which manner, superiorities, that occupy the whole field of the imagination, will vanish, or shrink to their proper diminutiveness, when compared with the distance by which even the highest of men are removed from the Supreme Being: and this comparison is naturally introduced by all acts of joint worship. If ever the poor man holds up his head, it is at church: if ever the rich man views him with respect, it is there; and both will be the better, and the public profited, the oftener they meet in a situation in which the consciousness of dignity in the one is tempered and mitigated, and the spirit of the other erected and confirmed. Moreover, the public worship of Christians is a duty of divine appointment. (Matt. xviii. 20. Heb. x. 25.) Independently of these passages of Scripture, a disciple of Christianity will hardly think himself at liberty to dispute a practice set on foot by the inspired preachers of his religion, coeval with its institution, and retained by every sect into which it has been since divided. Paley's Philos. vol. ii.

As to the manner in which public worship should be conducted, if we advert to the history of the primitive church, we shall find, that when the congregation was assembled, the first act of divine service which they performed was the reading of the Holy Scriptures. (See Tertullian de Anima, c. 3. Justin Martyr, Apolog. ii.) When the reading of the Scriptures was ended, then followed the singing of psalms. (See Tertullian, *ubi supra*. Pliny Epist. ad Trajan. Clemens Alex. Stromat. l. 6. Origen, De Orat. § 6.) The psalms or hymns which were sung by the primitive Christians were either taken out of the Holy Scriptures, and particularly out of the book of Psalms, or such as were of their own private composition. (Tertullian, Apolog. c. 39.) As to their manner of singing, it was, says Origen, (De Orat. § 6.) in good tune and concert, all the people bearing a part in it. With respect to church-music, organs, and the like, they were not known in the primitive ages to which we now refer; for it cannot be rationally conceived that in those days of continual persecution or violence they could either use or preserve them. The singing of psalms was followed by the preaching of the word. (See Tertullian de Anima, c. 3.) The subject of the sermon was usually a commentary or explication of the lessons that had been just before read. (See Just. Martyr, Apolog. ii. Origen contra Celsum, lib. iii.) As for the length of the sermon, it usually lasted an hour. It began with an exordium, and then explained verse after verse, and sentence after sentence, shewing the natural and literal signification of the words, and then the spiritualized or mystical meaning of them, and concluded with a suitable application of all, either by way of exhortation to piety and virtue, or by way of dehortation from vice and impiety; always accommodating the discourse to the capacities of the hearers. (Origen contra Celsum, lib. iii.) The preacher was usually the bishop of the parish. (Just. Martyr, Apolog. ii.) Or, the bishop decreed a presbyter, or some other fit person, to preach in his room. When the sermon was finished, the congregation rose up to present their common and public prayers unto Almighty God (Just. Martyr, Apolog. ii.); standing being the usual posture of praying, at least the constant one on Sundays, on which days they esteemed it a sin to kneel; and the preacher frequently concluded his sermon with an exhortation to his auditors to stand up and pray to God, which is found to be the case in Origen's sermons. When the congregation stood up, all turned their faces towards the east, which was their usual custom (Tertullian, Apolog. c. 16.); for which practice they alleged the following reasons: 1. Respect and reverence to their lord and master Jesus Christ; this being the title given to him in the Old Testament, according to an erroneous translation of the word *branch* in the Septuagint. So that the east was called by Tertullian a type of Christ. 2. The similitude (Zach. vi. 12.) of the arising of the sun to our spiritual arising out of the darkness of sin and corruption, as Clem. Alex. expresses it. (Stromat. lib. vii.) 3. The advice of Origen to pray towards the eastern climate, as denoting our diligence in the service of God, in being more forward to arise and set about it than the sun is to run its daily course, for which he produces the authority of an Apocryphal text, Wisdom, xvi. 28. (Orig. de Orat. § 20.) 4. The opinion they entertained of the excellence of this quarter above others. (Orig. De Orat. § 21.) The congregation being thus turned towards the east, they put themselves into a posture of prayer, stretching out their hands, and lifting up their eyes towards heaven. (Clem. Alex. Stromat. lib. vii. Tertull. Apolog. c. 30.) The minister then began to pray, his usual garb being a pallium, or, as we call it, a cloak; which was deemed a more simple and plain garment than the toga, which was used through the whole Roman empire. But it does not appear from any authority of ancient writers, that they put a surplice or any other kind of linen garment over their cloaks. The prayer was pronounced, as Cyprian says (De Orat. Domin. § 2.), with a modest and bashful voice, that being most proper for those who came to acknowledge the multitude and heinousness of their sins, and to beg God's pardon and grace, which is the end and design of prayer. The people did not vocally join with the minister in the prayers, but satisfied themselves with testifying their assent to what he expressed, by saying Amen, or so be it. Indeed it was impossible for the people to respond, since they had no fixed public form of prayer, except the Lord's prayer, which they frequently, though not always, repeated; and as to their other prayers, every bishop or minister of a parish was left to his own liberty or ability therein. The constant repetition of the Lord's prayer with other prayers was not thought to be necessary, but it was frequently omitted. Accordingly they regarded the Lord's prayer as given by Christ for a pattern of all other prayers, so that Cyprian (De Unit. Ecclef. § 11.) calls it the law or rule of praying. But though the repetition of the Lord's prayer was not necessary, yet it was usual. Although they used that, they had also other prayers. Their usual method, according to Tertullian (De Orat.), seems to have been, first to begin with the Lord's prayer, as the ground and foundation of all others, and then, according to their circumstances and conditions, as he expresses it, to offer up their own prayers and requests. These other prayers, however, were not restricted or imposed forms; but the words and expressions of them were left to the prudence, choice, and judgment of every particular bishop or minister. In other words, the primitive Christians had no stinted liturgies, or imposed forms of prayer. As to prescribed forms, there is not the least mention of them in any of the primitive writings, nor the least word or syllable tending to it, according to lord King, which, as he says, is an unaccountable silence if there ever were such, but rather some expressions intimating the contrary; such as the minister's praying ὅση δύναμις, according to his ability. (Just. Mart. Apolog. ii. Origen, Comment. in Matth. et in Johann.) The noble author now cited has shewn from parallel passages, that the minister's praying ὅση δύναμις, or according to the utmost of his ability, imports the exercise of his gifts and parts in suitable matter and apt expressions; and that the primitive prayers were such appears farther from a passage in Origen, which explains the verse in Matth. vi. "When ye pray, use not mere repetitions, &c." It is very unlikely, continues his lordship, that they were obliged to prescribed forms, because they never read a syllable of their prayers out of any book whatever; which is evident from their posture of prayer, that was two-fold, either with their hands and eyes lifted up to heaven, or with their eyes shut. (Tertull. de Orat. Origen in Matth. vi. 5. De Orat. § 9. Contra Celsum, lib. vii.) If they had used prescribed and imposed forms, they must necessarily have remembered them, which would have been an intolerable load to the strongest memory; especially to have repeated, word after word, the prayers of their fast-days, which must have been several hours long, since some of their fasts were prolonged from the morning of one day to the beginning of another. Whether their prayers were divided into several collects, our author has not been able positively to determine; but he thinks it probable, that on their fast-days they made several distinct prayers, and that at their ordinary meetings, their prayer after sermon was but one entire piece. According to Just. Martyr (Apolog. ii.), the prayer that preceded the confirmation of the eucharistical elements "was one long prayer, to which the people said, Amen." Lord King's Enquiry into the Constitution, Discipline, Unity, and Worship of the Primitive Church, part ii. See LITURGY.

WORSLEY, in *Geography*, a populous township in the parish of Eccles, and county of Lancaster, England, 6 miles W.N.W. from the town of Manchester. In the year 1811, this place contained 6151 inhabitants, who occupied 1012 houses; and nearly the whole of whom were engaged in manufactures and the coal-mines. At this place is the famous tunnel for the Bridgewater canal, (see CANAL,) and a large brick mansion, called Worsley-hall, which belonged to, and was inhabited by, the late duke of Bridgewater. See Lancashire Gazetteer, 1808.

WORSTED, or WORSTEDE, a market-town in the hundred of Tunstead, and county of Norfolk, England, is situated 4 miles S.S.E. from North Walsham, and 120 miles N.E. by N. from London. It was formerly a place of much celebrity, and of considerable trade; but is now greatly on the decline, and is chiefly remarkable for the invention, or first twisting, of that sort of woollen yarn or thread, which hence obtained the name of worsted. This manufacture is mentioned in the second year of Edward III. when the weavers and workers of worsted stuffs were required by parliament to work them in a better manner than they had previously done. These stuffs, and knit and wove hose, constitute the chief manufacture of the town. A weekly market is held on Saturdays, and here is an annual fair. The church consists of a nave, two aisles, a chancel, and a square tower. The population of the parish, according to the return of the year 1811, amounted to 619, occupying 112 houses.

Contiguous to the town is Worsted-hall, the seat of sir George Berney Brograve, bart., a commodious mansion, situated in a pleasant park.—Beauties of England and Wales, vol. xi. Norfolk; by J. Britton, F.S.A. 1809. Blomefield's History of Norfolk, vol. xi. 1810.

WORSTED, and WORSTED *Manufacture*. The term worsted is applied to yarn, and manufactured goods made of combed wool. Worsted is properly a branch of the *Woollen Manufacture*, to which article we refer our readers; but the latter term, strictly speaking, is applied only to yarn, or pieces made entirely or in part of carded wool. The characteristic distinction between combing-wool and short or clothing-wool has been already stated under the article WOOL. (See WOOL and WOOLLEN *Manufacture*.) Worsted goods were made in England as early as the time of Edward II. In the account of exports in the following reign, already given in the article WOOLLEN *Manufacture*, the number of pieces of worsted goods exported is nearly double that of woollen cloths. According to Camden, the name is derived from Worsted, a town in Norfolk, where worsted stuffs were first made. According to Dr. Parry, in his "Essay on the Merino Breed of Sheep," worsteds were called by the Flemings '*Ostades*,' and as the manufacture was in their hands long before it was introduced into England, it is probable that our appellation is a corruption of their's. Ostade was long ago a common surname in Flanders, and was perhaps that of some person famous for this particular branch of the woollen trade, which afterwards was appropriated to an establishment of similar manufacturers in Norfolk.

Worsted yarn is made of long or combing-wool, in which the fibres are all laid even parallel with each other by the wool-comb. It may be classed into two great divisions, the soft and the hard worsted yarn. The soft yarn is made of the shorter kinds of combing-wool, the sorting of which has been already described under the article WOOL. The short and long combing-wools are both prepared for spinning by the comb in the same manner, except that for some kinds of fine hard yarn made from the latter, the wool is combed, and afterwards spun nearly without oil. This is the case with the yarn for bombazines. The soft yarn for hosiery receives but little twist in the spinning, and two, three, or more threads are afterwards twined together on what is called a doubling-mill, to make a thread of requisite strength and thickness to be woven on the stocking-frame. See STOCKING-*Frame*.

Knitting-

Knitting-yarn is twined much harder than yarn for the frame. For mixed coloured ftockings, part of the wool is dyed and mixed with the white in the procefs of combing. The principal feats of the worfted hofiery manufacture in England were Nottingham and Leicefter ; but of late years the worfted hofiery has declined at the former place, the trade there being principally confined to filk and cotton articles. Formerly hofiery comprifed a variety of worfted articles, particularly caps, which were generally worn in England before the introduction of hats.

At Aberdeen, in Scotland, there is a confiderable manufacture of hofiery, the wool being principally fupplied from London. Worfted ftockings, and lamb's-wool hofiery, to the amount of from fifty to feventy thoufand pounds, are faid to have been annually exported from Aberdeen to Holland. Of the number of hands employed in worfted hofiery in England, or the annual value of the goods made, we have no correct account. Perhaps fome eftimate may be formed from the amount of exports of woollen hofiery given under the head *Woollen Manufacture*, in the table of exports, in which it will be feen, that in the year 1816 the worfted hofiery exported amounted to one hundred and fifty-one thoufand and fixty pounds. This, we believe, includes the hofiery made of woollen yarn, or what is generally called lamb's-wool yarn, an article which, fince the beginning of the prefent century, has been greatly increafing in demand. Soft worfted yarn for hofiery, during the laft twenty years, has been principally fpun and doubled by machines in large worfted-mills. Previoufly to that time, worfted-making by hand-fpinning was a diftinct trade from hofiery. The worfted-maker bought his different forts of combing-wool from the wool-ftapler, combed and fpun it, and fold the yarn to the hofier. Since then, the hofiers have been principally fupplied with worfted yarn from large mills eftablifhed in Leicefterfhire, Nottinghamfhire, and Warwickfhire. Of late, however, many of the hofiers are manufacturing their own yarn on machines or mules turned by the hand, or in fmall mills turned by horfes or water.

The combing-wools of Kent are better fuited for hofiery worfted yarn than any other in England, particularly for machine-fpinning. This excellence is derived partly from the foftnefs as well as foundnefs of the wool; but particularly from the ftaple being nearly of one uniform thicknefs from the bottom to the top. See Wool.

Picardy and Normandy were the principal feats of the worfted hofiery in France. Under the article Woollen *Manufacture*, it will be feen that 1,250,000 pounds weight of wool were confumed annually in the manufacture of hofiery in Picardy before the French revolution.

The ftocking-frame was invented by William Lee, M.A. of Cambridge, in 1589, and was afterwards introduced into France. This invention took place in England only 28 years after the knitting of hofiery yarn on needles had been introduced from Spain. See Stocking-*Frame*.

Hard worfted yarn for worfted ftuffs or pieces is fpun much fmaller, and twifted much harder, than the foft worfted yarn for hofiery. In all the ftouter kinds of worfted goods, the long or heavy combing-wool is ufed. (See Wool.) Under the article Woollen *Manufacture* we have noticed the introduction of the worfted trade into England, and various places where it was firft eftablifhed. Norwich and fome of the towns in Norfolk and Suffolk appear to have been the firft where any confiderable quantity of worfted pieces or ftuffs were made. The names which the different kinds of worfted pieces have received are very numerous, being often derived from the manufacturer who introduced a flight change either in the mode of weaving or finifhing the goods. Thefe names foon became obfolete, being fupplanted by other kinds of worfted goods, fo that we do not know at prefent to what particular kind of pieces fome of them were formerly applied ; the effential difference confifting in their being woven plain, twilled, or figured, or made with a warp of fingle or doubled yarn, and woven ftouter or more flightly, or of greater or lefs width, and whether they were glazed or not in the finifhing.

The moft important diftinction between worfted pieces and woollen cloth confifts in the former not being milled or raifed, fo as to cover the furface with a pile, but the thread is left bare. To take off the loofe hairs which rife from the furface, the worfted pieces are paffed over a red-hot cylinder, in the fame manner as many kinds of cotton (fee Cotton *Manufacture*): this procefs is called *finging*. For fome particular purpofes, a flight degree of milling has recently been attempted to be given to worfted pieces in the fulling-mill. The glazing communicated to fome kinds of worfted goods is given by preffing them between fheets of ftiff glazed prefs-paper and heated iron plates, which are compreffed in a ftrong preffing-frame. For the weaving of figured pieces, fee Weaving, and Draught *of Looms*.

Some kinds of very fine worfted goods are made with a warp of mohair or filk, as filk camlets and bombazines. The latter goods, with a filk warp and wefted with hard worfted yarn of the fineft kind, are manufactured at Norwich. The term bombazine appears to be derived from bombycina, a kind of filk drefs ufed by the Romans, and faid to come from Affyria. It is generally underftood to have been made from the threads of an infect called the bombyx. Bombycina is fometimes confounded by commentators with byffinum and fericum. Byffinum appears to have been a very fine kind of linen or lace; fericum unqueftionably means filken ftuff, fo called from the Seres, the nation whence it was procured. Probably bombycina was a coarfer kind of filk. In the middle ages, the word bombycina was applied to cotton. Macpherfon's Annals of Commerce. See Byssus.

Bombazines are woven with a twill, and have, as before ftated, a warp of filk and a weft of fine worfted yarn. The Dutch refugees, who fled from the perfecution of the duke of Alva, introduced the manufacture of this article into Norwich in the year 1675, when the Dutch elders, according to Blomefield, prefented bombazines in court at Norwich. (Blomefield's Hift. of Norfolk, vol. ii. p. 205.) Worfted goods were made in Norwich as early as the reign of Edward II. This appears from a patent granted to John Peacock, for the meafuring every piece of worfted made in the city of Norwich or county of Norfolk. Norwich has continued from that time one of the principal feats of the worfted and ftuff trade. The fale of ftuffs made in Norwich only, in the reign of Henry VIII., amounted to 100,000*l.* annually, befides worfted ftockings, which were computed at 60,000*l.*

Norwich is at this day the only part of England where any confiderable number of the very fineft ftuffs and bombazines are made. The manufacture of the coarfer kinds of worfteds, except camlets, has been transferred in a great meafure into Yorkfhire. The period preceding the American revolution, from the year 1743 to 1763, may perhaps be regarded as the moft flourifhing era of the worfted manufactures of Norwich. According to the account of Arthur Young in 1771, the manufactures of this place had increafed four-fold in the preceding 70 years. The number of looms was then eftimated at 12,000, and each loom was fuppofed to employ fix perfons in preparing and finifhing

 the

the material; and the total annual value of the goods was eftimated at above 1,200,000*l*. Of thefe goods the eftimate then was,

		£
The export to Rotterdam	- -	480,000
——— to London	- -	550,000
——— to various places	- -	200,000
Total value	-	1,230,000

The number of perfons employed being from feventy to eighty thoufand.

Since the time to which Arthur Young refers, the manufacturers of Norwich have engaged extenfively in the trade of filk fhawls and other articles, in which no worfted whatever is ufed. Still, however, the worfted manufactures of Norwich may be confidered as in a flourifhing ftate. The number of looms employed in worfted at the prefent time (1818) may be eftimated at 10,000; half of which weave camlets, calimancoes, and other ftuffs; and the other half bombazines, narrow and broad. The former are chiefly for home confumption, the latter for the Spanifh market. The Eaft India company take a confiderable quantity of the fine camlets manufactured at Norwich.

By far the greateft part of the worfted yarn employed at Norwich is fupplied by machine-fpinning, from the worfted-mills in Yorkfhire, Lancafhire, and Durham. But fome yarn ftill continues to be fpun in the old manner, by the running-wheel, in Suffolk, Effex, Hertfordfhire, and Cambridgefhire. In Norfolk alone, the ufe of the diftaff ftill remains. This inftrument is the moft ancient of which we have any notice, either in facred hiftory, or the fabulous traditions of Grecian mythology handed down to us by Homer and Hefiod. It is at prefent vulgarly called the rock. In ufing it, the thread is drawn out from the end of the fliver of combed wool. The motion is communicated to a rough kind of fpindle, by twirling it between the right-hand and the thigh, which is fuffered to continue revolving when fufpended by the thread, which the fpinftrefs gradually lengthens with her fingers.

In wheel-fpinning, a fmall portion of the combed wool or fliver is laid acrofs the finger, from the centre of which, called the twitch, the thread is drawn out. About thirty years fince, the counties of Norfolk, Suffolk, Hertfordfhire, and Effex, not only fupplied all the yarn that was wanting for the manufactures of thofe diftricts, but fent large quantities of worfted yarn to Halifax and Manchefter. At prefent the trade is completely turned, and, as we have before ftated, the greater part of the yarn ufed at Norwich is fent there from the northern counties of England. This change has occafioned great diftrefs in the villages where the yarn was formerly fpun, by depriving the wives and children of the cottagers of their common employment.

Until the middle of the laft century, worfted goods were manufactured in confiderable quantities in Warwickfhire, Oxfordfhire, and Northamptonfhire; but about that time the extenfion of the worfted trade in the Weft Riding of Yorkfhire, particularly at Halifax, Bradford, and Wakefield, gradually drew this trade in a great meafure away from thofe counties. The manufacturers in Yorkfhire, or rather the merchants who bought the worfted pieces from the manufacturers, were, however, long unacquainted with the beft modes of dyeing and dreffing them; they were therefore fent to London or Coventry to be finifhed, but afterwards they were finifhed in Yorkfhire. The demand to Spain, Portugal, Italy, and the Levant, took off the greater part of the worfted goods manufactured at Halifax; thofe manufactured round Wakefield and Bradford, confifting chiefly of tammies and fhalloons, were confumed principally by England and her colonies. The Piece-hall at Halifax was firft opened about the year 1780; and the intervening time, from thence to the year 1792, or the breaking out of the French war, may be regarded as the moft flourifhing era of the worfted trade in Yorkfhire. Though the cheapnefs of calicoes, as an article of female drefs, fince the improvements in the cotton manufacture, materially abridged the fale for fome kinds of worfted goods in England, this was more than compenfated by the increafed demand for carpets with worfted warps, and other articles of luxury, in which worfted yarn was employed.

The demand in foreign markets, from the year 1782 to 1792, for Englifh worfted goods, greatly exceeded that of any former period; but after the breaking out of the French war, the worfted trade at Halifax began to decline. The greater part of the foreign markets being clofed againft us, moft of the mercantile houfes engaged in the export of worfted pieces were in confequence ruined or declined; the trade altogether, and many of the fmall manufacturers, engaging in the cotton trade. The introduction of Englifh calicoes into Turkey and other parts tended alfo to leffen the regular demand for fhalloons and other worfted goods, as articles of female drefs, in thofe countries. Soon after the breaking out of the French war in 1792, the fpinning of worfted by machinery was eftablifhed at Bradford and the vicinity; and continuing to increafe, drew round that place the manufacturers of worfted goods on the decline of the Halifax trade. Bradford is now become the principal feat of the worfted manufacture in Yorkfhire; and fome of the proprietors of the worfted mills, befides fupplying the fmaller manufacturers with yarn, employ a very great number of looms themfelves, and carry on this branch of trade on a fcale of extent never before known in the worfted manufacture. Within the laft two years, the worfted trade has alfo greatly revived at Halifax.

The following are the kinds of worfted pieces at prefent principally made in Yorkfhire.

Bombazets are woven both plain and twilled, with the warp of fingle thread; they were preffed, and finifhed without glazing: the width 22 inches, length 29 yards.

Tammies, or *durants*, with fingle warps twilled, and generally coarfer than twilled bombazets: width from 32 to 36 inches, length 29 yards.

Shalloons are woven with a twill, and have a warp of fingle thread. We believe the name was derived from Châlons in France. The pieces are from 32 to 36 inches wide, and 29 yards long.

Cubicas are very fine fhalloons fo called.

Sayes, or *anafcottes*, are twilled and made with fingle warps; they are of two kinds, one running 27 inches wide and 30 yards in length, the other 42 inches in width and 44 yards in length.

Moreens are woven plain and watered or emboffed, and are made very ftout, being principally ufed for furniture: their width is 28 inches, length 24 yards.

Calimancoes are woven plain and ftriped: width 17 inches, length 29 yards.

Camlets are both plain and twilled: width 18 inches, length 29 yards. They are fhorter than bombazets, but not many are made in Yorkfhire with doubled warps.

Laftings have doubled warps, fometimes of two and fometimes of three threads, and are made with great variety of patterns, either plain, twilled, or flowered, and are diftinguifhed by different names, according to their figures and quality;

quality; as prunelle, amens, (probably from Amiens in France, where they were manufactured,) and drawboys: the width 18 inches, length 30 yards.

Worfted fhag, or velvet woven like corduroi and cut, is made principally at Banbury, in Oxfordfhire, and at Coventry; but has been manufactured alfo in Yorkfhire.

In the worfted manufactures of France, there were greater varieties of pieces than in England. One kind of camlet, made with a fine warp from the wool of the Angora goat and a weft of fine worfted, was remarkably beautiful; but we believe it has not been manufactured in Yorkfhire or at Norwich.

For fome account of the worfted manufactures of France, fee Woollen *Manufacture;* under which article we have given the hiftory of the worfted manufacture as connected with the woollen, and where may be feen the number and value of the worfted pieces exported from England in the year ending January 1817. See alfo *long combing-wool,* under the article Wool.

Worsted *Spinning*. In the article Wool we have given an account of the different kinds of long wool which are proper for fpinning into worfted, alfo the manner of forting and fcouring them. This wool muft be prepared for fpinning by repeated combings, with a comb or heckle that is provided with a great number of long fteel pins which are fharp-pointed. Thefe points being few in number compared with the teeth of cards, they can be fafely introduced between and drawn through the long fibres of the wool, in order to feparate and ftraighten them, without materially breaking them. Another object of the combing is, to feparate the fhort fibres which are intermixed with the long ones; for in fpinning any kind of thread, it is defirable that the fibres fhould be all as nearly as poffible of a length.

Wool-combing.—In the ordinary procefs of wool-combing by hand, the implements ufed are, 1. Two combs for each workman. 2. A poft, to which either of the combs can be fixed, to fupport them during the operation. 3. A comb-pot, which is a fmall ftove to heat the teeth of the combs, which is found to facilitate the combing. The combs are fhewn at *fig.* 1. *Plate* I. *Woollen Manufacture:* each comb is compofed of two rows of pointed fteel teeth, *a* and *b*, difpofed in two parallel planes. One of the rows contains longer teeth than the other. They are fixed into a wooden ftock or head *c*, which is covered with horn, and has a handle *d* fixed into it, perpendicular to the planes of the rows of teeth. The rows of teeth are about feven inches long, and each row contains about twenty-four teeth. The length of the longeft teeth is near twelve inches, and the fhorter ones about eight inches. The teeth are made of fteel, of a round figure, and regularly tapering from the bafe, where they are fixed into the ftock, to the point, which is quite fharp. The teeth are about one-fixth of an inch in diameter at the bafe; and the interval between the two adjacent teeth at the bafe is rather lefs than their diameter, or one-eighth of an inch. The fpace between the two planes in which the teeth are difpofed is about one-third of an inch at the bafes of the teeth. The teeth fhould be ftraight and well-tempered, and polifhed. If they become crooked in working, the workman muft ftraighten them, and fet them all in a true line. The combs ufed for the laft combing of the wool have three rows of teeth.

In the wool-comber's fhop a poft is fixed, as fhewn by *fig.* 2, in order to fupport the combs occafionally during the working. An iron ftem *g* is fixed faft into the poft, and projects horizontally from it; the extreme end of it turns upwards with a point, which is inferted into a hole through the middle of the handle of the comb. Alfo at the other end of the ftem *g*, clofe to the poft, there is a fmall hook *h* rivetted, which terminates with a pointed pin, fituated in an horizontal direction. This point is inferted into a hole made in the end of the handle of the comb, in the direction of its length. The end of the comb-handle being firft placed on the point of the hook *h*, it is let down upon the other point *g*, which, by paffing through the handle, fixes the comb quite faft to the poft, as fhewn at *fig.* 2.

In the operation of combing wool, it is neceffary to heat the teeth of the combs, in order to foften and relax the fibres of the wool, and render them more eafy to work. The heat alfo tends to diftribute the oil with which the wool is lubricated. The combs are heated in a comb-pot or ftove, *fig.* 3, which is a fmall furnace built in brick, to inclofe a fire-place, of which A is the door, B the afh-pit, and C the flue. Above the fire a circular caft-iron plate *a a* is placed. This is made flat, except in the central part, where there is a concavity, to obtain a better action of the fire. Immediately over the plate *a*, another plate, *b b*, is placed parallel to the former, but with a fufficient fpace between them to admit the teeth of the combs: feveral pieces of iron are placed between the two plates, to keep them at a proper diftance afunder, and to divide the fpace into fmall cells proper for the combs.

In ufing this ftove, the workman muft be careful not to heat it too much, and a damper in the flue is very ufeful to regulate the draught; if the heat is too great, it fpoils the temper of the comb-teeth, and injures the wool alfo. The moft improved ftove is heated by fteam, which will give a fufficient warmth, but cannot overheat the combs.

In order to comb the wool, it is feparated into handfuls, each containing near four ounces of wool, which is about a proper quantity to be combed at once. Thefe handfuls are fprinkled with oil, and the wool is rolled in the hands to diftribute it equally. The quantity of oil varies from $\frac{1}{10}$th to $\frac{1}{12}$th of the quantity of wool by weight. The comb is firft heated by introducing the teeth into the ftove, in one of the cells between the two iron plates; when it has acquired fufficient heat it is withdrawn, and another comb is put in its place. The heated comb is then faftened to the poft, with its teeth pointing upwards, in order to be filled with wool; the comber takes one-half of the handful of wool in his hand, and catches it upon the teeth of the comb by throwing the wool over the points, fo that they penetrate it; then by drawing the wool towards him, and at the fame time downwards to the bottom of the teeth, a portion of the wool will remain in the teeth. The lock of wool is again caft upon the teeth, and drawn through them, and every time fome wool remains; this is repeated as often as is neceffary, until all the wool is gathered upon the teeth. The comb thus filled is placed with its points in the ftove, and the wool which is upon it remains outfide of the ftove, but will become flightly warmed. The other comb, which was heating whilft the firft was filling, is now filled in turn, in the fame manner as the firft, and is then put to heat with the wool upon it, and whilft this is going on, the workman occupies himfelf in making a handful ready for the next combing.

When both combs are properly warmed, the comber holds one of them with his left-hand over his knee, as he is feated on a low ftool, and with the other comb held in his right-hand he combs the wool upon the firft, by introducing the points of the teeth of one comb into the wool contained in the other, and drawing them through it; this is repeated for 14 or 15 ftrokes, until the fibres of the wool are feparated, difentangled, and laid parallel. In combing, he di- rects reƈts the combs ſometimes with the teeth of one parallel to the teeth of the other, and ſometimes with the teeth of the two combs at right angles, or in a croſs direction; but in all caſes he muſt take care to begin gradually, by introducing the points of the teeth, firſt into the extremity of the wool which is contained in the teeth of the comb, and then penetrating deeper into the wool at every ſucceeding ſtroke, till at laſt he works the combs as near as he poſſibly can without actually bringing their teeth in contact: without this precaution, he could not draw the comb through the wool without breaking the fibres, and tearing the wool out of the teeth of the comb; but if he proceeds cautiouſly, the wool will be diſentangled, ſeparated, and ſtraightened.

During the working, he frequently changes the combs, ſo as to work the wool upon both combs; but as the wool will gradually accumulate upon that comb which is moſt worked, he manages them ſo that at the end of about 35 or 40 ſtrokes nearly all the wool will be gathered upon one of the combs, and will hang from its teeth in a fair lock of ſtraight and regular wool. This comb he puts to heat for a moment, then fixes it to the poſt, and proceeds to draw off the wool from the comb in a ſliver. To do this, he takes hold of the wool which projects from the teeth with the fingers and thumbs of both hands, and draws it away from the teeth of the comb in a direction perpendicular to their length, without ſliding it off their points: as the wool comes away, he takes freſh hold, always ſeizing the wool at a given diſtance from the teeth. A portion of the wool which conſiſts of ſhort fibres will not come off, becauſe it does not reach to the place where the comber graſps the wool; it therefore remains in the teeth of the comb, and is drawn off afterwards. This ſhort wool, which is called noil, is unfit for worſted ſpinning; it is compoſed in part of the ſhort fibres which are naturally intermixed in the long ones, and alſo of the fragments of long fibres which are broken in the proceſs of combing. The quantity of the noil depends upon the kind of wool, and alſo on the care with which the comber has conducted his proceſs; but it will ſeldom exceed $\frac{1}{6}$th or $\frac{1}{8}$th of the quantity of the raw wool by weight.

The wool which is drawn off from the comb forms a continued ſliver or band, the fibres of which are ſtraight and parallel, but not ſufficiently ſo for ſpinning; it is therefore combed over again, and frequently it is repeated a third time. The firſt combing is called hacking, and the ſlivers produced by it are extended five together upon a table; then holding them down with one hand, they are broken again into handfuls by drawing them with the other. Theſe are combed again in the manner before deſcribed, but the heat given to the combs is much leſs. The ultimate ſliver, which is drawn off from the comb the laſt time, ſhould be very even, and compoſed of long and parallel fibres. On examining it againſt the light, every part ſhould appear equally denſe, without any entanglements of the fibres, for on theſe particulars the perfection of the ſpinning will in a great meaſure depend.

The combed wool produced from ſixteen pounds of wool uſually weighs eleven or eleven and a half pounds, for about two pounds are loſt in waſhing, and the reſt in noil and waſte in the combing. When the combing is finiſhed, the ſlivers are formed into ſix parcels, each containing ten or eleven ſlivers, which are rolled up together into a ball, and ticketed with their weight and quality, the wool-comber's mark, and wool-ſtapler's mark. In this ſtate, combed wool is called tops or Jerſey, and is ſold to the ſpinners in the country, and in cottages, who ſpin it into worſted-thread by the ſimple hand ſpinning-wheel; but the manufacturers who ſpin by machinery have wool-combers at their mills, and they uſually employ combing-machines in addition.

Combing-Machines.—The firſt combing-machine was invented by the Rev. Edmund Cartwright. His firſt two patents were in 1790, and he had another in 1792; but the machine was not rendered perfect, or brought into extenſive uſe, till a later period: and in 1802 he obtained an act of parliament to renew or extend the term of his patent. The ſpecification which he enrolled in conſequence contains drawings and deſcriptions of machines nearly of the ſame kind as thoſe which are now in uſe at many of the great worſted-mills, and which we ſhall deſcribe. Mr. Cartwright propoſed to form the raw wool into continued ſlivers, by joining the pieces of wool together, and ſlightly twiſting them, and in this ſtate they could be preſented to the combing-machine; but as this plan was not found to ſucceed, it was found neceſſary to comb the wool firſt by hand, in order to reduce it to ſlivers. This is ſtill the common practice, and takes away great part of the advantage of the machine; but we have ſeen a preparing-machine for this purpoſe, which operated very well upon the raw wool. The inventor's name we have not learned; but the rudiments of it are to be found in Mr. Cartwright's ſpecification of 1790.

Preparing-Machine.—The raw wool is ſpread upon a horizontal feeding-cloth, which is extended over two rollers, and circulates upon them: by its motion, the wool is carried forwards, and preſented to a pair of fluted rollers, which draw it in. This feeding-cloth is ſituated at the top of the machine, at the height of about five feet from the floor, ſo as to allow room for the reſt of the machinery beneath it. A principal part of the machinery is carried by a horizontal wheel of five feet diameter, which is mounted upon a vertical axis, and is turned rapidly round by the mill. This wheel carries four porcupines, which are ſmall cylindrical rollers, armed with ſpikes or teeth rather hooked. The rollers are ſituated horizontally in the plane of the wheel, with their length nearly in the direction of radii. They are about ſeven inches in diameter, and fourteen inches long, and are fixed upon horizontal ſpindles, which proceed from the circumference of the great wheel nearly to its centre, one extremity of each ſpindle being ſuſtained by the rim of the wheel, and the other in a ſupport fixed to the perpendicular axis. The porcupines are fixed on the ends of the ſpindles, near the circumference of the wheel; and on the oppoſite end of each ſpindle is a ſmall cog-wheel, to work in a worm or endleſs ſcrew, which is fixed concentric with the axis, being cut on the outſide of a hollow tube, through which the vertical axis paſſes.

By this means, the four porcupines which the wheel contains have a two-fold motion, *viz.* they are all carried round in a circle by the motion of the wheel, and at the ſame time each one has a ſlow rotative motion on its own axis, in conſequence of the cog-wheels, which work in the threads of the fixed worm.

The feeding-cloth is ſo ſituated, that the four porcupines in the great wheel will paſs in ſucceſſion exactly beneath the fluted rollers, which take the wool from the feeding-cloth; and the teeth of the four porcupines being ſharp-pointed, and rather bent forwards at the points, they penetrate and catch the wool as it comes through theſe fluted rollers, and hangs down from them. A portion of wool is thus carried away by each porcupine every time it paſſes beneath the fluted rollers; but by the ſlow revolving motion of the porcupines on their own axes, each one preſents a different row of teeth every time, and thus by degrees they become clothed with the wool which they take up.

This wool they deliver to a larger porcupine, which is placed beneath the revolving-wheel, or on the oppofite fide to the feeding-cloth. This porcupine is a cylinder nineteen inches diameter, and fourteen inches long: its axis is placed horizontally, and directed nearly to the centre of the vertical axis; fo that the fmall porcupines will be parallel to the large one when they pafs over it. The great porcupine is furnifhed with rows of teeth exactly fimilar to thofe of the fmall ones, which teeth are not very numerous, but large and fharp-pointed, and rather hooked, with the points forwards. When the fmall porcupines pafs over the large one, there is fo little clear fpace between their teeth, that the wool which is contained in the teeth of the fmall ones will be taken off by the large one, and remain in its teeth. The reafon of this is, that the teeth of the large porcupine prefent themfelves to the teeth of the fmall ones with the points forwards, and the fmall porcupines at the fame time move with the points of their teeth backwards. It was before ftated, that the porcupines move with the points forwards when they take the wool from the feeding-rollers, but this wool is applied on the upper fide of the porcupines, and the great porcupine is at the lower fide; hence the direction of the teeth is reverfe in the two cafes, and occafions the wool to be given to the great porcupine, a fmall quantity at a time, from each of the fmall porcupines, as they pafs over it. The great porcupine being turned flowly round upon its axis clothes itfelf with the wool in a continued fleece, and this is drawn off from its teeth by a pair of fluted rollers, between which it paffes in a continued fliver or band; this band is alfo conducted through a fhort tube, which revolves round its axis, and rolls up the fliver, to make it adhere better together in a round and compact form.

The action of this machine is not to comb the wool, but to divide the mafs of raw wool, which is fpread on the feeding-cloth, into a great number of fmall and equal portions by the fucceffive ftrokes of the fmall porcupines; thefe portions are again mixed together in one film of wool upon the great porcupine, from which the wool is drawn off in a continued fliver, and as much twift is given to it as is requifite to make the fliver fufficiently compact to fubmit it to the combing-machine.

Cartwright's Combing-Machine, or *Combing-Table;* called alfo amongft the workmen *Big Ben.*—In *Plate* II. *fig.* 1. *Worfted Spinning*, is a horizontal plan of the machine, which exhibits nearly all its parts; we have alfo given a perfpective view in *fig.* 2. of the operative parts, as they would appear if detached from the framing which fuftains them. A A is a circular ring of wood, which is fixed down on the framing; B B is a fimilar ring, which is fitted into the fixed ring, with liberty to turn round within it. The interior of this ring is furnifhed with a row of comb-teeth, with the points directed to the centre, and there are two other rows of fhorter teeth beneath, fo as to make three circular rows of teeth. This forms a large circular comb, called the combing-table, about five feet diameter; it is moved flowly round in the direction of the arrow by means of a pinion, which works into a ring of cogs, fixed in fegments withinfide of the circular comb beneath the row of teeth, as is fhewn in the fection, *fig.* 3.

The wool is filled upon the teeth of the circular comb by means of two machines F and G, called crank-lafhers. Thefe fupply the wool by lafhing or throwing the lock of wool upon the teeth of the comb, and then drawing up the wool from the comb, with a motion very fimilar to that of the hand of the workman in filling the combs, as we have before defcribed. The crank-lafhers repeat their ftrokes with great rapidity; but as the comb-table is kept in continual motion, the wool which is lafhed upon the teeth by the firft crank-lafher F is carried away, and in its courfe comes beneath the other crank-lafher G, by which more wool is filled upon the teeth, and they receive the intended portion. This wool, by the rotation of the comb-table, is then carried beneath a fmall comb K, which works by a crank movement, but with its teeth always horizontal; they penetrate through the wool, and then rife up fo as to comb it. After this operation, the wool is taken off from the teeth of the comb-table between a double pair of fluted rollers N, fituated immediately over the comb-teeth; thefe draw off the combed wool in a continued fliver, which is conducted through another pair of plain rollers R, and falls into a tin can placed there to receive it.

This machine was not found capable of combing the raw wool, chiefly becaufe the comb-teeth are not heated, and alfo becaufe the actions of lafhing on the wool, and afterwards combing it, begin to act upon wool, at firft with their full force, and break the fibres if they are entangled together; hence it is found beft to comb the wool by hand once over, or for fine goods twice. The wool is thus formed into flivers, which are joined together, by laying them on a table, with the ends lapped over each other; and rolling them together, they will join into one long fliver. Three of thefe flivers are put into tin cans *i i*, which are placed upon a circular table I, and carried upwards to the crank-lafher F or G, which are both of fimilar conftruction. The table I is mounted on an axis, fo as to be capable of turning flowly round horizontally, in order to twift the three flivers together into one; but in the machines which we have feen in ufe, this movement is commonly neglected, for if the flivers are prepared by hand-combing, as we have before defcribed, they will hang together without twifting.

The flivers, which are carried up from the cans to the crank-lafher (fee *fig.* 3.), firft pafs over a roller at *e*; the axle of this roller is alfo the fixed centre of motion of a trough H, which forms one part of the crank-lafher. The fliver of wool is conducted along the trough H, and then turns over a fecond roller at *f*; the centre-pin of this roller is the joint, which unites the end of the trough H with a moveable frame *d d*, which has a tube *g* fixed in front for the fliver of wool to pafs through. A little below the middle of this frame *d d* are holes through its fides, to receive the pin of a crank *b b*, of which the central axis is fupported in bearings fcrewed to the frame of the machine, and it is turned round by the power of the mill. By means of a pair of bevelled wheels D and E, *fig.* 1. the cranks of the two crank-lafhers are connected together, and have a common motion, but in a direction at right angles to each other. At the lower end of each of the moving frames *d d*, a pair of fluted rollers *i* are fixed, which draw the fliver between them. The rollers are put in motion by means of a cog-wheel *k*, fixed on the extremity of the axis of the lower roller; this is turned by a fmall pinion, fixed at the end of an axis, which paffes through the frame *d d*, and which at the oppofite end has a wheel *h*, that receives motion from a pinion fixed faft to the pin of the crank. The upper of the two fluted rollers is preffed down againft the lower one by fprings, which bear on its pivots with fufficient force to hold the wool firmly between them, and draw the fliver forwards when they turn round.

The motions of the crank-lafher are not eafy to be underftood from a verbal defcription. It muft be recollected, that the upper end of the frame *d d* which carries the rollers, being jointed to the end of the trough H, it muft always move in the arch of a circle, as fhewn by the dotted lines, *fig.* 3; the centre of this arch is *e*: alfo that the middle part of the frame *d*, where the crank-pin paffes through it, it, muſt deſcribe a circle when the crank revolves: in conſequence, the rollers *i*, which are at the lower end of the frame, will move in a curve, as ſhewn by the dotted lines. It is an oval or diſtorted ellipſis, with the longeſt diameter horizontal.

At the ſame time the fluted rollers circulate in this orbit, they are in continual motion on their own axis, by the communication of wheel-work before deſcribed, and they draw the ſliver of wool down the tube *g*; the end of the ſliver, which projects from below the rollers, hangs down from them in a lock, and by the motion of the crank-laſher this is thrown againſt the points of the teeth in the comb-table. At the period when the wool is thus thrown on the teeth, the rollers are moving nearly in an horizontal direction, ſo as to draw the wool in the direction of the length of the teeth, and they penetrate the wool; but as the rollers proceed in their elliptic orbit, they begin to riſe and draw the wool upwards away from the teeth in an inclined direction, as is evident by tracing the dotted courſe marked out for the rollers. By thus drawing up the wool between the teeth, a portion of the wool will be left in them; the rollers then riſe up rapidly in their oval courſe, and the wool is raiſed quite above the teeth; the rollers then move forwards to make another ſtroke, and during ſuch advance, the rollers, being in continual motion, draw forwards the ſliver of wool, and the end hangs down ready to be laſhed on the teeth of the comb next time.

The motions of the ſmall comb K muſt be next deſcribed. The whole machine receives its motion by means of a wheel or pulley *c*, *fig.* 1, upon the axis of the crank for the laſher G; D and E are the bevelled wheels by which the other crank is turned; at the extreme end of the axis C is a pinion, which turns a bevelled wheel L, and on the axis of this is a wheel turning two others M M of equal ſize; on the extremities of the axes of the wheels M M are two cranks *l l* of equal radii, which are both jointed to an iron bar *m m*, and both turning round together in the ſame direction, they cauſe the bar to move in a direction parallel to itſelf, and every part of the bar deſcribes a circle equal to the radius of the cranks. The ſmall comb K is fixed to this bar, and partakes of its motion, whereby the points of its teeth are carried horizontally into the wool contained in the teeth of the great comb, then riſe upwards and draw through the fibres, in order to comb them.

In order to remove the little comb when it becomes filled with wool, it is attached to the bar *m* by means of a comb-holder or ſocket L, which has a groove at each end to receive the little comb, and it can be mounted or withdrawn at pleaſure. This ſocket L is moveable upon a horizontal pin fixed at the end of the bar *m*, ſo that it can be turned with either end upwards; and as the little comb can be fixed at either end of the ſocket, a ſpare comb is placed in the upper groove of the ſocket, whilſt the lower groove holds the comb which is in uſe; but when this becomes filled with wool, which it has gathered from the comb-table, the ſocket L is inverted by turning it half round upon its centre-pin, and by this means the freſh comb is brought down into uſe, and the other can be taken away to clear off the wool from it. There is a ſmall bolt fixed to the pin on which the ſocket L turns, which can be ſhot into a notch when the ſocket is in a perpendicular poſition, and will then hold the ſocket faſt from turning, and keep the comb in a proper poſition for its work. In this way, the little comb can be taken away and replaced by a freſh one as often as is neceſſary, without ſtopping the machine, for the ſmall comb does not move very quick. The ſame boy who attends to change the combs, when neceſſary, alſo ſets up the wool in the great comb-teeth with a ſmall ſcraper, ſo that the ſmall comb will penetrate through it with more certainty and effect. The plane of the rows of teeth in the ſmall comb is not horizontal, or parallel to the teeth of the combing-table, but inclined thereto, ſo that thoſe teeth of the ſmall comb which firſt come into action upon the wool do not penetrate deeply into it; but as the comb-table turns round, the wool advances beneath the ſmall comb, and is operated upon thoſe teeth which go deeper, and the laſt teeth of the comb go as deep as they can, not to touch the teeth of the comb-table.

The wool is now combed, and only remains to be drawn off in a continued ſliver; this is done by the drawing-off rollers N, which are fluted iron rollers, placed horizontally over the comb-teeth, and nearly in the direction of a radius of the comb-table: they are ſupported in an iron frame, and are turned round by a pair of bevelled wheels from a vertical axis P. This axis extends the whole height of the machine, and is put in motion by means of a pair of bevelled wheels, and an oblique axis Q, which is turned by a bevelled wheel and pinion on the extreme end of the axis of the firſt crank-laſher.

The great comb receives its motion from the perpendicular axis P, which turns a large wheel T by a pinion on the lower end of it: on the upper end of the axis of this wheel is the pinion which works in the ring of teeth withinſide of the comb-table: in this way, a very ſlow motion is given to the comb-table. There are two pair of drawing-off rollers N, ſituated cloſe together, and parallel to each other; the firſt pair are put in motion as we have deſcribed, and the back pair are turned by means of equal cog-wheels, ſo that they move with the ſame velocity.

The wool upon the comb-table is gathered in the hand, to form a ſliver, and the end is introduced between the rollers, which continually draw off the wool as the comb-table turns round. After paſſing through both pairs of rollers, the ſliver is conducted through a forked iron, then through a round wooden tube, and is at laſt delivered by two plain wooden rollers R into a tin can placed beneath to receive it. Theſe rollers are alſo turned by bevelled wheels on the perpendicular axis P. The drawing-off rollers only take away the long wool, the fibres of which are long enough to reach to the rollers. The two rollers compoſing the front pair of drawing-off rollers are not placed immediately over each other, but the upper roller overhangs the lower one, ſo that the plane in which the axes of the upper and lower rollers are both ſituated is inclined at about an angle of 45 degrees to the plane of the comb-table: by this means, the wool is drawn off from the comb, at an angle of 45 degrees, to paſs between the rollers.

The noils, *i. e.* the ſhort wool and broken fibres, which will not reach the drawing-off rollers, remain in the teeth of the comb-table, and alſo as much of the long wool as is on the lower ſide of the comb, and theſe are called backings: both are taken off by a boy, who is ſeated for that purpoſe within the circle of the comb-table; he firſt draws off the backings from beneath the comb, and then, with one hand above the teeth, and the other below, he draws off the noils.

Theſe two ſorts of wool are handed to a boy on the outſide of the machine, who puts them into ſeparate boxes. The backings are filled on the ſmall combs before they are put into the machine, and become ſomewhat combed by the action of the ſmall comb: when the ſmall combs are removed from the machine, the wool upon them is further combed by hand, and then drawn off from them in a continued ſliver, by means of an additional piece of machinery, which is at the ſide of the machine.

This

This combing-machine is found to break the fibre of the wool, and it increafes the quantity of noil very much, unlefs the wool is previoufly combed once or twice by hand; and as it then becomes only a fubftitute for the fecond or third combing, it faves little or no expence. The advantage of the machine is found, in the great regularity and equality of the fliver which is produced by it, a circumftance of particular importance for fine fpinning. In combing by hand when the fliver is drawn off, thofe fibres which the comber firft takes hold of are longer than the others; then as the fliver continues to be drawn, fhorter fibres are found in it, and the fhorteft are laft of all. Thefe are called the long and fhort ends of the fliver; the fhort end is always marked by twifting or rolling it up, in order that when the flivers are joined together into one for fpinning, the long and fhort ends may be equally intermixed and difperfed throughout the whole length. In drawing off the wool from the combing-machine, the long and fhort fibres are intermixed and taken up together, fo that the fliver is of very equal texture.

There have been feveral other attempts to make combing-machines which deferve notice, though they have not come into ufe.

Meffrs. Wright and Hawkfley had a patent in 1793 for a combing-machine; and Mr. Toplis of Cuckney had alfo a patent of the fame date, which contains fome good ideas. Mr. Hawkfley, in 1797, had a patent for improvements on Cartwright's: the principal one was, to make the combing-table by the combination of a number of fmall combs, which could readily be applied to the table, or detached at pleafure. If this would allow the combs to be heated, as the inventor propofed, they would work much better.

Mr. Amatt had a patent in 1795, and Mr. Pearce in 1798: after this time, Mr. Cartwright's machines had received fome improvements from Mr. Hawkfley, and came into ufe; and we find lefs fpeculation on the fubject.

Gilpin's Combing-Machine.—In 1811, Mr. George Gilpin of Sheffield perfected a very ingenious machine, which combed the raw wool in a moft complete manner. We do not hear that this machine is yet come into ufe, although we have no doubt of its anfwering the purpofe, having frequently examined it while at work: its only fault was a complication of parts, which might be eafily removed.

The outline of this machine is taken from that of Mr. Toplis in 1793, but is very much improved and perfected. *Fig.* 4. of *Plate* I. *Worfted*, is a fketch of the principal parts. The machine works with eight combs at once, which are of rather larger fize than the ordinary hand-combs, the rows of teeth being twenty inches long. Thefe combs are fixed upon two reels or frames A, B, which revolve upon their axles by the power of the mill; four combs, D and E, are fixed upon each reel, and in fuch pofition that both ends of the comb-teeth, *viz.* the points and roots, are equally diftant from the centre of the reel to which they are fixed; and the reels, with the combs fixed upon them, form two revolving wheels or frames. The combs D and E are fo made, that they can be detached from the reels, or replaced and fixed faft in a moment, by the attendants; and they can, therefore, be heated in a ftove, in the fame manner as the hand-combs. The wool is alfo filled upon the combs by hand, and the combs and wool are heated in the ufual manner before they are put into the machine, in order to comb the wool.

One of thefe reels A is fimply turned upon its axis, but the other reel B has a curious compound motion given to it by the machinery: thus it revolves on its own axis; but the axis alfo advances to, and recedes from, the other reel with a motion parallel to itfelf, which is repeated four times in every revolution. Whilft B advances towards A, it moves with only one-third of the velocity with which it returns from A. The advancing movement is of a limited and conftant extent; but at the fame time, there is a third movement which regulates this extent, fo that at every fucceeding ftroke which the machine makes, the two reels will approach nearer together.

Suppofe all the combs filled with wool, and mounted in their places upon the reels, the machine is then put in motion, and the two reels A and B turning round in oppofite directions, their combs D and E meet each other; and by the compound movement of B, (*viz.* advancing flowly towards A, and turning round at the fame time,) the combs D and E approach in fuch a manner, that the points of each comb penetrate the wool which is in the other comb, and this is reciprocal of both combs. When the teeth are thus entered into the wool, the moveable reel B retreats quickly from the other, and the teeth, by drawing through the wool, comb and feparate its fibres.

The circular motion of both reels is not regular and equable, but is communicated by means of elliptical cog-wheels, which occafion the reels to move round very flowly, at the moment when the comb of the reel B is drawing out or combing the wool; but this motion being finifhed, the reels begin to turn round more rapidly, and at the fame time the reel B approaches towards A with a flow movement, in order to prefent another pair of combs to each other, which meet; and each one penetrates the wool which is upon the other, and then the reel B draws out to comb it, in the manner before defcribed.

In this way they continue to make fucceffive ftrokes, until the wool is fufficiently combed: the machine is then ftopped, and the combs taken off one by one, to be replaced by others, which are filled with frefh wool, and properly heated.

There is likewife another movement of the reel A, which we have not yet mentioned: the axis of that reel has a flow motion backwards and forwards, endways in the direction of its length, for a fhort diftance. The intention of this is, that the fame parts of the combs fhall never come oppofite to each other at two fucceffive ftrokes.

It fhould be obferved, that when the machine is firft fet to work, the combs at their point of meeting do not come within three or four inches of each other, and the points only penetrate amongft the longeft fibres of the wool upon the combs; but at every ftroke which is made, the combs advance nearer together, and take deeper into the wool, until, after a certain number of ftrokes are made, the combs approach as near as they can without touching. They continue to work in this manner for fome time, and when the intended number of ftrokes is made, a bell rings as an indication that the machine fhould be ftopped. This is done by drawing a lever, and in confequence the machine will ftop itfelf in the exact pofition for changing one of the combs on each reel. Thefe are removed, and others ready filled with wool and heated are put on in their places, which being done on both reels at the fame time by two perfons, is only the work of a moment. The machine is then put in motion again, but by the machinery it will ftop itfelf again at the required pofition for changing the next pair of combs; it is then put forwards, and fo on, until all the eight combs are changed.

The combs which are removed from the machine are put into the ftove to heat for a few moments, and then the wool is drawn off from them by a feparate machine. The head of the comb is here placed in a perp dicular groove, fo that its teeth ftand horizontal; and a piece of of metal, which is fixed to the head of the comb, and projects therefrom like a tooth, enters into the fpiral groove of a fcrew, which ftands in a perpendicular pofition, and is continually turned round by the machinery. By this means, the comb is regularly and flowly let down in the groove, from top to bottom. A pair of fluted rollers is placed horizontally, and parallel to the teeth of the comb, in fuch a pofition that the comb, in defcending, will pafs with its teeth at a proper diftance from them, to draw off the wool in a fliver. After paffing through thefe fluted rollers, the fliver is conducted through a perpendicular revolving tube, which gives a roundnefs to it, the fame as it would acquire by being rolled between the hands, and then it is conducted between a pair of plain rollers, which deliver it into a tin can placed before the machine.

A wooden roller is placed above the fluted rollers, with eight pieces of board projecting from it in the direction of radii. When the roller turns round, thefe boards act to ftroke the wool upon the comb, and raife it into a proper fituation to be drawn off by the fluted rollers.

The combs are prepared for drawing off the wool, by heating them as before mentioned, and by fliding the wool from the roots of the teeth half way towards their points. In this ftate, the combs are carried one by one to the drawing-off machine, and the head of one comb is put into the top of the perpendicular groove: it will be prevented from falling down in the groove by the projecting tooth, which enters the fpiral groove of the perpendicular fcrew. The wool is gathered up and introduced between the fluted rollers; the machine is then put in motion, and by means of the fcrew the comb is gradually lowered down, and the wool is drawn off from it in a fliver, which is rolled up into a compact form by the revolving tube, through which it paffes, and is delivered into the can by the plain rollers.

The attendant holds another comb ready to follow the firft, and when the firft has defcended to a certain point, he flips the next comb into the perpendicular groove, fo that it refts upon the former, and the wool upon the two combs joins as it were in one. The ftroker, when they pafs before it, lays the fibres all one way, and the wool is drawn off by the rollers in a continued fliver, which does not prefent the flighteft appearance of joinings. Another comb is then put in, and the wool joins to the former, and fo on. The backings, or wool at the back of the comb, are drawn off by the boy ftationed behind the machine; and the combs, as they come through below, are received by boys, who afterwards take away the noil or fhort wool which remains in the teeth, and then put the combs back into the ftove to heat them, ready to be filled again, in order to proceed with another combing. When the wool of all the eight combs is drawn off, the motion of the drawing-off machine is ftopped at the moment when the eighth or laft comb has defcended half way through its courfe. In this ftate, the machine waits till another combing is finifhed, and then the fucceeding comb being placed on the top of that one which continues in the machine, the continuity of the fliver will be preferved.

The inventor of this machine ftates in his fpecification, that for common work the wool only requires to be operated upon once by the combing-machine; and in that cafe, the machine muft be adapted to make twenty-four ftrokes of each pair of combs before the bell rings. For medium work, fuch as would require to be combed twice over, in the ufual manner of hand-combing, it muft be combed twice over by the machine: thus, after having been combed once in the manner before defcribed, the fliver of wool is broken up into handfuls, and filled on the combs again by hand as before, and combed over again in a fimilar manner; but the combs are lefs heated for the fecond time of combing. By changing a wheel, the machine fhould be adapted to make only fourteen or fixteen ftrokes before it ftops, when it is intended to comb twice over. The wool intended for the fineft fpinning fhould be combed three times over, and the machine fhould be fet to make fourteen or fixteen ftrokes of each pair of combs.

The machine has alfo two different movements for the drawing out of the moveable comb-reel: in one, the motion is over a fpace of ten inches, and is adapted to comb fuch wool as is fix or eight inches length of ftaple, and is called wether wool; but by a flight alteration, the excurfion of the moveable reel can be increafed to thirteen inches, and is then adapted to comb hey wool, or wool which is from eight to eleven inches length of ftaple.

Mr. Gilpin's machine has the advantages of heating the combs and of filling them by hand, both of which are effential to any machine which is propofed to comb the raw wool. The filling is an operation which requires difcretion, if it is expected that the long fibres fhall be preferved without breaking. The perfon who fills the wool on the teeth takes a greater or lefs lock of wool in his hand, according to the condition of it, and the degree of entanglement: alfo in drawing it between the comb-teeth, the force is proportioned to what the wool will bear. Mr. Gilpin's fpecification ftates, that under certain circumftances, when the wool will not wafh well, but remains taggy, it is advifeable to fill it upon the combs, and flip it off; then fill it again, preparatory for the machine. As the object of this firft filling is chiefly to warm the wool, the end may be in part attained by laying the wool upon the top of the ftove for a few minutes before it is filled.

Planking.—Let us fuppofe that the wool is combed either by the hand, or by the machine, and we will proceed to explain the means of preparing it into a thread. The combing-machines reduce the wool into a continued fliver, which is ready for the drawing-frame; but the fhort flivers produced by the hand-combing muft be firft joined together by what is called planking. Thefe flivers are rolled up by the combers, ten or twelve together, in balls called tops, each of which weighs half a pound: at the fpinning-mill thefe are unrolled, and the flivers are laid on a long plank or trough, with the ends lapping over, in order to fplice the long end of one fliver into the fhort end of another. The diftinction of the two ends of the fliver has been before explained; the long end being that which was firft drawn off from the comb, and contains the longeft fibres of the wool; the fhort end is that which came laft from the comb, and contains the fhort fibres. The wool-comber lays all the flivers of each ball the fame way, and marks the long end of each by twifting up the end of the fliver. It is a curious circumftance, that when a top or ball of flivers is unrolled and ftretched out ftraight, they will not feparate from each other without tearing and breaking, if the feparation is begun at the fhort ends, but if they are firft parted at the long ends they will readily feparate.

Breaking-Frame.—Here the flivers are planked or fpliced together, the long end of one to the fhort end of another; they are immediately drawn out and extended by the rollers of the breaking-frame. A fketch of this machine is given in *Plate* II. *fig.* 5; it confifts of four pairs of rollers, A, B, C, D. The firft pair A receives the wool from the inclined trough E, which is the planking-table. The flivers are unrolled, parted, and hung loofely over a pin, in reach of the attendant, who takes a fliver and lays it flat in the trough, and the end is prefented to the rollers A, which being in motion

motion will draw the wool in; the fliver is then conducted through the other rollers, as shewn in the figure: when the fliver has paffed half througb, the end of another fliver is placed upon the middle of the firft, and they pafs through together; when this fecond is paffed half through, the end of a third is applied upon the middle of it, and in this way the fhort flivers produced by the combing are joined into one regular and even fliver.

The lower roller C receives its motion from the mill, by means of a pulley upon the end of its axis, and an endlefs ftrap. The roller which is immediately over it is borne down by a heavy weight *e*, fufpended from hooks, which pafs over the pivots of the upper roller. The fourth pair of rollers D moves with the fame velocity as C, being turned by means of a fmall wheel upon the end of the axis of the roller C, which turns a wheel of the fame fize upon the axis of the roller D, by means of an intermediate wheel *d*, which makes both rollers turn the fame way round. The firft and fecond pairs of rollers, A and B, move only one-third as quick as C and D, in order to draw out the fliver between B and C to three times the length it was when put on the planking-table. The flow motion of the rollers A is given by a large wheel *a*, fixed upon the axis of the roller A, and turned by the intermediate cog-wheels *b*, *c*, and *d*; the latter communicates between the rollers C and D. The pinions on the rollers C and D being only one-third the fize of the wheel *a*, C and D turn three times as faft as A, for *b*, *c*, and *d*, are only intermediate wheels. The rollers B turn at the fame rate as A. The upper roller *c* is loaded with a heavy weight, fimilar to the rollers A; but the other rollers, B and D, are no farther loaded than the weight of the rollers.

The two pairs of rollers A B and C D are mounted in feparate frames, and that frame which contains the third and fourth pairs, C D, flides upon the caft-iron frame F, which fupports the machine, in order to increafe or diminifh the diftance between the rollers B and C. There is a fcrew *f*, by which the frame of the rollers is moved, fo as to adjuft the machine according to the length of the fibre of the wool. The fpace between B and C fhould be rather more than the length of the fibres of the wool. The intermediate wheels *b* and *c* are fupported upon pieces of iron, which are moveable on centres: the centre for the piece which fupports the wheel *b* is concentric with the axis of the roller A; and the fupporting piece for the wheel *c* is fitted on the centre of the wheel *d*. By moving thefe pieces, the intermediate wheels *b* and *c* can be always kept in contact, although the diftance between the rollers is varied at times. By means of this breaking-frame, the perpetual fliver which is made up by planking the flivers together is equalized, and drawn out three times in length, and delivered into the can G.

Drawing-Frame.—Three of thefe cans are removed to the drawing-frame, which is fimilar to the breaking-frame, except that there is no planking-table E. There are five fets of rollers, all fixed upon one common frame F, the breaking-frame which we have defcribed being the firft. As faft as the fliver comes through one fet of rollers, it is received into a can, and then three of thefe cans are put together, and paffed again through another fet of rollers. In the whole, the wool muft pafs through the breaker and four drawing-frames before the roving is begun. The draught being ufually four times at each operation of drawing, and three times in the breaking, the whole will be $3 \times 4 \times 4 \times 4 \times 4 = 768$; but to fuit different forts of wool, the three laft drawing-frames are capable of making a greater draught, even to five times, by changing the pinions; accordingly the draught will be $3 \times 4 \times 5 \times 5 \times 5 = 1500$ times.

The fize of the fliver is diminifhed by thefe repeated drawings, becaufe only three flivers are put together, and they are drawn out four times; fo that in the whole, the fliver is reduced to a fourth or a ninth of its original bulk.

The breaking-frame and drawing-frame, which are ufed when the flivers are prepared by the combing-machines, are differently conftructed; they have no planking-table, but receive three of the perpetual flivers of the combing-machine from as many tin cans, and draws them out from ten to twelve times. In this cafe, all the four rollers contribute to the operation of drawing: thus the fecond rollers B move $2\frac{1}{3}$ times as faft as the rollers A; the third rollers C move 8 times as faft as A; and the fourth rollers E move $10\frac{1}{2}$ times as faft as A. In this cafe, the motion is given to the different rollers by means of bevelled wheels, and a horizontal axis, which extends acrofs the ends of all the four rollers, to communicate motion from one pair of rollers to another.

There are three of thefe fyftems of rollers, which are all mounted on the fame frame; and the firft one, through which the wool paffes, is called the breaking-frame, but it does not differ from the others, which are called drawing-frames. The flivers which have paffed through one fyftem of rollers are collected four or five together, and put through the drawing-rollers. In all, the flivers pafs through three drawings, and the whole extenfion is feldom lefs than 1000 times, and for fome kinds of wool much greater.

After the drawing of the flivers is finifhed, a pound weight is taken, and is meafured by means of a cylinder, in order to afcertain if the drawing has been properly conducted; if the fliver does not prove of the length propofed, according to the fize of worfted which is intended to be fpun, the pinions of fome of the drawing-frames are changed, to make the draught more or lefs, until it is found by experiment that one pound of the fliver meafures the required length.

Roving-Frame.—This is provided with rollers the fame as the drawing-frames: it takes in one or two flivers together, and draws them out four times. By this extenfion, the fliver becomes fo fmall, that it would break with the flighteft force, and it is therefore neceffary to give fome twift; this is done by a fpindle and flyer. (See *fig.* 6.) A B are the two pairs of rollers, between which the fliver is paffed; the firft rollers A turn round flowly, but the others B revolve four times as quick, to draw the fliver to four times its original length; and as faft as it iffues from the roller, it is twifted by the motion of the fpindle C, and wound up upon the bobbin *a*. The fpindle C is put in motion by a whip-cord band, which paffes round the pulley *c*, and alfo round the wheel D. This wheel is fixed on a vertical axis *e*, which has a pinion on the upper end, to give motion to the lower roller B, by means of a bevelled wheel upon the end of its axis. The oppofite end of the axis has alfo a bevelled pinion upon it, to give motion to a bevelled wheel fixed upon an horizontal axis, which carries another bevelled pinion, to give motion to a bevelled wheel fixed upon the end of the axis of the back rollers A. The fizes of thefe wheels and pinions are fo proportioned, that the back rollers A turn only once to every four turns of the front rollers B, as before mentioned.

The back rollers are capable of being fet at a greater or lefs diftance from the front rollers, according to the length of the fibres of the wool, and in all cafes the diftance fhould be rather more than the length of the fibres, but not a great deal.

The

The fpindle is fupported on its point, and fuftained by a collar at the middle of its length. Upon the top of the fpindle, the flyer *e* is fcrewed; it has two branches, which turn downward, and one of them has an eye at the lower end, through which the roving is conducted, in order to lay it upon the bobbin *a*. This bobbin is fitted loofely upon the upper part of the fpindle, and refts with its weight upon a piece of wood projecting from the bobbin-rail *f*. The rail is made to rife and fall continually with a flow motion, fo as to prefent every part of the bobbin in fucceffion to the eye of the flyer, and thereby wind the roving upon every part of the length of the bobbin. The bobbin is not fixed upon the fpindle, but is fitted loofely thereupon; and by refting upon the piece of wood which is fixed to the bobbin-rail, there is fo much friction and refiftance to the motion of the bobbin, that it gathers up the roving by winding it round itfelf as faft as the rollers give it out. The twift given to the roving is juft enough to make it hang together, and one turn in each inch is ufually enough. Some roving-frames are made with four pairs of rollers, and draw ten or twelve times; and in this way, it is not neceffary for the fliver to pafs fo frequently through the drawing-frame.

Spinning-Frame.—This is fo much like the roving-frame, that a fhort defcription will be fufficient. The fpindles are more delicate, and there are three pairs of rollers inftead of two; the bobbins which are taken off from the fpindles of the roving-frame, when they are quite full, are fluck upon wires at L (*fig.* 7.), and the roving which proceeds from them is conducted between the rollers. The back pair A turns round flowly; the middle pair turns about twice for once of the back rollers; and the front pair B makes from twelve to feventeen turns for one turn of the back rollers B, according to the pinions which are employed, and thefe can be changed according to the degree of extenfion which is required.

The fpindles muft revolve very quickly in the fpinning-frame, in order to give the requifite degree of twift to the worfted. The hardeft twifted worfted is called tammy-warp, and when the fize of this worfted is fuch as to be twenty or twenty-four hanks to the pound weight, the twift is about ten turns in each inch of length. The leaft twift is given to the worfted for fine hofiery, which is from eighteen to twenty-four hanks to the pound. The twift is from five to fix turns *per* inch. The degree of twift is regulated by the fize of the whirls or pulleys upon the fpindle, and by the wheel-work, which communicates the motion to the front rollers from the band-wheel, which turns the fpindles.

It is needlefs to enter more minutely into the defcription of the fpinning machinery for worfted, becaufe the conftruction is very fimilar to the water-frame for fpinning cotton, invented by fir Richard Arkwright, and which is fully defcribed in our article *Manufacture of* COTTON. The differences between the two are chiefly in the diftance between the rollers, which in the worfted-frame is capable of being increafed or diminifhed at pleafure, according to the length of the fibres of the wool, and the draught or extenfion of the roving is far greater than in the cotton.

Reeling.—The bobbins of the fpinning-frame are placed in a row upon wires before a long horizontal reel, and the threads from 20 bobbins are wound off together. The reel is exactly a yard in circumference, and when it has wound off 80 turns, it rings a bell; the motion of the reel is then ftopped, and a thread is paffed round the 80 turns or folds which each thread has made: the reeling is then continued till another 80 yards is wound off, which is alfo feparated by interweaving the fame thread; each of thefe feparate parcels is called a ley, and when feven fuch leys are reeled, it is called a hank, which contains 560 yards. When this quantity is reeled off, the ends of the binding thread are tied together, to bind each hank faft, and one of the rails of the reel is ftruck to loofen the hanks, and they are drawn off at the end of the reel. Thefe hanks are next hung upon a hook, and twifted up hard by a ftick, then doubled, and the two parts twifted together, to make a firm bundle. In this ftate, the hanks are weighed by a fmall index-machine, which denotes what number of the hanks will weigh a pound, and they are forted accordingly into different parcels. It is by this means that the number of the worfted is afcertained as the denomination for its finenefs: thus No. 24. means that 24 hanks, each containing 560 yards, will weigh a pound, and fo on.

This denomination is different from that ufed for cotton, becaufe the hank of cotton contains 840 yards inftead of 560; but in fome places, the worfted hank is made of the fame length as the cotton.

To pack up the worfted for market, the proper number of hanks are collected to make a pound, according to the number which has been afcertained; thefe are weighed as a proof of the correctnefs of the forting, then tied up in bundles of one pound each, and four of thefe bundles are again tied together. Then 60 fuch bundles are packed up in a fheet, making a bale of 240 pounds, ready for market.

From this account of the proceffes of worfted fpinning, it will be feen that they are very fimilar to thofe of cotton-fpinning, after the firft preparation of the wool by combing inftead of carding.

WORSTED-*Cord*, in *Sheep-Farming*, is a fort of cord which is fometimes ufed for tying round the necks of fheep affected with the fcab, after it has been well fmeared over with the common mercurial ointment of the fhops, in order to cure them of that difeafe. See SCAB.

WORT, in the *Materia Medica*, is the fweet infufion of malt; firft propofed by Dr. Macbride as a dietetic article to fcorbutic perfons, from an apprehenfion that it would ferment in their bowels, and give out its fixed air, by the antifeptic powers of which the ftrong tendency to putrefaction in this difeafe might be corrected. It was fome time before a fair trial of this propofed remedy could be obtained, and different reports were made concerning it. In 1762, the lords of the admiralty gave orders to have the wort tried in the naval hofpitals at Portfmouth and Plymouth; but the murmurs of the patients, on account of reftrictions that were neceffary for determining its efficacy, put a ftop to the farther exhibition of it; and indeed Dr. Huxham, in 1764, informed the ingenious and benevolent propofer of this remedy, that it had been tried with very bad effects. But Dr. Macbride affures us, on the teftimony of a gentleman who made ufe of the wort, that it may be taken for a length of time, to the quantity of a quart in the day, without producing any ill effect whatever; and he refers to Van Swieten's Commentary, vol. iv. p. 673. where we learn, that the baron's lady, when a nurfe, ufed regularly to drink a pint of it every night going to bed, in order to increafe her milk.

After the failure of fuccefs in the naval hofpitals, orders were iffued to have the wort adminiftered on fhip-board, where no temptations of frefh vegetables would offer to make the men uneafy. But a confiderable time elapfed, before any reports were made either of its good or bad effects. Dr. Macbride, however, perfifted in recommend-

ing

ſing it, and lived to publiſh ſeveral caſes, in a poſtſcript to the ſecond edition of his work, in 1767, from which it appears, that ſcorbutic complaints of the moſt dangerous kind have actually been cured at ſea by the uſe of wort. Its general effects were, to keep the patients open, and to prove highly nutritious and ſtrengthening; it ſometimes purged too much; but this effect was eaſily obviated by the tinctura thebaica. Other unqueſtionable caſes of its ſucceſs in this diſeaſe are to be ſeen in the London Med. Obſ. and Inq. vol. v. p. 61. See alſo SCURVY.

The uſe of wort has hence been adopted in other caſes, where a ſtrong putrid diſpoſition in the fluids appeared to prevail, as in cancerous and phagædenic ulcers; and inſtances are publiſhed of its remarkable good effects in theſe caſes. See London Med. Obſ. and Inq. vol. iv. p. 367, &c. Prieſtley on Air, vol. 3. Appendix.

As the efficacy of the malt infuſion depends upon its producing changes in the whole maſs of fluids, it is obvious that it muſt be taken in large quantities for a conſiderable length of time, and rather as an article of diet than medicine. The quantity of one to four pints has generally been directed. See SCURVY.

WORT, *Improved Machine for ſtirring Malt in making of*, in *Rural Economy*, a contrivance for this purpoſe in brewing and diſtilling, ſuited to vats of this ſort, which are employed in forming the wort or waſh. There are many modes of ſtirring malt in the vats or tubs for maſhing in, employed in different places and inſtances; but they are in moſt caſes either expenſive, or inadequate to the purpoſes as well as the powers which are made uſe of in the work. Among the former may be ranked the admirably well-contrived machine that is in uſe by Jellet and Co. at Dollhill, in Somerſetſhire, which is on a planatory ſyſtem, and anſwers the intention very effectually; but its great coſt renders it liable to objection in many caſes. The well-known contrivance of a male ſcrew ſtanding upright in the centre of the vat, on which a bar works by means of a female ſcrew operating on the male ſtandard one, and thus cauſing the ſpikes with which the different wings of the bar are armed to ſtir the malt as the ſpiral motion proceeds, is certainly ſimple, neat, and cheap; but as it requires two men, one at each end, and makes but little change of locality among the malt-grain, much cannot be urged in favour of its efficiency for this uſe. The inſtrument known by the name of the hedge-hog, which is in uſe in ſome breweries, is a dreadful-looking machine, that would ſeem intended to divide ſome very tough or viſcous ſubſtance rather than to ſtir malt in this intention. It conſiſts of a roller about two feet in diameter, and ſix or ſeven in length, made of iron ſkeleton work; the longitudinal bars are bound with rings or hoops, furniſhed with ſpiky rims, to keep in due bounds a ſort of chain-work, armed alſo with ſpikes, which chains revolve upon the rings as the frame rolls round, urged by the power of horſes, and thus not only tears a paſſage through the contents of the maſhing-vat, but keeps raking them up, carrying a conſiderable portion with the ſpiky chain quite over the wheel, and expoſing the malt perpetually to the influence and action of the air; a practice invariably diſapproved of by all good brewers. In this caſe, there are expence, labour, friction, &c. all crowded into one form, without any material advantage.

A plan has, however, been lately ſuggeſted for ſtirring malt while in the maſhing-vat by a machine or contrivance wrought by the power of horſes, or in other ways, which is nearly without friction, and diveſted of the intervention of any ſecondary action that may be troubleſome or expenſive. It is very ſimple; and one vat of this ſort may be ſtirred by a very trifling power; but as in large breweries and diſtilleries from malt a number of maſhing-vats are moſtly requiſite, which generally require to be ſtirred in ſucceſſion, an arrangement is given for facilitating and bringing the operations of five vats, one in the middle and four around it, into a narrow or ſmall compaſs, and under the action of one power; which not only affords much convenience, but occaſions the expence and the labour to be greatly leſſened; conſequently it may be uſeful in large as well as ſmall eſtabliſhments of this nature.

In this plan, the centrical circular vat for this purpoſe is raiſed ſufficiently to admit the neceſſary gear and other matters for a horſe-walk underneath it. The upright axle paſſes through the floor, and through the centre of the vat, proceeding up to a beam in which it moves in a metal buſh, as it does alſo below, where it reſts on a ſtep. It does not, however, touch either the floor or the vat; but at the diſtance of a few inches it is ſurrounded by a cylinder, forming part of the vat, which prevents its contents from paſſing through the aperture in the floor. This cylinder correſponds in height with the exterior edge of the vat, and is firmly cloſed at the bottom, where, as well as at the outer part, it is rounded off, ſo as to be the more eaſily drained and cleaned.

As it is requiſite at times to move the malt in the other vats, while the central one is at reſt, there ariſes a neceſſity for conſtructing the wings of the ſtirring-frame in the latter in ſuch a manner as may liberate them, leaving them inactive, while the axle proceeds in its ordinary revolutions.

The ſtirring-frame is made of iron; it has four wings ſtanding at right angles, and they all join to an iron collar which ſurrounds the axle at ſome diſtance, that is, leaving about an inch intermediately all around. When the ſtirring-frame is to move with the axle, it is faſtened to it by two iron pins, with long handles, ſo as to enable the workmen to affix them in their proper ſockets, without going into the vat. Theſe pins paſs through the collar into the axle, thereby cauſing the ſtirring-frame to move round in the vat, as the axle is moved round by the horſe, or other power.

As the ſtirring-frame in the centre vat cannot be connected all the way down its depth with the axle, on account of the cylinder, and as it would be liable to ſwag, if depending entirely on its junction with the collar, oblique ſtays are indiſpenſable; they are carried out about two-thirds of the length of the frame, where they are rivetted: their upper ends are ſecured to another collar, ſurrounding the axle above.

Each wing of the frame conſiſts of two iron bars, one at the top, and one at the bottom; between the bars are three fixed upright valves made of thin ſheet-iron, and ſtanding at angles of forty-five degrees; and they are faſtened above and below into the horizontal iron bars, ſo as to be perfectly ſtrong and ſteady in their poſitions. The valves do not, however, all ſtand the ſame way: the internal ones all point inwards, the outward ones all point outwards, and the middle ones alternately inwards and outwards.

Thus far wholly relates to the centrical vat, which may be ſurrounded by four others of leſs capacity, in which there will be found the differences noticed below: 1. That the bottoms not being perforated no cylinders are required. 2. That the axles for their reſpective frames reſt on ſteps at their bottoms, in which iron gudgeons move in iron buſhes. 3. That the frames all connect with the axles for the whole of their depth. And 4. That no ſtays or collars are wanted in them.

On

On the main axle are four drums of about one-fourth the diameter of the centre vat; they are each about one foot in thicknefs, and deeply grooved all around, like the fheave of a pulley, for the purpofe of receiving a band. An interval of about fix inches is left between them, in the intention of receiving the band refpectively, fo that the correfponding drums on the axles in the other vats may be left at reft whenever thofe vats are not at work. Thus the four drums which are firmly fixed to the main axle, and revolve with it, turn the four drums fixed to the axles in the four vats refpectively. But as the four drums on the main axle are all of different heights from the furface of the vat, the feveral drums on the axles in the other vats muft be refpectively of correfponding heights with thofe that act upon them on the main axle. An idea of the manner in which the bands extend to the four vats may be formed by obferving that in order to produce greater conftriction, and confequently greater power, they all form a figure of 8 in their progrefs; thereby occafioning the four furrounding vats to be ftirred by a counter motion; that is, the frames will revolve the oppofite way to that in the centrical vat. The drum on each of the leffer vats fhould, however, be of the fame fize as that on the central axis from which it receives its motion, whereby the whole will move at the fame rate, and the malt be equally ftirred.

The intervals between the different vats will allow ample accefs to the works, and admit befides of ftandards, &c. for the fupport of the flooring above, there being no part of the machinery that in the leaft interferes with thofe fpaces; and the bands being completely out of the paffage of all work, they can be eafily fhifted off and on to the central drum by means of a pole with an iron at its end, formed fo as to embrace and direct them into the grooves.

On the whole it is fuppofed, that the plan here laid down may be fafely afferted to be cheap, fimple, and effectual; and that it would not probably be eafy to find any machinery for this ufe lefs complex, and in which the power is fo immediately applicable to the object. For though it might be objectionable in work requiring perfect regularity, and an unvaried equable motion, without which the operations would be ill performed, and the machinery itfelf be liable to great injury, and to be perpetually out of order, yet in the bufinefs of merely ftirring the malt in a mafhing-vat in the making of wort or wafh, inequality of motion can never produce any bad effect.

The driving power in thefe cafes fhould move rather flowly, and when of the animal kind, it may be increafed without the addition of more ftrength, merely by extending the length of the lever, and caufing the animal by fuch means to defcribe a larger circle; but which may not, however, be always convenient for want of perpendicular fupport for the flooring above. On moft occafions, the mafhing-vats in making wort or wafh may, however, be computed not to exceed twelve feet in diameter, in which cafes the horfe-walks need not be more than twenty feet over, equal to about twenty yards in circumference; and in this cafe, fuppofing the horfe to move at the rate of two miles in the hour, he would go round eighty-eight times in the courfe of that time, and caufe the malt to be ftirred nearly three times in the fpace of every two minutes; but if the lever were longer, the motion within the vats would be flower in proportion.

WORTH, in *Geography*, a town of Bavaria; 12 miles E. of Ratifbon.—Alfo, a town of the principality of Heffe Darmftadt; 20 miles E.S.E. of Darmftadt.

WORTH *Barrow Bay*, a bay of the Englifh Channel, on the fouth coaft of the county of Dorfet; 11 miles E. of Weymouth.

WORTHIEST *of Blood*, in *Law*, an expreffion denoting the preference given in defcents to fons before daughters.

WORTHING, in *Geography*, a fafhionable and much-frequented watering-place in the parifh of Broadwater, and county of Suffex, England, is fituated on the fea-coaft, 11 miles W. from Brighthelmftone, 9½ E.S.E. from Arundel, and 58 S. by W. from London. Formerly an obfcure fifhing-village, Worthing is much indebted for its prefent improvement to its fituation on a very extenfive ftretch of fine level fandy beach, peculiarly convenient for bathing, and to the range of chalk-hills behind it called the South Downs, affording at once fhelter to the town and fands, and fpace for exercife to the invalid. The town extends northward from the fhore, but fome new buildings are fituated near the beach, and are adapted to the reception of families of the firft rank. The Steyne, a range of handfome houfes, and the parallel row called Warwick-buildings, form the E. and W. fides of a fquare, open to the fea on the S. and to the Downs on the N. A quarter of a mile from the beach is a neat chapel, erected by fubfcription in 1812. Worthing has a theatre, libraries, bathing-machines, and warm baths, and is thus amply provided for the ufe and amufement of vifitors. Warwick-houfe is not only the moft diftinguifhed manfion in Worthing, but for its extent and appearance entitled to a high rank among the noble manfions of the kingdom. It was erected by the earl of Warwick, while proprietor of the manor of Broadwater; but no longer belonging to that family, it is ufually occupied by fome perfons of diftinction in the bathing-feafon. Broadwater village is half a mile from Worthing; it was the chief place of the barony of Camois, in the time of Edward I. The parifh alfo comprehends Offington, the ancient but now much-altered feat of the lords de la Warr. The church of Broadwater is conftructed on the cathedral plan, with a mixture of the circular and early-pointed ftyles of architecture. The population of Worthing fluctuates according to the feafon of the year; but that of the whole parifh of Broadwater, in 1811, was 2692 perfons, and the houfes were 629.—Beauties of England and Wales, Suffex; By F. Shoberl, 8vo. London, 1813.

WORTHINGTON, a poft-town of Maffachufetts, in the county of Hampfhire, containing 1391 inhabitants; 19 miles N.W. of Northampton.

WORTLEY, a townfhip in the parifh of Tankerfley, and county of York, England. According to the population report of 1811, it contained 173 houfes, and 925 inhabitants, moft of whom were employed in agriculture.

WORTON CREEK, a river of Maryland, which runs into the Chefapeak, N. lat. 39° 20′. W. long. 76° 16′.

WORTOWA, a town of Bohemia, in the circle of Chrudim; 14 miles S. of Chrudim.

WORUMBANG, a town of Africa, in Mandingo. N. lat. 12° 40′. W. long. 6° 55′.

WOSCHNICK, or WOZNICKI, a town of Silefia, in the principality of Oppeln; 14 miles N.N.E. of Beuthen.

WOSITZ, a town of Pomerelia; 10 miles S.E. of Dantzic.

WOSSBERK. See WEISENBERG.

WOSTERZEDECK, a town of Bohemia, in the circle of Kaurzim; 12 miles S.W. of Kaurzim.

WOSTOCK, a town of Brandenburg, in the Middle Mark; 11 miles S.S.E. of Berlin.

WOSTROW, a town of Bohemia, in the circle of Czaflau; 12 miles S.W. of Czaflau.

WOTCHAT,

WOTCHAT, in *Agriculture* and *Rural Economy*, a term provincially applied in ſome diſtricts to an orchard.

WOTRALLY, in *Geography*, a town of Hindooſtan, in Myſore; 8 miles N. of Allumbaddy.

WOTROW. See OSTRITZ.

WOTTON, *Sir* HENRY, in *Biography*, was born at Boughton-hall, in Kent, in 1568, and in 1584 entered of New college, Oxford, from which he removed to Queen's college. During his reſidence in the univerſity, he applied with diligence to the ſtudy of logic and philoſophy, of polite literature and civil law, and at this time compoſed a tragedy, which gained the applauſe of his fellow-collegians. Upon the death of his father in 1589, he availed himſelf of the ſmall patrimony that was left to him in travelling through France, Italy, Germany, and the Low Countries, in order to improve his acquaintance with men and manners in theſe ſeveral countries. On his return in 1596, he was appointed ſecretary to the earl of Eſſex; and when this nobleman was apprehended on a charge of high treaſon, he conſulted his own ſafety by quitting the kingdom. As he fixed his reſidence chiefly at Florence, he employed himſelf in compoſing a treatiſe, which was publiſhed after his death in 1657, under the title of "The State of Chriſtendom; or, a moſt exact and curious Diſcovery of many ſecret Paſſages and hidden Myſteries of the Times." When a plot was detected by the grand-duke of Tuſcany for taking away the life of James, king of Scotland, Wotton was engaged to communicate intelligence of it to the king. Having fulfilled this miſſion, he returned to Florence; and when James came to the crown, he recompenſed his ſervice by conferring upon him the honour of knighthood. In 1604 he was appointed ambaſſador in ordinary to Venice, where he acquired ſuch reputation that ſeveral young gentlemen of rank attended him for improvement. In his way through Augſburg, he drew up the following humorous definition of an ambaſſador:—"Legatus eſt vir bonus peregre miſſus ad mentiendum reipublicæ cauſa;" *i. e.* an ambaſſador is a good man, ſent abroad to lie for the ſervice of his country. This ſentence was afterwards alleged as a maxim avowed by the religion profeſſed by the king of England; and it ſo far excited the diſpleaſure of James, that Wotton, after his return, remained for five years unemployed. An apology, however, regained the royal favour, and he was ſent on an embaſſy firſt to the United Provinces, and afterwards in 1615 to Venice. After three years' reſidence he returned with the hope of ſucceeding to the office of ſecretary Winwood, but he was otherwiſe employed in various foreign embaſſies, from the laſt of which to Venice he did not return till after the death of James, when he was appointed, as a recompence for his ſervices, to the provoſtſhip of Eton college in 1624. Soon after his ſettlement in this ſituation, he publiſhed his "Elements of Architecture." But as the ſtatutes of the college required his aſſuming the clerical character, he took deacon's orders, without undertaking what he conſidered as too ſerious a charge, the cure of ſouls. In his domeſtic entertainments he maintained the reputation of hoſpitality, and in his connection with the ſeminary over which he preſided, he was a liberal encourager of genius and application. For the amuſement of advanced life he had contemplated a life of Luther, with the hiſtory of the Reformation; but Charles I. perſuaded him to undertake a hiſtory of England, in which, however, he made little progreſs. Having large demands on government for money advanced in foreign ſervices, his circumſtances were embarraſſed, and he frequently ſolicited his majeſty to grant him new preferment. But death was the only termination of his wants and wiſhes; and this happened in December 1639, in the 72d year of his age. His remains were interred in the chapel of Eton college, and the following epitaph was inſcribed on the ſtone that covered them by his own order: "Hic jacet hujus ſententiæ primus author, *Diſputandi Pruritus Eccleſiarum Scabies.* Nomen alias quære." His accompliſhments and literary acquiſitions were very diſtinguiſhed; and they are hyperbolically ſtated in Cowley's elegy, when he ſpeaks of him as one

"Who had ſo many languages in ſtore,
That only fame ſhall ſpeak of him in more."

Buſineſs occupied ſo much of his time, that he had little leiſure for writing. After his death were publiſhed his "Reliquiæ Wottonianæ;" and they have often been reprinted. Of his poems, there is one entitled "A Hymn to my God in a Night of my late Sickneſs," which has been highly extolled. Biog. Brit.

WOTTON, WILLIAM, a learned clergyman, was born in 1666, and under the tuition of his father, who was alſo a clergyman, he became a perfect phenomenon as to the knowledge of languages; for at the age of five years he could read the Latin, Greek, and Hebrew languages almoſt as well as Engliſh. Accordingly he was entered of Catharine-hall, Cambridge, ſome months before he was ten years of age: at twelve years and five months he took the degree of B.A., ſome time before which he had been celebrated in a copy of verſes by Dr. Duport, not only for his acquaintance with the learned languages, including Arabic, Syriac, and Chaldee, but his knowledge of geography, logic, philoſophy, mathematics, and chronology. He commenced B.D. in 1691, and being chaplain to the earl of Nottingham, this nobleman preſented him in 1693 to the rectory of Middleton-Keynes, in Buckinghamſhire. His firſt work appeared in 1694, and was entitled "Reflections upon Ancient and Modern Learning." A ſecond edition was publiſhed in 1697, and to this was annexed Dr. Bentley's Diſſertation upon Phalaris, which involved Wotton in controverſy, and ſubjected him to the ſarcaſm of Swift's Battle of Books. Wotton defended his own book againſt the objections of ſir W. Temple and others, and ſome obſervations in the Tale of a Tub, in the third edition in 1705. In 1701 he publiſhed "The Hiſtory of Rome, from the Death of Antoninus Pius to the Death of Severus Alexander," 8vo. undertaken at the requeſt of biſhop Burnet, for the uſe of his pupil the duke of Glouceſter; and recommended by Leibnitz to George II. when electoral prince. In 1706 he attacked "Tindal's Rights of the Chriſtian Church," and in 1707 archbiſhop Teniſon conferred upon him the degree of D.D. Notwithſtanding his talents and learning, his life was irregular, and of courſe his circumſtances embarraſſed, ſo that in 1714 he was obliged to retire into South Wales, where he employed himſelf in writing. He alſo acquired the Welſh language, and was able to preach in it. Dr. Wotton, ſays one of his biographers, was one of thoſe ſcholars, whoſe early proficiency, being chiefly the reſult of an extraordinary memory, was not followed by mature products correſponding to the expectations they excited. He died at the age of 60, in the year 1726. Nichols's Lit. Anecd. Gen. Biog.

WOTTON-*under-Edge*, in *Geography*, a large and populous market-town in the upper diviſion of the hundred of Berkeley, Glouceſterſhire, England, is ſituated at the baſe of a ridge of woody hills (whence its name is evidently derived), at the diſtance of 19 miles S.S.W. from Glouceſter, and 108 miles W. by S. from London. It is a borough by preſcription, though it ſends no members to parliament. In the

the reign of king John it was nearly deftroyed by fire, and a place called the Brands is fuppofed to mark its ancient fcite. The prefent town confifts of feveral ftreets, and ftands on nearly fixty acres of ground; the buildings in general are good, and fome, belonging to families of property, are modern and elegant. The government of the town is vefted in a mayor and twelve aldermen. In the year 1252, Maurice, lord Berkeley, an anceftor of the prefent earl of Berkeley, who now holds the manor, obtained a grant of a weekly market on Fridays, and an annual fair, both of which are ftill held. The church is a fpacious, handfome fabric, and contains numerous monuments and fepulchral memorials. Here is a free-fchool, erected in 1385, by Catherine, relict of Thomas, lord Berkeley: alfo an alms-houfe for fix poor men and fix women, built and endowed in 1632, by Hugh Perry, alderman of London, at the charge of 1000*l.*: a like fum was given by fir Jonathan Dawes, fheriff of London, for the relief of the poor. In the population return of the year 1811, the houfes in this town were enumerated as 217, the inhabitants as 1527; the latter are chiefly employed in the clothing manufacture, which is carried on to a confiderable extent in the town and its vicinity: one factory only, called New Mill, employs under its roof about 200 men, women, and children. Spanifh wool alone is manufactured at this place, and is employed for the weaving of broad-cloth and kerfeymere.—Rudge's Hiftory of Gloucefterfhire, 2 vols. 8vo. 1803. Beauties of England and Wales, vol. v. Gloucefterfhire, by J. Britton and E. W. Brayley, 1804.

WOTYECHOW, a town of Poland, in the palatinate of Lublin; 12 miles W.S.W. of Lublin.

WOTZLERSDORF, a town of Auftria; 10 miles W. of Zifterfdorf.

WOUDRICHEM. See WORCUM.

WOVEN STOCKINGS. See STOCKING.

WOUGHS, in *Mines*, are the walls or fides fometimes of hard ftones, and fometimes foft; when foft, the miners fay they are rotten: thefe are the bounds of an entry. Betwixt them all forts of earth, ftones, and ore lie; or, as philofophers fay, grow.

WOULD, or WELD, among *Dyers*. See WELD, and DYER's *Weed*.

WOULD, in *Agriculture*, a term applied in fome cafes to fignify an open uninclofed tract of country.

WOULD *Land*, that which remains in the ftate and condition of would. There is much of this fort of land in many counties and diftricts of this country which might be ftill greatly improved and converted to far better purpofes than at prefent, by fimply inclofing them and turning them into a ftate of proper and fuitable cultivation. This has been already done with large tracts in Yorkfhire and Gloucefterfhire to very great benefit, and the fame may be the cafe with many others in different places. See WASTE *Land*.

WOULDS, a term applied by fome writers on hufbandry to crops of the woad kind. See WOAD.

WOULDING. See WOOLDING.

WOULMARA, in *Geography*, a town of Bengal; 28 miles S. of Midnapour.

WOUNDS, in *Surgery*, conftitute the moft ancient and important branch of it, accidental injuries of this kind having in all probability preceded the exiftence of many of the difeafes to which mankind are now liable. The turbulent and enterprifing fpirit of the earlieft generations foon produced wars, and the effufion of human blood; and even the natural habits of every people, in a ftate of inferior civilization, would conduce to the receipt of wounds, fince the chace, by which food was fo commonly procured, would itfelf caufe many accidental hurts. Surgeons ufually define a wound to be a folution of continuity, or a divifion of the foft parts, more or lefs recently produced, commonly attended with a greater or leffer degree of hemorrhage, and almoft always occafioned by an external mechanical caufe.

There are fome chirurgical writers who make objections to defining a wound to be a *recent* and *bleeding* divifion of the foft parts, and M. Richerand is one of this number. He difapproves of thefe terms, becaufe a wound, when long in healing, and accompanied with fuppuration, cannot admit of fuch a definition. And he obferves, that writers who have defined a wound in this way, have been obliged to call every fuppurating wound, if only of three days' ftanding, an ulcer, which he conceives to be altogether abfurd. The epithet *bleeding*, he contends, is not applicable in a general definition of wounds, fince gun-fhot wounds are not ordinarily followed by an effufion of blood from the divided parts. Nofographie Chir. tom. i. p. 2. edit. 4.

It muft be acknowledged, that there is confiderable difficulty in fixing the precife period when a wound fhould ceafe to be fo denominated, and take the appellation of an ulcer. The wound, after feveral important furgical operations, is fometimes a month or two before it is entirely healed; yet, generally fpeaking, as long as there is a profpect of a cure within a reafonable length of time, and the cicatrization does proceed, though flowly, furgeons moftly ftill call the fuppurating breach of continuity a wound, and not an ulcer. When, however, a wound is very long kept from healing by injudicious applications, conftitutional caufes, attacks of hofpital gangrene, debility, &c. the cafe, we think, is moft commonly regarded rather as a fore, or ulcer, than as a wound. An ulcer, ftrictly fo called, does indeed feem to imply a breach of continuity arifing from the procefs termed *ulceration*, or *ulcerative abforption*, in which a chafm, or lofs of fubftance, is actually produced in the part by the action of the abforbent veffels. (See ULCERATION, and ULCER.) This procefs is alfo concerned in the production of every fore which is the confequence of a burn; for though parts may be at once killed, and converted into efchars by the fire itfelf, yet the feparation of fuch deadened parts, or floughs, fo as to leave an ulcer behind, is the refult of a procefs, in which the abforbents of the adjoining living furface remove the particles of matter, which form the connection between thofe parts which are killed and thofe which are alive.

In the perufal of Richerand's fentiments, who has betrayed fo much delicacy and fo many fcruples about the admiffion of definitions, and who is at the fame time the author of a modern fyftem of phyfiology, we confefs that we were rather furprifed to find him infifting upon burns, and the apertures by which abfceffes fpontaneoufly burft, being wounds, and not ulcers. In fact, he feems to regard the formation of a breach of continuity, in thefe cafes, as entirely the refult of phyfical and mechanical caufes, and not as the confequence of a vital procefs, in which the action of the abforbent veffels has a very confiderable fhare.

With refpect to the propriety of the epithet *bleeding*, in the definition of a wound, there cannot be any real objection to it in a general fenfe; for although a wound does not bleed when in a fuppurating ftate, yet it has almoft always done fo on the firft occurrence of the injury. Even the generality of gun-fhot wounds, though it may not be their ufual nature to bleed much, commonly pour out fome blood.

We have ftated, that wounds are produced by external mechanical caufes. There are, however, exceptions to this remark;

remark; for it ſometimes happens that breaches of continuity, both in the ſoft and hard parts, are cauſed by the violent action of the muſcles. Thus, the patella and os brachii are occaſionally fractured by the powerful contraction of the muſcles; and the muſcles either tear themſelves aſunder, or rupture the tendons with which they are connected. Sometimes, alſo, the ſharp point of a broken bone wounds the ſuperincumbent integuments, and changes the caſe into a compound fracture. Here we ſee the cauſe is mechanical, but yet not of an external kind, as in ordinary examples.

Wounds are divided by the writers on ſurgery into ſeveral kinds, the diſtinctions being founded either upon the ſort of weapon with which the injury was inflicted; or upon the circumſtance of a venomous matter having been inſerted into the part; or, laſtly, upon the particular ſituation of the wound, and the nature of the wounded parts themſelves. Hence we have *cuts*, *inciſions*, or *inciſed wounds*, which are ſuch as are produced by ſharp-edged inſtruments, and are generally free from all contuſion and laceration. The fibres and texture of the wounded part have ſuffered no other injury but their mere diviſion; and there is conſequently leſs tendency to inflammation, ſuppuration, gangrene, and other bad conſequences, than in the generality of other ſpecies of wounds. Inciſed wounds alſo may uſually be healed with greater quickneſs and facility than other wounds, which are accompanied with more or leſs contuſion and laceration: the ſurgeon has only to prevent the ſolution of continuity from gaping, or, in other words, he has ſimply to bring the oppoſite ſides of the wound into contact with each other, and keep them in this ſtate a few hours, and they will unite and grow together.

Another claſs of wounds are *ſtabs*, or *punctured wounds*, made by the thruſt of pointed weapons, like bayonets, lances, ſwords, daggers, &c. and alſo by the accidental and forcible introduction of conſiderable thorns, large nails, &c. into the fleſh. Theſe wounds frequently penetrate to a great depth, ſo as to injure large blood-veſſels, viſcera, and other organs of importance; and as they are generally inflicted with much force and violence, the parts ſuffer more injury than what would reſult from their ſimple diviſion. It alſo deſerves notice, that a great number of the weapons, or inſtruments, by which punctured wounds are occaſioned, increaſe materially in diameter from the point towards their other extremity; and hence, when they penetrate far, they muſt force the fibres aſunder like a wedge, and cauſe a ſerious degree of ſtretching and contuſion. It is on this account that bayonet wounds of the ordinary ſoft parts are very often followed by violent inflammation, an alarming degree of tumefaction, large abſceſſes, fever, delirium, and other very unfavourable ſymptoms. The opening which the point of ſuch a weapon makes is quite inadequate for the paſſage of the thicker part of it, which can only enter by forcibly dilating, ſtretching, and otherwiſe injuring the fibres of the wounded fleſh.

A third deſcription of wounds are the *contuſed* and *lacerated*, which ſtrictly comprehend, together with a variety of caſes produced by the violent application of hard, blunt, obtuſe bodies to the ſoft parts, all thoſe intereſting and common injuries denominated *gun-ſhot wounds*. Many bites rank alſo as contuſed and lacerated wounds. In ſhort, every ſolution of continuity, which is ſuddenly produced in the ſoft parts by a blunt inſtrument, or weapon which has neither a ſharp point nor edge, muſt be a contuſed, lacerated wound.

Poiſoned wounds are thoſe which are complicated with the introduction of a venomous matter, or fluid, into the part. Thus the ſtings and bites of a variety of inſects afford us examples of poiſoned wounds; but a more ſerious and dangerous inſtance, which we meet with in this climate, is ſeen in the cuts accidentally received in the diſſection of putrid bodies, or in handling inſtruments infected with any irritating venomous matter; as ſometimes happens to the ſurgeon in the performance of operations on gangrenous limbs, and in the application of dreſſings to venereal and other infectious ulcers. The moſt dangerous, however, of all the poiſoned wounds, which ever occur in this kingdom, are thoſe reſulting from the bite of the viper, and from the bites of rabid animals, particularly the dog and cat. See HYDROPHOBIA.

Wounds are farther divided by ſurgical writers into *wounds of the head*, *wounds of the face*, *wounds of the throat*, *wounds of the cheſt or thorax*, *wounds of the belly or abdomen*, *wounds of the limbs or extremities*, *wounds of the arteries*, *wounds of the veins*, &c. &c.

Wounds may likewiſe be univerſally referred to two other general claſſes, *viz. ſimple* and *complicated*. A wound is called *ſimple*, when it occurs in a healthy ſubject; has been produced by a clean, ſharp-edged inſtrument; is unattended with any ſerious ſymptoms; and the only indication is to re-unite the freſh-cut ſurfaces. A wound, on the contrary, is ſaid to be *complicated*, whenever the ſtate of the whole ſyſtem, or of the wounded part, or wound itſelf, is ſuch as to make it neceſſary for the ſurgeon to deviate from the plan of treatment requiſite for a common ſimple wound. The differences of complicated wounds muſt, therefore, be very numerous, as they depend upon many incidental circumſtances, the principal of which, however, are, hemorrhage, nervous ſymptoms, contuſion, the unfavourable ſhape of the injury, the diſcharge or extravaſation of certain fluids indicating the injury of particular bowels or veſſels, the preſence of foreign bodies or of a virus in the part, loſs of ſubſtance, the attack of hoſpital gangrene, &c. See ULCER.

All large or deep wounds are attended with more or leſs ſymptomatic fever. It uſually comes on, as Dr. Thomſon obſerves, at a period varying from ſixteen to thirty-ſix hours after the infliction of the injury. Its occurrence is indicated by an increaſed warmth of the ſkin; by increaſe in the frequency, and generally alſo in the ſtrength of the action of the heart and arteries; by anxiety, thirſt, and by the ſuppreſſion of the powers of digeſtion. The ſymptomatic fever from wounds is generally of the inflammatory character; and it even ſometimes happens that a very high degree of ſymptomatic fever occurs in debilitated conſtitutions, and in perſons who have loſt a conſiderable quantity of blood. In theſe caſes, the frequency of the pulſe, however, is more remarkable than its ſtrength, and the fever which occurs ſeems to reſemble more an aſthenic fever than it does one that is truly inflammatory. It is of great conſequence to attend to the type of this fever in the treatment; for the loſs of blood, which may be required and ſuſtained with impunity in the one ſpecies of fever, may prove moſt injurious, if not fatal, in the other. Thomſon's Lectures, &c. p. 292.

We ſhall now proceed to offer a general deſcription of the ſeveral kinds of wounds, and the manner of treating them; and then notice the wounds of particular parts, and the ſurgical meaſures which ſeem beſt calculated to promote their cure. As, however, *wounds of the head*, comprehending its external coverings, and the cranium and brain, form the ſubjects of articles already publiſhed, theſe caſes will not fall under conſideration in the ſubſequent columns, the reader being referred for information concerning them to

Compression, Concussion, Extravasation, Head, *Injuries of*, and Trepanning.

Of Cuts or incifed Wounds.—Sharp-edged inftruments may produce a divifion of the parts upon which they act, altogether on the principle of direct preffure; in which cafe, they may be regarded as operating in the manner of a wedge. In other inftances, they both prefs and faw at the fame time, and then the folution of continuity is made with more facility, and carried to a greater depth, becaufe the fibres are elongated in the direction in which the inftrument faws, as well as in that in which it preffes.

In whatever way a cutting inftrument operates, feveral confequences refult from the divifion of the parts. 1ft, An effufion of blood from the divided veffels. 2dly, Pain, arifing from the divifion of nerves. 3dly, A gaping of the wound, or feparation of its edges from each other.

Anatomy teaches us, that almoft every part of the body is furnifhed with a confiderable number of blood-veffels, which indeed exift in fuch myriads, that it is impoffible to prick the fkin with the point of the moft minute needle, without opening one or more ramifications of veffels containing blood. But this effect always happens in a ftill greater and more remarkable degree, when the divifion, caufed by a fharp-edged inftrument, is at all extenfive.

If the wounded veffels are of fmall fize, the blood iffues from them only in moderate quantity; but when they are large, the hemorrhage is more copious, and it may be fo rapid as to prove almoft inftantly fatal. Many of the phenomena of hemorrhage have been already confidered in another place (fee Hemorrhage); and, on this account, we fhall not have occafion now to travel over the whole of that interefting topic again. There are, however, certain parts of the fubject which muft fall under confideration in the courfe of this article; and in mentioning them, we fhall take the opportunity of noticing a few ingenious fuggeftions, which have been made fince the period when the above-mentioned article was written, and which, when further inveftigated, may lead to very important improvements in the treatment of wounds.

It has been ftated, that hemorrhage is one of the circumftances which render wounds complicated; yet it is to be underftood, that when the bleeding is not fo confiderable as to hinder the union of the parts, and a further effufion of blood can be prevented by the very fame preffure which is neceffary to promote this union, the cafe is always regarded as a fimple wound. Such is that which is produced by the operation for the harelip, &c.

The fame experiment which demonftrates the prefence of blood-veffels in every fituation, namely, pricking any part of the body with a needle, proves alfo that filaments of the nerves are found every where, and at every point; for the flighteft prick of the fkin occafions pain, and pain cannot happen except where there are nerves. But wounds are obferved to be attended with a pain, which is more or lefs acute, according to the kind of cutting inftrument with which they are inflicted, the extent of the divifion, and efpecially according as the wounded perfon happens or not to be in expectation of the receipt of the injury. A patient, on whom an operation is to be performed, turns his whole attention to the effect which the ufe of the knife will produce upon his feelings, and he fuffers a great deal; but if an incifion be made when not expected, or a foldier be wounded in the heat of battle, the injury is fometimes not perceived till the bleeding attracts notice.

Immediately a part is divided with a cutting inftrument, the edges of the wound feparate more or lefs diftantly from each other, and the injury prefents a gaping appearance. This is an occurrence which is owing to feveral caufes, neceffary to be underftood by every furgeon who is defirous of knowing the beft mode of obviating it.

The firft caufe of the feparation of the lips of a wound from each other is, no doubt, the thicknefs of the inftrument with which the folution of continuity is made. A cutting inftrument, acting like a wedge, muft unavoidably feparate the parts between which it enters; but if this were the only caufe, the gaping of a wound would be very inconfiderable, fince the blades of moft cutting weapons are extremely thin. We find, however, that the oppofite furfaces of many wounds are drawn away from each other feveral inches, and the caufes to which the phenomenon is to be afcribed are the elafticity and contractile nature of the divided parts; fometimes one of thefe properties operating fingly, fometimes both of them together in the fame wound.

Elafticity is a quality which belongs to all animal fubftances, and it is inherent in them even after they have been deprived of life; but it does not prevail in an equal degree in every texture. Thus, the gaping of a wound depending upon this caufe varies very confiderably, according to the nature of the divided parts. The edges of an incifion made in the fkin become widely drawn afunder, becaufe the integuments are endued with great elafticity. The cellular membrane, when cut, gapes very little, becaufe it is lefs elaftic. The mufcles alfo are not remarkably elaftic; yet wounds of them, efpecially tranfverfe wounds, always have their oppofite fides feparated a vaft diftance from each other: but this is a circumftance which is owing not altogether to the elafticity of the parts, but partly to their contractile powers.

The feparation of the edges of a wound is not always in proportion to the elafticity of the wounded part; it is likewife proportioned to the tenfion of this part at the very moment of the injury. An exceedingly fimple experiment proves the truth of this obfervation: if the fkin which covers the knee be divided tranfverfely in the dead fubject, while the leg is bent upon the thigh, and another fimilar incifion be made in the other knee, while the leg is extended, the feparation which happens between the edges of the divifion will be found to be much greater in the firft than in the fecond example.

The contractile power, or irritability, which is a peculiar property of mufcular fibres, and by virtue of which they tend continually to fhorten themfelves, is the moft powerful caufe of the feparation which occurs between the oppofite fides of a tranfverfe wound of any mufcle. The feparation thus produced is the greater in proportion as the cut mufcular fibres are longer, inafmuch as the contraction of which the mufcles are capable, by reafon of their contractile power, is itfelf in a ratio to the length of the mufcular fibres. Thus, as Boyer obferves, if two mufcles be divided tranfverfely, the fibres of one of which are three times as long as thofe of the other, the feparation which takes place between the edges of the wound of the former will be three times as great as what follows, between the fides of the divifion made in the latter.

The force with which the feparation is produced by the contractile power of the mufcles, is not in proportion to the length of the mufcular fibres, but to their quantity. Each mufcular fibre being regarded as a feparate diftinct power, it is obvious, that the more thefe powers are multiplied, the greater muft be the effect refulting from their action.

It appears alfo, that in addition to the firft contraction of a divided mufcle, a fecondary and increafed contraction of the part may be excited, when it is expofed and irritated.

From

From what has been ftated, it feems then that in wounds of parts deftitute of contractile properties, as the fkin, cellular membrane, ligaments, fafciæ, &c. their elafticity is the only caufe of fuch wounds gaping, or of the feparation which happens between the oppofite furfaces of the injury; but that in mufcular wounds the feparation is the effect both of the contractile and elaftic powers of the part. Hence, as we have already obferved, the feparation is greater the more tenfe the mufcle is at the inftant when the wound is inflicted.

"The edges of every incifed wound (fays profeffor Thomfon) are more or lefs retracted, or drawn from each other, and this generally in proportion to the fize of the wound, and the nature of the parts upon which it is inflicted. The different foft textures of which the human body is compofed are more or lefs elaftic, and are in the healthy condition of the body kept in a certain degree of tenfion. When the fibres, therefore, of any of thefe textures are divided, they recede from each other; thofe of fkin farther than thofe of cellular membrane, and thofe of mufcle farther than thofe of fkin. The fibres of mufcle contract moft of all. The extremities of a divided artery recede confiderably from each other; the veins lefs than the arteries, and the nerves probably lefs than the veins. To oppofe this contraction of divided parts by fuitable means, is one of the main objects which the furgeon propofes to himfelf in the cure of wounds; for the retraction of the edges of wounds from each other always prevents re-union by the firft intention, and very often retards it for a long time by the fecond." See Thomfon's Lectures on Inflammation, p. 280; alfo Union *by the Firft Intention*.

The prognofis of wounds made with a cutting inftrument varies according to the extent and depth of the divifion, the nature of the injured parts, and the circumftances which attend the accident. Deep large wounds are more dangerous and more difficult to cure than thofe which only intereft the fkin. Wounds, accompanied with injury of confiderable veffels or nerves, are more or lefs dangerous, according to the magnitude or number of thofe veffels or nerves. Simple wounds, in which the only indication is to bring the divided parts together, fo that they may re-unite, are the moft favourable cafes of all. On the other hand, complicated wounds are more or lefs hazardous, according to the particular nature of the complication. In the prognofis of wounds alfo, we muft not forget to take into confideration the patient's age, his kind of conftitution, and the difeafes under which he may labour. Generally fpeaking, the moft dangerous examples of incifed wounds are thofe which are made about the throat by perfons who attempt to deftroy themfelves. Here there are fo many large blood-veffels, nerves, and other parts of great importance, that deep incifed wounds too often prove fatal, either immediately, or in the courfe of a few days. Sometimes the patient opens the carotid artery, and perifhes of hemorrhage on the fpot, before any affiftance can be rendered. In other inftances, he divides fome of the principal branches of the external carotid, and after lofing a great deal of blood he faints, and the hemorrhage fpontaneoufly ceafes for a time. The fainting indeed is often the very thing which faves his life, by checking the effufion of blood until a furgeon arrives, who ties the veffels as foon as they begin to bleed again. Cut wounds of the extremities, when fuch arteries as the femoral and brachial are injured, may alfo fuddenly deftroy the patient, by the great quantity of blood which is fometimes loft before the arrival of furgical affiftance.

A furgeon, called to a recent cut or incifed wound, has three objects which he fhould endeavour to accomplifh without the leaft delay.

The firft, and that which requires his immediate interference, is the bleeding, which muft be checked, or the patient may lofe his life in a few minutes.

The fecond is the removal of all extraneous matter, foreign bodies, &c. from the cavity of the wound.

The third is to bring the oppofite furfaces of the wound into even contact, and to adopt proper meafures for keeping them in this pofition, until they have grown together again.

1. *Hemorrhage.*—For an explanation of the means which nature employs in the fuppreffion of bleeding from divided arteries, as well as for an account of the beft chirurgical meafures for promoting this object, and a detail of numerous obfervations on the principles by which the conduct of the furgeon fhould be regulated in the ufe of the ligature, we beg to refer to the articles Hemorrhage and Ligature.

In the prefent place we fhall briefly notice how the furgeon ought to act in cafes of incifed wounds, accompanied with hemorrhage, without paffing over, however, a few things which have been fuggefted fince the above-mentioned articles were written.

It has been ftated, that in every wound the bleeding is the thing which demands the earlieft attention; becaufe if lofs of blood be not prevented without delay, the patient will frequently die in the courfe of a few feconds, or minutes. Every other confideration may be deferred; but when large veffels are injured, they muft be immediately fecured, or elfe the fudden death of the patient will leave the furgeon no opportunity of exhibiting his fkill and ufefulnefs in other matters connected with the treatment.

It is not, however, every bleeding which is thus ferious and alarming; for the flighteft and moft fuperficial cuts are always attended with fome effufion of blood. When the divided veffels are of inferior fize, the bleeding foon fpontaneoufly ceafes, and no furgical meafures need be taken on this particular account. When the wounded veffels are even fomewhat larger, and their fituation is favourable for compreffion with a bandage, it is often advifeable to clofe the wound, and apply a comprefs and roller, inftead of having recourfe to ligatures, which always produce irritation, fuppuration, and an obftacle to the union of that part of the wound in which they lie. Yet, let the furgeon, before he determines to truft to preffure, be well affured, that the bleeding can be thus perfectly and fafely commanded without the employment of ligatures; for by the failure of compreffion, hemorrhage has often been renewed from time to time, and many a life been loft. We therefore wifh it to be diftinctly underftood, that in almoft all cafes of confiderable bleeding, the patient will not be fafe unlefs the veffels be tied, and that the only exceptions are a few inftances in which the bleeding arteries can be effectually compreffed againft a fubjacent bone, and are not of very large fize. In all other examples, tying the bleeding veffels is the only fafe mode of proceeding. When the artery is of large diameter, and its mouth can be readily feen, the moft proper inftrument for taking hold of it is a pair of arterial forceps. With this inftrument, the end of the veffel is to be drawn out a little way from the furrounding flefh, in order that a ligature may be put round it without the inclufion of any other parts, which would be unneceffary, painful, and on feveral accounts difadvantageous. In applying the ligature, the furgeon muft take care to pull its two ends in fuch a manner that the noofe will not rife above the mouth of the veffel; and, for the purpofe of altering the direction of the force employed in drawing the ligature, the ends of the thumbs are found moft convenient. When the bleeding arteries are not very large and diftinct, they are generally taken up with a tenaculum; and of late years a double tenaculum, the points of which fhut together, like the blades of a pair of forceps, has been occafionally ufed, and we have heard fome well-informed furgeons fpeak highly of the invention, which we believe was originally made by profeffor Afalini, an ingenious furgeon at Milan, in Italy.

The ligatures having been applied, one end of each is to be cut off clofe to the knot, in order to diminifh the quantity of extraneous matter in the wound.

When a large artery, like the brachial or femoral, is opened, but not cut through, it often happens that the furgeon cannot get at it without making a dilatation of the wound, and bringing the wounded part of the veffel more fairly into view. In cafes of this defcription, the firft duty of the practitioner is to comprefs the artery above the wound, and apply a tourniquet. Thus he will put an immediate ftop to the bleeding; but if he omit this effential ftep, the veffel will continue to bleed fo profufely and rapidly, that in the inevitable obfcurity and confufion thence refulting, the patient may actually lofe his life before the veffel is fecured. When, however, a tourniquet has been applied, the furgeon can examine the wound, and fearch for the artery with much greater fuccefs, as now the ftate of things is no longer concealed under a continual ftream of blood.

As foon as the wounded portion of the artery is difcovered, it ought not to be extenfively diffected and feparated from its furrounding connections in order to let the furgeon pafs his finger under it. This mode of proceeding is now acknowledged by fome of the beft furgeons to be unneceffary and injurious; and it will be quite fufficient to feparate the artery fufficiently to pafs an eye-probe or aneurifmal needle under it, with which a double ligature is to be drawn beneath it. The probe or needle having been cut off, one ligature is then to be tied above the aperture in the artery, and the other below it. Were only a fingle ligature applied above the wound in the artery, the bleeding would ftill be kept up, becaufe the blood paffes into the lower continuation of the veffel through numerous large anaftomofes, in a quantity that is truly furprifing.

The principles which fhould guide the furgeon in the ufe of the ligature, were not known until the late Dr. Jones publifhed his valuable treatife on hemorrhage. As an able furgeon has obferved, "he has banifhed the ufe of thick and broad threads, of tapes, of referve ligatures, of cylinders of cork and wood, linen compreffes, and all the contrivances, which, employed as a fecurity againft bleeding, only ferved to multiply the chances of its occurrence." Lawrence in Medico-Chir. Tranf. vol. vi. p. 162.

In the article SURGERY, we have noticed the method of cutting off both ends of the ligature clofe to the knot on the face of the ftump, with a view of leffening the quantity of extraneous matter in the wound, and promoting a complete union of the divided parts, without any fuppuration. The period of the firft invention of this method appears uncertain. Mr. Hennen, who feems to have been the firft who adopted the method in the army, had it fuggefted to him in 1813 by a Mr. Hume, as the practice of fome American naval furgeon; and he has fince found that it had been done in Scotland 16 years before the above year. Dr. Ferguffon alfo faw the practice adopted in Sweden as early as the peace of Amiens. Mr. Hennen mentions 34 amputations, in which this treatment was followed by fuccefs. His accounts are highly in favour of the method. See Hennen's Military Surgery, p. 189, &c.

This plan has been tried by Mr. Lawrence: "The method I have adopted (fays this gentleman) confifts in tying the veffels *with fine filk ligatures*, and cutting off the ends as clofe to the knot as is confiftent with its fecurity. Thus the foreign matter is reduced to the infignificant quantity, which forms the noofe actually furrounding the veffel, and the knot by which that noofe is faftened. Of the filk which I commonly employ, a portion fufficient to tie a large artery, when the ends are cut off, weighs between $\frac{1}{50}$th and $\frac{1}{80}$th of a grain: a fimilar portion of the thickeft kind I have tried weighs $\frac{1}{30}$th of a grain, and of the flendereft $\frac{1}{120}$th."

Mr. Lawrence ftates, that the kind of filk twift which is commonly known in the fhops by the name of dentift's filk, and which is ufed in making fifhing-lines, is the ftrongeft material, in proportion to its fize, and therefore the beft calculated for our purpofe, which requires confiderable force in drawing the thread tight enough to divide the fibrous and internal coats of the arteries. This twift is rendered very hard and ftiff by means of gum, which may be removed by boiling it in foap and water; but the twift then lofes a part of its ftrength. The ftouteft twift which Mr. Lawrence has ufed, is a very fmall thread compared with ligatures made of inkle. The quantity of fuch a thread neceffary for the noofe and knot on the iliac artery weighs $\frac{1}{70}$th of a grain; or, if the gum has been removed, about $\frac{1}{76}$th. But the fineft twift kept in the filk fhops is ftrong enough in its hard ftate for any furgical purpofe; and the noofe and knot, according to Mr. Lawrence's ftatement, would not weigh $\frac{1}{30}$th of a grain.

It farther appears from the report of this gentleman on the fubject, that there is no danger of thefe ligatures cutting completely through the veffel, as fome furgeons have apprehended; and that although he has not yet afcertained what becomes of the pieces of ligature after the wound is united, he has never feen abfcefs nor any other bad fymptom occafioned by them. At the time when Mr. Lawrence wrote, he had employed this method of fecuring the arteries in ten or eleven amputations, in fix operations on the breaft, and in the removal of two tefticles. The cafes all did well, excepting a man who loft his thigh, and who died of an affection of the lungs. See Lawrence on a New Method of tying the Arteries in Aneurifm, Amputation, &c. in Medico-Chir. Tranf. vol. vi. p. 156, &c.

It merits notice, however, that the propofal of cutting off the ends of the ligatures clofe to the artery has not received the univerfal approbation of furgeons; and, in particular, Mr. Guthrie, of London, and Mr. Crofs, of Norwich, have urged objections againft the practice. The former gentleman, at the fame time, does not entirely condemn the method, but merely argues that it is liable to inconveniences, when adopted in wounds which are to be healed by the firft intention. See Obf. on Gun-fhot Wounds of the Extremities, p. 93.

Profeffor Scarpa alfo, whofe experiments lead him to prefer large ligatures and intervening fubftances between them and the veffel, muft be numbered amongft thofe who difapprove of the new plan. Like all his writings, the memoir which he has recently publifhed refpecting the ligature of arteries is highly interefting, and drawn up with the greateft candour.

Mr. Crofs, of Norwich, is more decidedly adverfe to this new practice; and he founds his objections chiefly upon fome

fome experiments which were made upon animals, and which, he conceives, juftify the following conclufions:

Firft, If the wounds do not unite by the firft intention, the ligatures may efcape with the difcharge, without any inconvenience.

Secondly, If common ligatures of twine are cut fhort, the wound may unite over them, and they may be found in abfceffes after an interval of many weeks.

Thirdly, If the fineft dentift's filk be employed in the fame way, the wound uniting over it, the ligature may be detached from the veffel, and remain buried in an abfcefs, where it will be found at different periods, from one to feven months; and this may happen whether the veffel be firmly compreffed with a fingle ligature, or divided between two ligatures, fo as to imitate the circumftances under which veffels are tied after operations.

Fourthly, If Indian filk, fine as hair, be put round a veffel, fo as to diminifh its diameter, or to effect its obliteration, by juft compreffing its fides together, it may remain in this fituation without exciting abfcefs, or producing any inconvenience. The ligature may be thus applied to comprefs an artery for the cure of aneurifm; but not to fecure veffels divided in operations. If a thin ligature be drawn fufficiently tight upon a veffel on the face of a ftump to be fecure, Mr. Crofs is perfuaded, that the extremity of the veffel, which becomes infulated as it were, muft die. (See London Med. Repofitory, vol. vii. p. 363.) In one cafe of amputation alfo, in which the practice was tried, the ftump was long in healing, and feveral fmall abfceffes repeatedly formed.

On the other hand, we muft take into confideration, that M. Delpech, of Montpellier, has practifed it to a confiderable extent for feveral years paft, without any inconvenience. M. Roux has alfo tried the plan in three operations on the breaft; the cafes did well, and no ill confequences arofe from the prefence of the bits of thread under the cicatrix. See Relation d'un Voyage fait à Londres en 1814, ou Parallele de la Chirurgie Angloife avec la Chirurgie Françoife; Paris, 1815, p. 134—136.

Mr. Hennen, in anfwer to Mr. Guthrie, alfo obferves, that in the cafes where it was tried at Bilboa, "neither pain, heat, nor tumour, febrile exacerbation, nor formation of pus, could be fairly traced to the fhort cut ligatures, which would not in all human probability as readily have fucceeded to the ligatures ufually employed; while, on the contrary, the progrefs of healing has been fenfibly more rapid where they have been ufed." Obf. on Military Surgery, p. 193.

Since Mr. Lawrence communicated to the Medical and Chirurgical Society of London the defcription of a "New Method of tying the Arteries in Aneurifm, Amputation, and other Surgical Operations," he has conftantly employed the method therein propofed, both in St. Bartholomew's hofpital and in private practice; and, as he informs us, he has now tried it in many operations of almoft every defcription. "The general refult of my experience is (fays he), that this plan, by diminifhing irritation and inflammation, and fimplifying the procefs of dreffing, very materially promotes the comfort of the patient, and the convenience of the furgeon, *while it has not produced ill confequences or any unpleafant effect in the cafes which have come under my own obfervation.*

"I have found in my own practice, what has been confirmed by others, who have communicated to me the refult of their experience, that the fmall knots of filk generally feparate early, and come away with the difcharge; that where the integuments have united by the firft intention, the ligatures often come out rather later, with very trifling fuppuration, and no painful inflammation; and that, in fome inftances, they remain quietly in the part.

"In two or three inftances, I have been told that the ligatures feemed to have caufed irritation and pain. Thefe were amputations; and we are accuftomed to fee effects, quite as confiderable as were alluded to here, produced by the ftate of the bone and other caufes, where the ordinary method of fecuring the arteries is practifed; fo that I could not, on clofe inquiry, find any reafon to afcribe what was complained of to the ufe of the filk ligatures, and the practice of cutting off their ends clofe to the knots." Medico-Chir. Tranf. vol. viii. p. 490.

Mr. Lawrence contends, that under fome circumftances the method will be attended with peculiar advantages, as in crowded military hofpitals, where the deftructive hofpital gangrene either exifts, or may make its appearance. Every meafure tending to accelerate the union of wounds, whether after operations or under other circumftances, is of great importance in averting the probability of this calamitous occurrence.

This mode of cutting off both ends of the ligature clofe to the knot has now been fuccefsfully applied to operations for aneurifm. Mr. Lawrence has himfelf found it anfwer his expectations; and we learn, that Mr. Carwardine, of Thaxted, tied the femoral artery with a fmall filk ligature, in a cafe of popliteal aneurifm, and cut off the ends clofe to the knot. The wound united entirely by the firft intention, not a particle of pus having been formed at any time; and it continued perfectly found at the diftance of fome months from the operation. Op. cit. p. 492.

If this practice prove generally beneficial in operations for aneurifm, there can be no doubt it will alfo be advantageous in other cafes, in which the furgeon is called upon to cut down to and take up punctured or partially divided arteries in accidental wounds.

Although doubts are yet entertained by fome practitioners, whether this new method of applying ligatures is entitled to praife and imitation, all furgeons are unanimous about the propriety of leffening as much as poffible the quantity of extraneous bodies in wounds: hence, even they who difapprove of cutting off both ends of the ligature clofe to the knot, fanction and adopt the practice of cutting off one-half of each ligature clofe to the veffel, as the other portion will fuffice for the removal of the knot and noofe as foon as they are detached from the tied artery. When the wound is brought together, the ligatures are to lie in the neareft interfpaces left between the plafters.

2. *Of the Removal of Clots of Blood, extraneous Subftances, foreign Bodies, &c. from the Wound.*—This forms the fecond indication to which the attention of the furgeon is particularly required, when he is firft called to an incifed wound. It is, indeed, an object of very material importance, becaufe if it be not attended to, the wound may be brought together as nicely, as accurately, and as fkilfully as poffible, and every thing look well in the beginning; yet that defirable event, union by the firft intention, will not follow, but inftead of it a fevere degree of pain, confiderable fwelling of the circumference of the injury, extenfive rednefs, and fuppuration and abfceffes. All thefe fevere and untoward confequences arife from the irritation produced by the prefence of foreign bodies in wounds; and as an incifed wound can generally be examined with the utmoft facility, and made properly clean, without putting the patient to much pain, the neglect on the part of the furgeon becomes the more blameable. In other deep, narrow, lacerated wounds, and in many gun-fhot injuries, it is often difficult at firft to afcertain

tain whether there are extraneous ſubſtances in the fleſh or not; but in open inciſed wounds no ſuch difficulty and obſcurity prevail, and the practitioner who cloſes them, without having aſſured himſelf that they are perfectly free from all extraneous matter, betrays either the moſt ſupine negligence, or an utter ignorance of his profeſſional duty. It is true an inciſed wound made with a clean, ſharp inſtrument, which has not broken, can obviouſly have no foreign bodies in it. But very conſiderable and dangerous cuts are often produced by glaſs, china, &c. which are apt to break at the moment, and leave ſome of their fragments in the part. Sometimes alſo the weapon with which the wound is made is unclean, and occaſionally dirt, gravel, &c. get into the wound, in conſequence of the patient falling upon the ground at the time when he receives the injury. We ſhall merely repeat, that as extraneous bodies operate as an irritation to all kinds of wounds, the ſurgeon ought to take care to remove them immediately the bleeding veſſels have been ſecured.

Mr. John Hunter believed, that blood retaining the living principle was rather an uſeful ſubſtance in the union of wounds than otherwiſe; and he only conſidered blood, which had been deprived of this principle by long expoſure, the effect of ſtyptics, &c. as hurtful, when left on the ſurface of the wound. Yet this is a doctrine which is by no means ſanctioned by the approbation of the beſt modern practitioners, all of whom are decidedly of opinion, that leaving any blood upon the ſurface of a recent wound, when the oppoſite ſurfaces of ſuch wound are to be brought into contact, is diſadvantageous, retarding the cure, and rendering union by the firſt intention leſs certain. The preſence of blood in the cavity of the wound, indeed, muſt have the effect of producing a greater or leſſer ſeparation of thoſe ſurfaces, which ought ſtrictly to touch each other; and we decidedly believe, that the practiceof freeing wounds as much as poſſible from clots of blood may be ſucceſsfully defended both upon theoretical and practical principles.

3. *Union of the Wound, Dreſſings, &c.*—We have ſaid, that when the ſurgeon has ſtopped the bleeding, removed extraneous ſubſtances, and properly cleaned the wound, the next indication is to bring the oppoſite ſides of the injury into contact with each other, and keep them quietly and ſteadily in this poſition until they have grown together again. Wounds are healed by two proceſſes; *viz.* by one, in which pus is produced, and granulations and new ſkin are formed; and by another, in which, if it perfectly and univerſally ſucceed, no ſuppuration whatſoever takes place. The latter, when it can be practiſed, is always the moſt deſirable, becauſe it is not only the quickeſt means of cure, but alſo the moſt perfect; the part being covered by the old original ſkin, which is always ſtronger and leſs diſpoſed to ulceration than what is new formed. Surgeons have termed this way of healing wounds *Union by the Firſt Intention*, (ſee theſe laſt words,) or *Adheſion;* and Mr. Hunter named the proceſs by which it, together with many other analogous effects, was accompliſhed in the animal body, the *Adheſive Inflammation.* See Inflammation.

The great recommendations of union by the firſt intention are, celerity of cure, the diminution of the pain and inflammation ariſing from the expoſure of raw ſurfaces, freedom from the inconveniences of ſuppuration, the prevention of the deformity, which would otherwiſe reſult from a large cicatrix, and the greater permanency and ſoundneſs of the cure, for the reaſons above ſtated.

The ſtrong tendency which divided parts of the animal body have to grow together, when kept a certain time in contact with each other, is an important fact, of which the moderns have taken much more advantage than the ancients. There are even caſes and experiments on record in ſupport of the opinion, that it is not entirely impoſſible for parts entirely detached from the reſt of the body to become united again, if quickly replaced. In the article Union *by the Firſt Intention*, we have noticed the intereſting experiments made by Duhamel and Mr. Hunter. The reſearches of the latter celebrated philoſopher brought to light ſeveral very curious and inſtructive facts. He proved that the teſticles of a cock, when removed and introduced into the abdomen of a hen, contracted a vaſcular connection with the ſurface of the viſcera, and lived. He aſcertained, that a ſound tooth might be tranſplanted from its ſocket, and acquire an union to the alveolary proceſs of another perſon. He alſo cut off the ſpurs of a young cock, and found that they might be made to unite to its comb, or that of another cock, and grow in ſuch ſituation. The poſſibility of this ſpecies of union ſhews how ſtrong the diſpoſition of the freſh ſurfaces of an inciſed wound muſt be to grow together; particularly when it is conſidered, that in the foregoing and in ſome of the following inſtances, there can be on one ſide no aſſiſtance given to the union, as the part entirely ſeparated from the reſt of the body is hardly able to do more than preſerve its own living principle, and (as Mr. Hunter expreſſes himſelf) accept of union.

The following obſervations on this ſubject are taken from profeſſor J. Thomſon's excellent book on inflammation: "Beſides thoſe examples that are ſeen in the tranſplantation of the teeth, it muſt be confeſſed, that inſtances of re-union among parts which had been entirely ſeparated are very rare in the human body; ſo rare, indeed, that moſt practitioners ſtill treat with diſbelief and ridicule the few inſtances which have been put upon record. But the different facts which have been learned reſpecting the tranſplantation of the teeth, together with the experiments of Duhamel and Mr. Hunter, prove indiſputably the poſſibility of parts being re-united which have been completely ſeparated from the animal ſyſtem to which they belonged, and in which the circulation of the blood muſt neceſſarily have ceaſed for a time. There is nothing therefore in the nature of the fact recorded, that can juſtify us, I conceive, (ſays Dr. Thomſon,) in doubting the veracity of thoſe, by whom ſimilar inſtances of re-union between other parts of the body have been related.

"That practitioners have generally failed in effecting this re-union, is frankly acknowledged by thoſe who have related caſes ſo very extraordinary. I ſhall mention to you (continues this author) a few of thoſe rare caſes, and leave it to your own judgment to deduce from them the concluſions, which the characters of the authors by whom they are related, and the nature of the facts themſelves which they relate, may ſeem to you to warrant.

"The firſt example of this kind which I find diſtinctly recorded is by Phiorovant, in the 54th page of his ſecond book of the Secrets of Surgery: 'In that time, when I was in Africa, there happened a ſtrange affair: a certain gentleman, a Spaniard, that was called Il Signior Andreas Gutiero, of the age of twenty-nine years, upon a time walked in the field, and fell at words with a ſoldier, and began to draw. The ſoldier ſeeing that, ſtruck him with the left-hand, and cut off his noſe, and there it fell down in the ſand. I then happened to ſtand by, and took it up, and piſſed thereon to waſh away the ſand, and dreſſed it with our balſamo artificiato, and bound it up, and ſo left it to remain eight or ten days, thinking that it would have come to matter; nevertheleſs when I did unbind it, I found it faſt conglutinated, and then I dreſſed it only once more, and he was perfectly whole, ſo that all Naples did wonder thereat, as is well

known;

known; for the ſaid Signior Andreas doth live, and can teſtify the ſame.'

"Blegny, in his Zodiacus Medico-Gallicus, for the month of March, 1680, mentions a caſe, in which a noſe that had been cut off with a ſabre was replaced by a military ſurgeon of the name of Winſault, and in which a perfect re-union was obtained, he affirms, by the uſe of ſtitches, and of agglutinating plaſters.

"A third caſe of the ſame kind is related by Garengeot, at the 55th page of the third volume of his Operations of Surgery. 'In the month of September, 1724, a ſoldier of the regiment of Conti, coming out of L'Epée Royale from an inn, at the corner of the ſtreet Deux-Ecus, was attacked by one of his comrades, and in the ſtruggle had his noſe bitten off, ſo as to remove almoſt all the cartilaginous part. His adverſary perceiving that he had a bit of fleſh in his mouth, ſpat it into the gutter, and endeavoured to cruſh it by trampling upon it. The ſoldier, who on his part was not leſs ſpirited, took up the end of his noſe, and threw it into the ſhop of M. Galin, a brother-practitioner of mine, till he ſhould run after his adverſary. During this time, M. Galin examined the noſe that had been thrown into his ſhop, and as it was covered with dirt, he waſhed it at the well. The ſoldier returning to be dreſſed, M. Galin waſhed his wound and face, which was covered with blood, with a little warm wine, and then put the extremity of the noſe into this liquor to heat it a little. Having in this manner cleanſed the wound, M. Galin now put the noſe into its natural ſituation, and retained it there by means of an agglutinating plaſter and bandage. Next day the re-union appeared to be taking place; and on the fourth day, I myſelf dreſſed him with M. Galin, and ſaw that the extremity of the noſe was perfectly re-united and cicatrized.'

"Theſe (ſays profeſſor Thomſon) are the only caſes which I have been able to find diſtinctly ſtated of the re-union of a noſe which had been completely cut off. This event, from analogy, we have reaſon to believe is poſſible, and nothing ſhort of a contrary teſtimony in the inſtances I have related could juſtify us, I conceive, in denying the truth of the fact."

Dr. Thomſon then details a caſe, extracted from vol. xxxiii. of the Journal de Médécine, where the point of a finger which had been cut off was re-united by M. Boſſu, ſurgeon at Arras. Dr. Thomſon alſo mentions, that he has been informed by different perſons entitled to credit of a conſiderable number of caſes ſimilar to the preceding, in which the points of fingers and toes completely ſeparated were afterwards re-united.

Although it muſt be acknowledged that the foregoing caſes of the union of parts completely ſevered from the body are uncommon, the ſame obſervation does not apply to inſtances in which the detached part ſtill retains a partial and ſlight connection with the reſt of the body, by means perhaps of only a few fibres or little bit of ſkin. "Many caſes," ſays Dr. Thomſon, "are upon record, and many more have been obſerved, in which parts have re-united, which were divided all to a very ſmall portion of cutis,—a portion ſo ſmall that it is not eaſy to conceive that any effectual circulation could be carried on through it; and in theſe caſes it deſerves to be remarked, that it was generally the noſe, or the extremities of the fingers and toes, which re-united, after having been ſeparated and replaced. I have ſeen two examples of the re-union of the noſe, where it was almoſt entirely ſeparated. In one of them it adhered only by the ſkin of one of the alæ, and in the other chiefly by the ſeptum. Arcæus mentions a caſe in which the noſe, with moſt of the upper jaw, was ſo ſeparated as to hang down upon the chin, and yet a re-union was effected. A caſe is mentioned by Lombard, in which the noſe, nearly cut off and unreplaced for ſome hours in winter, was made to re-adhere by ſtitching and proper dreſſings. Another caſe of the ſame kind occurred to Loubet." (Lectures on Inflammation, p. 243.) In the Dictionary of Practical Surgery, an inſtance is mentioned, in which an ear that had been completely ſeparated from the head, with the exception of a ſmall bit of ſkin, was united again with the aid of a ſuture; and Dr. Thomſon has himſelf ſeen portions of the little toe and little finger, after being nearly cut off, ſucceſsfully re-united.

The knowledge of all theſe facts cannot but prove uſeful in the practice of ſurgery, inaſmuch as it teaches the practitioner to attempt the union of parts, under circumſtances which would otherwiſe appear entirely hopeleſs and diſcouraging.

In promoting union by the firſt intention, ſurgery is merely to officiate as the handmaid of nature. There are only two indications to be fulfilled: the firſt is to bring the edges of the wound into reciprocal contact, and keep them ſo; the other is to avert the acceſs of immoderate inflammation, by which the agglutination of the wound would certainly be prevented. The firſt object is accompliſhed by a proper poſition of the wounded part, by bandages, by adheſive plaſter, and by ſutures. The ſecond is fulfilled by a ſtrict obſervance of the antiphlogiſtic regimen, and particularly by avoiding every kind of motion and diſturbance of the wound. The reſt is the work of nature.

The poſition of the part is to be regulated on the principle of relaxing the wounded integuments and muſcles. If the extenſor muſcles are injured, the joints which they move ought to be placed in an extended poſture; if the flexor muſcles are wounded, the limb is to be bent. When the integuments alone are cut, the ſame poſture which relaxes the muſcles ſituated immediately beneath the wound alſo ſerves in general to relax the ſkin. In tranſverſe wounds of muſcular fibres, it is aſtoniſhing what immenſe effect the obſervance of a proper poſture produces. This is never to be neglected, whatever may be the other means adopted.

Bandages may frequently be made to contribute very eſſentially to keeping the ſides of wounds duly in contact with each other. This is ſtrikingly illuſtrated in caſes of harelip, where we ſee that the oppoſite edges of the fiſſure may be brought forward ſo as to touch, and be maintained in this poſition by the ſimple uſe of compreſſes and a bandage. Such was the mode of treatment preferred by M. Louis after the operation for the harelip, and were it not for the greater convenience and certainty of the twiſted ſuture, it is the plan to which ſurgeons would yet have recourſe. (See HARELIP.) The *uniting*, or, as it was formerly named, the *incarnative bandage*, is one which operates in keeping the oppoſite ſurfaces of wounds accurately applied to each other, ſo that the opportunity may be afforded for them to unite and grow together again. The common uniting bandage can only be uſed in wounds which take a direction correſponding to the length of the body or limbs, and which are ſituated where a bandage can be employed with convenience and effect. It conſiſts of a double-headed roller, having a ſlit between the two heads. The ſlit muſt be ſufficiently large to allow one head of the roller to paſs through it with facility. The wound having had the requiſite dreſſings put on it, the ſurgeon is to take one head of the roller in each hand, and apply the bandage to that part of the limb which is oppoſite the wound. One head of the roller is then to be brought round, ſo as to bring the ſlit over the breach of continuity. The other head is then to be brought round in the oppofite direction, and paffed through the flit. The bandage is now to be drawn moderately tight, and its two heads being carried round the limb again, the fame artifice is to be repeated. A fufficient number of turns of the roller muft be made to cover the whole length of the limb.

When the wound is deep, it is recommended to place fmall longitudinal compreffes beneath the roller, at a little diftance from the edges of the wound.

As the uniting bandage can only be made ufe of for longitudinal wounds, which never have a confiderable tendency to gape, nothing can be more abfurd than the application of it with immoderate tightnefs. By fuch cruel and injudicious practice, many a limb and life have been loft; for, if the bandage be very tight on its firft application, what a dangerous conftriction of the limb or part muft follow, when the fwelling, neceffarily arifing from the wound, has had time to come on. It is thus that infufferable pain, gangrene, and fphacelus, have frequently been brought on, when, if the part had been fimply dreffed and left uneonfined, every thing would have gone on moft favourably. It is right to ftate, however, that modern furgeons are not partial to the uniting bandage, and we freely declare our conviction, that it is a means which may very well be difpenfed with in practice.

If it has any advantages, they confift in its having more power than the adhefive plafter alone to maintain the oppofite fides of deep wounds in contact, and in its acting without the irritation frequently arifing from the application of refinous fubftances to the fkin. It is not, however, exempt from ferious inconveniences. Its total concealment of the wound, its lying in irregular folds, fo as to create an uneven cicatrix, and the preffure and conftriction attending its ufe, &c. might be mentioned. (See Firft Lines of Surgery, p. 68. edit. 3.) So little is the uniting bandage now employed, that although we have feen fome thoufands of wounds, we have not noticed its ufe in a fingle inftance during the laft twelve or fifteen years. When preffure can be made to affift the other dreffings, furgeons almoft always refort to compreffes and a fimple roller. In a few particular cafes, in which the limb would be too much difturbed by the application and removal of a common roller, the eighteen-tailed bandage is to be preferred. See BANDAGE, and FRACTURE *of the Thigh*.

Adhefive plafter may be faid to be the moft common means employed in the practice of furgery for bringing the edges of wounds together. When ufed for this purpofe, it was fometimes technically called by the old furgeons the *dry future*, in oppofition to futures ftrictly fo named, which are ufually made with a needle, and are invariably attended with a degree of bleeding. It was at one time fuppofed, that adhefive plafter could be of no material ufe, except in fuperficial wounds of the fkin. It is true, that adhefive plafter has no direct effect in bringing together the fides of a deep mufcular wound; yet we ought to recollect, that by drawing the integuments over the deeper part of the injury, it at once prevents the continuance of the expofed ftate of the cut furfaces, under which fuppuration would unavoidably follow. Nor does the ufe of adhefive plafter hinder recourfe to other meafures more calculated to bring the oppofite furfaces of the deeper part of the wound into contact, fuch as the obfervance of a proper pofition, and the ufe of compreffes and a bandage. It is alfo an error to fuppofe that adhefive plafter cannot be ufed in fituations where hair grows, or where it will foon become wet. If the part be well fhaved, and perfectly dried at firft, the application will not become loofe fo foon as to prove ineffectual. In fuch inftances, the plafter fhould be very frefh, and its quality may be made rather more adhefive than in ordinary cafes.

Adhefive plafter is generally applied in ftrips, between every two of which an interfpace is recommended to be left, for the purpofe of allowing any difcharge to efcape. To bring the edges of the wound effectually together, and at the fame time to leave a little room for the exit of the difcharge, are the objects to which we ought particularly to attend in the employment of adhefive plafter: hence, when the ftrips are broad, it is not unfrequent to cut out an oval piece of each ftrip juft where it croffes the line of the wound. Equal parts of the emplaftrum plumbi, and of the emplaftrum refinæ, form the compofition generally ufed in this country for adhefive plafter. They are melted over a flow fire and well mixed together, after which they are fpread upon linen with a warm fpatula.

Sutures, or *Stitches*, are of feveral kinds, but the only one which is now ufually employed in the cure of wounds is the *interrupted future*. The *quilled future* is rarely ufed at prefent, though it was formerly much in favour, and is not yet paffed over by fyftematic writers. As a defcription of thefe futures has been given in a feparate article (fee SUTURE), we fhall not repeat the particulars of the manner of making them. The *twifted future* is not unfrequently preferred for holding together the edges of cuts in the face, where the parts are liable to be in almoft conftant motion, and where the avoidance of the disfigurement of a large fcar is peculiarly defirable. This is the future which is always employed in the cure of the *Harelip*, in which article a defcription of it will be found. Thefe, and a future called *gaftroraphe*, which will be noticed in fpeaking of *wounds of the abdomen*, are all the kinds of futures which are ever employed by modern practitioners. The *glover's future*, or *continued ftitch*, is now nearly rejected from practice, and confined to the fewing up of dead bodies; a purpofe for which it is better adapted than for the union of any wound in a living fubject.

On the fubject of the propriety and advantage of ufing futures, as a means of keeping the fides of wounds in contact, much diverfity of fentiment has prevailed. Some furgeons, efpecially M. Pibrac and M. Louis, have urgently recommended their entire difcontinuance; and their obfervations are accompanied by facts which muft have confiderable weight. Their opinions and arguments, we acknowledge, have conftantly influenced us in practice; and if we do not join in the fentiment, that futures ought to be entirely abandoned, we at leaft believe that they are ftill a great deal too much ufed. M. Pibrac and M. Louis, however, are entitled to great praife for having leffened the employment of needles in furgery; and though there are few inftances in which the utility of futures appears to be confirmed by experience, there are many others in which the practice is altogether unneceffary and injudicious. "The practice of ftitching," fays Dr. Thomfon, "is undoubtedly much lefs followed at prefent than in any former period of the furgical art; and unlefs in fuperficial wounds, where we wifh to heal by the firft intention, or in wounds where (as in thofe of the abdomen) it is neceffary that the edges fhould not be allowed to feparate from each other, the ufe of ftitches may be, in moft inftances, advantageoufly fuperfeded by adhefive plafters and proper bandaging. It is by limiting the ufe of futures, not by profcribing them altogether, that the furgeon is likely to derive advantage from the employment of means fo powerful." (See Lectures on Inflammation, p. 287.) There are certainly hardly any two furgeons who think exactly alike about the cafes in which futures

futures are truly beneficial or not. Thus we do not admit that they ought to be ufed as frequently as the remarks of the above diftinguifhed profeffor would warrant; and the majority of fuperficial wounds, in which union by the firft intention is indicated, certainly, fo far from being benefited by futures, would be injured. Further obfervations, however, on this fubject will be found in the article SUTURE.

When futures are judged neceffary, their operation is always affifted by the application of fuitable compreffes and a bandage, the good effects to be derived from pofition of the part being alfo not neglected. The ftitches ought in general to be removed between the third and feventh day; for if they are allowed to remain longer, or even in fome cafes fo long, they excite inflammation, and fometimes ulceration.

Such then are the means which furgeons adopt for keeping the oppofite furfaces of wounds in contact, until an union has taken place. When the parts grow together again without any fuppuration, the mode of cure, as we have already explained, is well known to furgeons by the term *union by the firft intention.* Of the nature of this procefs, and of the way in which a connection is eftablifhed again between the parts which have been divided, we have endeavoured to give fome account in a preceding volume; we fhall not, therefore, expatiate on the fubject. See UNION *by the Firft Intention.*

The firft plafters and dreffings applied with a view of bringing about this defirable method of cure, fhould be allowed to continue at leaft three or four days, unlefs any untoward fymptoms, fuch as exceffive pain, the renewal of hemorrhage, &c. indicate the contrary. The feverity of the pain is fometimes owing to the future, fometimes to the immoderate tightnefs of the roller, and occafionally to there being extraneous fubftances yet lodged in the wound.

When too much inflammation is apprehended, the bandage fhould never be tight; and wetting it with cold water may be of ufe by keeping the parts cool. Perfect quietude, and the ufual antiphlogiftic remedies, are alfo not to be omitted. The old plan of covering the dreffings with thick woollen rollers, caps, and large maffes of tow, has now gone very much out of fafhion, as being inconfiftent with thofe principles which are recognized by every fcientific furgeon as beft calculated to avert and leffen inflammation.

When the firft dreffings are removed, the furgeon often finds union by the firft intention only accomplifhed at certain parts of the injury; and the connection, even there, ftill requires further fupport. However, when the wound is dreffed again, it is generally unneceffary to apply as many ftrips of adhefive plafter as were employed in the firft inftance. Their number may be gradually leffened at each future dreffing. The futures, if there be any, fhould alfo be now withdrawn, as they will do no more good, and their continued prefence may excite irritation and do harm. Suffice it to add, that throughout the fubfequent treatment the reft of the dreffings fhould be light, fimple, and unirritating.

Of the Cure of Wounds by Granulations, &c.—We remarked, that wounds are healed by two proceffes, one of which was not attended with the formation of pus, was the quickeft and moft perfect in its effects, and was called *union by the firft intention*, or *adhefion.* The other procefs now requires defcription. "When, in the treatment of a wound," fays profeffor Thomfon, "the re-union by adhefion, or by the firft intention, has either not been attempted at all, or, if attempted, has failed, nature brings about a cure by that flower and more complicated operation, which we now denominate the *procefs of granulation;* a procefs termed (as we have already remarked) by Galen *re-union by the fecond intention.* By many of the older furgeons, this mode of healing wounds is defcribed by the appellation of *fyfarcofis*, or *concarnation*, terms perhaps lefs liable to objection than that of granulation, which, in ftrict propriety, is a term expreffive of only one of the ftages of this mode of re-union, and which, of courfe, in order to avoid all ambiguity in the language we employ, ought not to have been ufed as a general term for the whole. In re-union by the fecond intention, the edges of the wound fwell and inflame more than in the procefs by adhefion; but, as in that procefs, fo in this, a layer of coagulable or organizable lymph is thrown out upon the divided furfaces. This layer is foon penetrated by blood-veffels, and, like the intermedium in adhefions, (fee UNION *by the Firft Intention,*) becomes an organized and living fubftance. So far thefe modes of re-union are fimilar; but in a fhort time after this layer of coagulable lymph has been thrown out upon the open and expofed furfaces of a wound, there is thrown out alfo upon the fame furfaces a quantity of pus, or the matter of fores. This fluid, like the coagulable lymph, is the immediate product of a change induced in the action of the capillary veffels exifting in the divided fubftances of the wound, a change by which they feem to become fecreting inftead of circulating tubes. The action by which pus is formed is now denominated *fuppuration:* the old furgeons gave to it the name of *digeftion.* See SUPPURATION.

"When the furfaces of the wound have been feverely injured, or when the patient is of a bad habit of body, a greater or lefs portion of thefe furfaces lofing its vitality, feparates from the remaining found part, and comes away in the form of a flough. The older furgeons, who are moft minutely accurate in the defcriptions which they have left us of difeafed appearances, call this the *deterfion* or *mundification* of the wound: the furgeons of the prefent day, *floughing*, or the *feparation of the flough.* See the article GANGRENE.

"In the healthy conditions of the body, and when the edges of the wound are uninjured, the fmooth furface of the layer of coagulable lymph which covers the bottom of the wound is, in the courfe of a few days after the fuppuration has taken place, raifed into a number of fmall eminences, like grains or papillæ. Thefe little eminences are termed *granulations*, and their formation in the healing of wounds, *the procefs of granulation.* By the older furgeons, this ftep, in the procefs of re-union by the fecond intention, was commonly termed *incarnation*, or *concarnation*, terms expreffive of the formation of a portion of new flefh." See GRANULATION.

"On the furfaces of thefe granulations, but moft frequently on the edges of the wound next to the fkin, fmall white fpecks appear; the quantity of pus which is fecreted gradually diminifhes, and the blueifh-white fpecks, by continuing to increafe in number and fize, come at laft to cover the furface of the wound. On examination, the furface of the wound will now be found to be covered by a kind of new fkin and cuticle. The formation of this new fkin has long been denominated the *procefs of cicatrization*, and the procefs of re-union by the fecond intention being now fully accomplifhed, the wound is faid to be completely *cicatrized.*" Thomfon's Lectures, p. 288.

The re-union of a wound by the firft intention is the work of one, two, or three days; while re-union by the fecond intention always requires a period of feveral days, and fometimes in difeafed conftitutions, or parts which have been much injured, of months, or of years. Thomfon, p. 290.

As the fame well-informed writer remarks in another place,

place, moſt wounds admit of being healed partly by adheſion, and partly by the proceſs of granulation. We have very good examples of this in the wounds made in amputation of the extremities, and in the extirpation of the mamma, or of other large tumours. We know, or at leaſt we have reaſon in theſe inſtances from the firſt to ſuſpect, that the whole of the wound will not heal by adheſion; but we are ignorant whether a large or a ſmall portion will be healed by that proceſs; and accordingly, we at firſt proceed in the dreſſing of ſuch wounds, as if we expected or intended that the whole ſhould heal by adheſion. We bring the edges of the wound together by adheſive ſtraps, or ſtitches, and ſupport theſe by proper bandaging. The adheſive ſtraps are of great uſe even in thoſe wounds in which it is impoſſible to bring the edges at firſt into contact. They bring and retain the edges near each other; they diminiſh the ſize of the wound; they keep ſurfaces in contact which have a diſpoſition to adhere; and ultimately, by the gradual elongation of the old ſkin, even where the diſtances between the ſizes is at firſt conſiderable, they bring the ſeparated edges to unite together. Op. cit. p. 293.

With reſpect, however, to the particular mode of dreſſing wounds which are to heal by granulations, it ſeems unneceſſary to enter into any long detail in the preſent place; becauſe the treatment is to be conducted on the very ſame principles which apply to ſores, and which we have ſo fully explained in another article. See ULCER.

We ſhall conclude this ſection of the ſubject of wounds with a few uſeful rules, which profeſſor Thomſon recommends to be obſerved in the dreſſing and examination of theſe caſes.

In examining or dreſſing a wound, we ought never to give the patient more pain from our modes of procedure, or methods of dreſſing, than is abſolutely neceſſary for his preſent good and future ſecurity. For inſtance, we ought never to probe a wound where probing can be of no uſe; and we ſhould be contented to remain ignorant of thoſe things, the knowledge of which could only gratify an idle curioſity.

Another good rule is, to have all the freſh dreſſings perfectly ready before the removal of thoſe which have been previouſly applied. A ſponge and warm water, adheſive ſtraps, pledgets of various ointments, lint, compreſſes, and bandages, are to be at hand, and not to be ſought for at the very moment when they are required for uſe.

As in many inſtances the removal of the dreſſings, and the application of others, take up a conſiderable time, we ought carefully to reflect what the poſition is which will be moſt eaſy to the patient, and at the ſame time moſt convenient to the ſurgeon.

When the bandage, adheſive plaſter, and other dreſſings, have become hard and dry, and glued together, and to the ſurrounding ſkin by blood, or other diſcharge from the wound, the ſurgeon ſhould ſoften and looſen the applications by wetting them a ſufficient length of time with warm water, which is to be preſſed out of a ſponge upon them, a baſin being held below the part for the reception of the water as it falls off the dreſſings. This duty is of much importance in ſaving the patient from a great deal of agony, which the abrupt removal of the adherent dreſſings would produce.

In removing the dreſſings which are under the bandage, we muſt be careful that the ligatures are not entangled, and that we do not pull them forcibly away. Pulling at the ligatures during the firſt dreſſings, as profeſſor Thomſon remarks, always occaſions pain; and if, in removing the dreſſings, the threads be incautiouſly torn off, a greater or leſs degree of hemorrhage may be produced, and much diſtreſs, if not danger, occaſioned. To avoid this accident, therefore, we ought always to ſearch for the ligatures previous to the removal of the dreſſings, and to ſeparate them from theſe dreſſings when they adhere, as they moſt frequently do.

Having formed and ſeparated the ligatures, we muſt next proceed to remove the adheſive ſtraps by which the edges of the wound are more immediately kept in contact. It moſtly happens, that a greater or leſs portion of theſe ſtraps is looſened from the ſurface of the wound by the fluid which exudes from it. This is the part, therefore, from which (ſays Dr. Thomſon) we ſhould firſt proceed to ſeparate theſe ſtraps, becauſe it is here that the edges of the wound may be ſuppoſed to recede fartheſt from each other, and the pus to have found the freeſt exit. But the manner in which the remaining adhering portion of ſtrap is to be ſeparated, is not, as may firſt appear, a matter of indifference. There is but one way in which it can be properly taken off, though it is one which is often neglected in practice. In removing theſe ſtraps, we are always to lay hold of them by the ends, firſt by the one, and then by the other end, and to pull them off in the direction of the wound, taking care never to raiſe the end of the ſtrap much above the level of the ſkin, nor to continue to pull by the end we hold, after we have ſeparated it as far as the wound. Were the ſtraps pulled off in a direction from and not towards the wound, the edges of the injury to which they adhere would be drawn away from each other; the ſlight adheſions which have formed between one ſide of the wound and the other would be torn, and the proceſs of re-union diſturbed and retarded. If we raiſe the end of the ſtrap, we alſo tear the edge of the wound from the ſubjacent parts to which it adheres.

Another good piece of advice given by profeſſor Thomſon is, that only one adheſive ſtrap, or at moſt two, ſhould be removed at once; and the part from which it has been removed being carefully wiped with the ſponge, and dried with a ſoft linen cloth, a freſh ſtrap is always to be applied before another is removed. It is from inattention to this rule that we ſee the ſurfaces of wounds and ſores daily torn open at each dreſſing, merely by the weight of the parts which have juſt been united.

The edges of the wound, particularly if it be a large one, ſhould always be held together by an aſſiſtant during the time of dreſſing.

When there are ſeveral wounds, only one is to be opened and dreſſed at a time, ſo that all unneceſſary expoſure of the parts may be avoided.

At each dreſſing care muſt be taken to prevent lodgments of matter, by placing the compreſſes and ſtraps of plaſter in the manner beſt adapted to preſs upon and obliterate any cavity in which the pus has a tendency to accumulate.

A pledget of ſome mild cerate or ointment is uſually applied over the adheſive plaſter, and its ſize ſhould exceed that of the wound. It is preferable to dry lint, which becomes adherent, troubleſome to remove, and often conceals and ſticks to the ligatures. If lint be neceſſary, it may be employed over the pledget. Modern ſurgeons, however, are far more ſparing of thick maſſes of lint, tow, flannel-rollers, &c. than their predeceſſors, as we have previouſly explained.

On the ſubject of bandages we ſhall here add nothing to what has been already ſtated in the foregoing ſection of this article.

In the dreſſing of wounds, ſays Dr. Thomſon, particularly

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larly in hofpital practice, where frequent change of linen is not at all times obtainable, it is of great confequence to the comfort of the patient, and to the general health and welfare of the other patients, that every attention fhould be paid to cleanlinefs, and that every thing filthy and offenfive fhould be removed from the room or ward as quickly as poffible. Above all things, care muft be taken not to let the matter touch the bed-clothes.

The frequency of dreffing muft be regulated by the quantity and quality of the difcharge from the wound, by the fituation of the injury, by the climate and feafon of the year, by the effects which the renewal of the dreffings feems to produce, and by the feelings, and fometimes the wifhes of the patient.

During the long-continued difcharge of pus from many wounds, the ftrength of the patient muft be fupported, and granulation and cicatrization promoted by nourifhing diet and proper cordials. The moft difagreeable, and unfortunately not an unfrequent termination of large wounds, is the formation of unhealthy granulations, attended with a general wafting of the body and hectic fever. See Thomfon's Lectures on Inflammation, p. 294, &c.

Of punctured Wounds, or Stabs.—Punctured wounds are not only dangerous on account of their frequently extending to a confiderable depth, and injuring important blood-veffels, nerves, and vifcera, but they are alfo dangerous, inafmuch as they often give rife to violent and extenfive degrees of inflammation. It is not uncommon to fee formidable collections of matter follow wounds of this defcription, efpecially when the inftrument with which they have been made has penetrated any aponeurofis, or fafcia. Stabs and all other punctures are not fimple divifions of the fibres of the body ; they are attended with more or lefs contufion and laceration, according to the particular form of the weapon, and the degree of violence with which the thruft has been made. Hence there is not the fame propenfity to union by the firft intention, which we obferve in wounds made with fharp-edged inftruments ; and when ligamentous expanfions are amongft the parts injured, it is not uncommon to fee a train of fevere local and conftitutional fymptoms follow. Immenfe agitation of the nervous fyftem fometimes enfues upon the infliction of a punctured wound ; and it has been generally attributed to the injury of tendons or nerves. This doctrine, however, is now almoft quite exploded, as furgeons fo frequently fee nerves and tendons wounded, without the occurrence of great conftitutional diforder. The truth is, that alarming nervous fymptoms do not follow punctured wounds in perhaps more than five cafes out of a hundred, in which tendons and nerves of fome fize are actually injured. It cannot, therefore, be fo much the injury of thefe parts, as other circumftances attending ftabs, which are the caufe of the fevere indifpofition fometimes fuddenly induced by fuch wounds. When they extend deeply, the confequences of the injury of large blood-veffels and vifcera will often account for the great conftitutional diforder, without having any recourfe to doctrines like the foregoing.

Punctured wounds are frequently followed by the formation of deeply-feated abfceffes and finufes, and hence the cure is often difficult, and fometimes it cannot be effected till after a confiderable time.

With refpect to the treatment of punctured wounds, we may obferve, that in this part of practice erroneous fuppofitions have commonly led to many ferious abufes. The unqualified idea, that the fevere confequences of moft punctured wounds are, in a great meafure, owing to the narrownefs of their orifices, has induced numerous furgeons to practife indifcriminately deep and extenfive incifions, for the purpofe of rendering their external communication confiderably wider. To have conftantly in view the converfion of fuch injuries into fimple incifed wounds has always been a maxim ftrongly infifted upon, and fet forth as the reafon of the above method of treatment. The doctrine even occafioned the frequent dilatation of punctured wounds by the ftill more abfurd and cruel means, the employment of tents.

Certainly, if the notion were true, that an important punctured wound, fuch as the ftab of a bayonet, is actually changed into a wound partaking of the mild nature of an incifion, by the mere enlargement of its orifice, the correfponding practice would be highly commendable, however painful it might be. But the fact is otherwife : the rough violence done to the fibres of the body by the generality of ftabs is little likely to be fuddenly removed by an additional violence—the enlargement of the wound. Nor can the diftance to which a punctured wound frequently penetrates, and the number and nature of the parts injured by it, be at all altered by fuch a proceeding. Thefe, which are the grand caufes of the collections of matter which often take place in the cafes under confideration, muft exift, whether the mouth and canal of the wound be enlarged or not. The time when incifions are proper is, when there are foreign bodies to be removed, abfceffes to be opened, or finufes to be divided. To make painful incifions fooner than they can anfwer any end is both injudicious and hurtful. They are fometimes rendered quite unneceffary by the union of the wound throughout its whole extent, without the leaft fuppuration.

It is true, as is obferved in a modern publication, that making a free incifion in the early ftage of thefe cafes feems a reafonable method of preventing the formation of finufes, by preventing the confinement of matter ; and were finufes an inevitable confequence of all punctured wounds, for which no incifions are practifed at the moment of their occurrence, it would undoubtedly be unpardonable to omit them. Fair, however, as this reafon for the ufe of the knife may appear to fome practitioners, it is only fuperficially plaufible, and a very little reflection foon detects its want of real folidity. Under what circumftances do finufes form ? Do they not form only when there is fome caufe exifting to prevent the healing of an abfcefs ? This caufe may either be the indirect way in which the abfcefs communicates externally, fo that the pus does not readily efcape ; or it may be the prefence of fome foreign body, or dead portion of bone ; or, laftly, it may be an indifpofition of the inner furface of the abfcefs to form granulations arifing from its long duration, but removeable by laying open the cavity. Thus it becomes manifeft, that the occurrence of fuppuration in punctured wounds is only followed by finufes, when the furgeon neglects to procure a free iffue for the matter after its accumulation, or when he neglects to remove any extraneous bodies. But as dilating the wound at firft can only tend to augment the inflammation, and render the fuppuration more extenfive ; and as likewife the new incifion may heal up by the firft intention before it has anfwered any purpofe at all ; the practice fhould never be adopted in thefe cafes, except for the direct objects of giving a free exit to matter already collected, and of being able to remove extraneous bodies palpably lodged in the part. We fhall once more repeat, that it is an erroneous idea to fuppofe the narrownefs of punctured wounds fo principal a caufe of the bad fymptoms with which they are often attended, that the treatment ought invariably to aim at its removal.

Recent punctured wounds have abfurdly had the fame plan of treatment applied to them as old and callous fiftulæ. Setons and ftimulating injections, which in the latter cafe fometimes act beneficially, by exciting fuch inflammation as is productive of the effufion of coagulating lymph, and of the granulating procefs, can never prove ferviceable when the indication is to moderate an inflammation which is difpofed to rife too high. The counter-opening, which muft be formed in adopting the ufe of the feton, is alfo an objection ; and though French authors have given us accounts of their having drawn their fetons acrofs patients' chefts, in cafes of ftabs, they will find fome difficulty in making the practice feem unattended with harm, much lefs productive of good. The candid and judicious furgical reader fhould not always think a plan of treatment right becaufe the patient gets well; for there is an effential difference between a cure promoted by really ufeful means and an efcape, notwithftanding the employment of hurtful ones.

For our own part, we cannot fee what good can ever poffibly arife from the ufe of fetons in cafes of punctured wounds. Will a feton promote the difcharge of foreign bodies, if any happen to be prefent ? By occupying the external openings of the wound, will it not be more likely to prevent it ? In fact, will it not itfelf act with all the inconveniences and irritation of an extraneous fubftance in the wound ? Befides, let it be recollected, that punctured wounds are rarely accompanied with the lodgment of foreign bodies. Is a feton a likely means of diminifhing the immoderate pain, fwelling, and extenfive fuppuration fo often attending punctured wounds ? It will undoubtedly prevent the external openings from healing too foon ; but cannot this object be effected in a better way ? In moft inftances where much matter is collected, and where the fuppuration is likely to laft a long while, in confequence of exfoliations, there will be no chance of the finus healing up prematurely ; and if fuch rifk fhould appear probable, it is always eafy to maintain an external opening by the daily introduction of a probe into the finus, and a fmall doffil of lint into its orifice. See Firft Lines of Surgery, edit. 3. chap. xvi.

When a furgeon is called to a punctured wound or ftab, he may often form fome opinion refpecting the depth and nature of the injury by examining the weapon with which it was done, and obferving how far the blood reaches along the blade from the point, and by attending to the quantity and quality of the fluids which may iffue from the external opening. Thus, the efcape of chyle or feces will denote that the bowels are injured ; the effufion of urine will indicate that the bladder or fome part of the urinary organs is wounded ; and the flow of much arterial blood will prove that a confiderable artery is opened. Wounds of the lungs will alfo be attended with particular fymptoms, as we fhall notice in fpeaking of wounds of the cheft. In many inftances, however, important vifcera and large deep-feated arteries are injured by ftabs, and yet no information can at firft be deduced refpecting what has happened from attention to local fymptoms alone. The faintnefs and great fudden proftration of ftrength, the faultering, low, and intermitting pulfe, the vomiting or coughing up of blood, and the coldnefs of the extremities, however, are ftill fufficient evidence that the cafe is complicated with injury of important organs, and that the patient is in a ftate of urgent danger. Thefe are matters which will be beft underftood when we come to the confideration of wounds of the cheft and belly, and therefore we fhall not dwell upon them at prefent.

From what has been already ftated, the reader muft be aware that we do not follow the bulk of furgical writers in recommending the indifcriminate dilatation of the orifices of punctured wounds ; nor do we admit the propriety of ufing the knife for the purpofe of preventing mifchief only expected and apprehended, but not actually exifting. Whenever we have had an opportunity of attending bayonet or other punctured wounds, unattended with any particular complication, we have always obferved nearly the fame principles as are now fo generally approved of in cafes of gun-fhot wounds. We have abftained from dilating the orifice of the injury, except when it was neceffary either to get at a bleeding artery in the firft inftance, or to give a freer egrefs to the difcharge in a later ftage of the cafe. We have given the preference to mild, fimple, unirritating, and fuperficial dreffings. We have not placed much faith in the utility of enveloping the parts in a tight bandage ; but, after applying the firft fuperficial dreffings, have ufually covered the limb with linen, wet with the lotio plumbi acetatis, or cold water. Whenever a roller was ufed, it was not with a view of making preffure, but of retaining the dreffings. The wound having been dreffed, we have then ufually put in practice all fuch means as are generally deemed moft efficient in preventing and diminifhing inflammation ; fuch as venefection, the exhibition of aperient and faline medicines, low diet, &c. When the pain was very fevere in the beginning, we have prefcribed opiates, and on the accefs of much fwelling, have always been careful to let the bandage be flack. We believe that, on the whole, the application of fuperficial dreffings and cold wafhes is moftly the beft practice for the firft twenty-four hours after the receipt of a punctured wound. But if after this period the pain fhould appear to increafe, and the fwelling to become more and more confiderable, the furgeon may then remove the bandages, and apply from fix to a dozen leeches to the neighbourhood of the wound. He muft alfo fubftitute for the cold lotion the ufe of fomentations, and emollient poultices, under which is to be laid over the orifice of the wound a fmall pledget of fpermaceti cerate, or other fimple ointment. The poultices and fomentations are to be renewed morning and evening, and the leeches may be repeated, if neceffary, three or four times.

By purfuing this antiphlogiftic fort of treatment, fuppuration may be fometimes entirely prevented, and the formation of large deep abfceffes frequently averted. Should extenfive collections of matter, however, take place, proper openings are to be then made without delay, either by dilating the original wound, or by making one or more incifions in other places, as may feem moft advantageous. The cafe, in fact, is then to be treated upon the very fame principles which are obferved in the management of abfceffes in general.

Of contufed and lacerated Wounds.—The inftruments which have the effect of producing what is termed a *contufion*, are either of an ordinary defcription, fuch as a cudgel, a ftone, &c. or they confift of balls, bullets, and other metallic bodies, which are impelled into the flefh with immenfe velocity by the explofion of gunpowder. The latter occafion particular kinds of injury, well known by the name of *gun-fhot wounds*, which are a clafs of cafes fo highly interefting, that although they are ftrictly only examples of feverely contufed wounds, furgeons have always found it expedient to treat of them as diftinct and peculiar cafes. Indeed, when it is recollected how many difficult, intricate, and momentous queftions the fubject of gun-fhot wounds embraces, the neceffity of confidering it by itfelf is immediately manifeft.

The blunt weapons, or obtufe hard fubftances, which, being applied with violence to any part of the living body, bruife, rupture, and otherwife hurt the fibres and veffels, may produce two different fpecies of injury. Firft, they may more or lefs forcibly comprefs and crufh the parts upon

upon which they act, so as to disorder the texture of those organs which are situated under the integuments, without, however, causing any breach of continuity in the skin itself. This is the case which is usually called a *bruise*, or *contusion*. Secondly, acting with a certain degree of violence upon the same parts, they may produce a solution of continuity which is named a *contused wound*. The latter effect more commonly follows when the surface of the contusing weapon or body is not very broad. The cases which rank as simple bruises have been described in another volume of this publication, (see CONTUSION,) and therefore we shall not detain the reader with any observations upon them in the present place.

The majority of wounds are attended with some degree of contusion. Those which are inflicted by the blunt edge of a sabre, or by the obtuse point of a bayonet or foil, are as much contused wounds as they are punctured ones; and hence, like other contused wounds, they do not often admit of being united by the first intention.

It must be confessed, indeed, that most of the endeavours to re-unite the sides of a contused wound, however skilfully directed, generally fail. An agglutination of the parts at most only takes place at the bottom of the wound, in which situation the flesh has suffered less contusion, the violence having spent itself, as it were, upon those parts upon which it first operated: hence suppuration of the external portion of the wound is mostly unavoidable. Still the attempt at re-union ought to be made; for if only the bottom of the wound should heal by the first intention, it will be a great advantage gained, more especially when the surface of a bone has been exposed and uncovered by the injury. However, in bringing the sides of contused wounds nearer together, the surgeon is not to attempt to do it with the same closeness and accuracy as in the instance of an incised wound. The injured parts would not bear the pressure, and the means requisite for this purpose; and it may be laid down as an established rule that nothing is more hurtful in cases of contused wounds than much pressure, either from strips of adhesive plaster, or a tight roller. Sutures in these cases are also totally unjustifiable; and we think we have seen several examples, in which a rash determination of the surgeon to close large contused wounds by stitches, tight strips of plaster, and bandages, has had no inconsiderable share in bringing on the rapid and fatal gangrene which carried off the patients. When we say, therefore, that a contused wound ought to be closed, and that its opposite surfaces should be brought nearer to each other, in order that the chance of some part of the injury uniting by the first intention may be taken, we do not mean to recommend dragging the parts together by main force, or placing them in a state of constriction. On the contrary, we think that they ought to be left quite unconfined, the adhesive plaster being used very sparingly, with considerable spaces between the strips, and so put on as rather to hold the loose parts together than to press and draw them into contact with each other. The wound then is not to be entirely covered with sticking-plaster, a practice which is hurtful even in incised wounds, but merely a strip applied at particular points, where the application promises to have great effect in hindering the wound from gaping, without producing any dangerous constriction of the parts. That a strip of adhesive plaster may frequently be used with striking advantage in contused and lacerated wounds experience daily proves; and the benefit must not surprise us, when we remember that by preventing the wound from gaping in the manner it would otherwise do, we not only afford an opportunity for parts of it to re-unite, but at once diminish an inevitable cause of inflammation and suppuration, *viz.* the exposure of a large raw surface to the air.

Contused and lacerated wounds not only differ from incised wounds in the circumstance of their being more disposed to suppurate, and more difficult to heal by the first intention, they differ also in the particularity of not bleeding much, sometimes even when the largest arteries are lacerated, as must be the case when whole limbs are torn away, in consequence of becoming entangled in different kinds of machinery.

This indisposition to hemorrhage is not altogether a favourable omen, because though the patient runs less chance of bleeding to death in these cases than in cut wounds, yet the very circumstance of the large vessels not pouring out blood evinces that the violence, contusion, and other injury done to the parts, in addition to the mere division of them, must have been excessively severe, and that the dangers of the subsequent inflammation, suppuration, and sloughing of the parts, more than counterbalance the present security from bleeding.

We shall not find, in all the records of surgery, any facts more extraordinary than those which have been published at different periods on the subject of whole limbs being torn away, not only without hemorrhage, but without any other fatal effects. The cases of limbs torn off related by Cheselden, in the Philosophical Transactions, by La Motte, in his Traité des Accouchemens, by Mr. Carmichael, in the fifth volume of the Edinb. Med. Commentaries, and others in the second volume of the Mém. de l'Acad. de Chirurgie, are some of the most remarkable.

As far as our observations extend, all lacerated and contused wounds should be treated according to common antiphlogistic principles. When the injury is extensive, and attended with a great deal of contusion, venesection is to be practised, and the oozing of blood from the surface of the wound may be encouraged by the use of fomentations. With respect to dressings, they should always be of a mild unirritating quality. After lessening, by a strip or two of adhesive plaster, the exposed cavity of the wound, when this is large and the surrounding skin loose, the part may be covered with pledgets of the unguentum ceræ, over which should be laid an emollient poultice. As the first dressings should not be removed for at least 24 or 36 hours, care ought to be taken to put into the poultice a sufficient quantity of sweet oil, to prevent it from becoming soon hard. Afterwards, however, the dressings may be changed once, twice, and even thrice a day, in bad cases, with advantage; for as soon as the sloughs begin to separate, and suppuration to take place, the necessity for changing the dressings and poultices more frequently is self-evident. In severe cases, fomentations may be used at the periods of dressing; and it will be found that nothing is so effectual in relieving the pain arising from the inflammation which has been induced. The employment of leeches also should not be forgotten, as a valuable means of palliating the inflammatory symptoms. Professor Asalini, of Milan, has lately written strongly in praise of the good effects which are produced by the application of cold washes to parts which have received contused wounds (see his Manuale di Chirurgia); and we believe the plan is particularly useful in the first instance, when it is a great object to check the increase of extravasated fluids in the surrounding parts. But afterwards we think emollient applications are the best; and, indeed, it may be questioned, whether the employment of cold lotions at first would not sometimes be objectionable, inasmuch as they must tend to stop the oozing of blood from the surface of the wound; a thing which is considered by many surgeons extremely beneficial, and an object which they think ought to be promoted even by the use of fomentations.

ations. This is a point, however, which comparative and unprejudiced experience is alone capable of deciding. If, in cafes of lacerated and contufed wounds, the furgeon is lefs frequently, than in incifed wounds, called upon to take meafures for ftopping bleeding immediately after the accident, he finds greater occafion for attending to another important duty, impofed upon him in his profeffional attendance upon wounded perfons in general: we allude to the early removal of all foreign bodies and extraneous fubftances from the wound. Cuts are ufually made with clean fharp inftruments; but contufed and lacerated wounds often occur in a manner which renders them particularly likely to contain dirt, gravel, bits of glafs, porcelain, &c. We have feen one cafe in which the patient could not ufe his arm for a twelvemonth, in confequence of fome fragments of a broken bottle not having been taken out of a wound of the hand in the firft inftance. The wound did indeed heal up; but the pieces of glafs occafioned fo much pain and inconvenience, that the part could not be ufed. New incifions were unfuccefsfully made for their removal, and the fingers were becoming permanently bent and contracted when we laft faw the patient. Whether the foreign bodies have been fubfequently extracted we know not; but the cafe deeply impreffed us with the importance of always removing extraneous fubftances while a wound is frefh, and beft admits of the requifite examination.

With regard to lacerated wounds, the fame practical remarks apply to them which have been offered on the fubject of contufed wounds; but the prognofis is generally confidered as more unfavourable, and in warm climates tetanus is alleged to be a very frequent confequence of thefe injuries. See TETANUS.

The bites of rabid animals afford examples of a moft dangerous defcription of lacerated and contufed wounds, the peril, however, originating not from the mechanical injury itfelf, but from the cafe being complicated with the infertion into the wounded part of a poifon or virus, the effects of which, when they do occur, almoft bid defiance to the power of the medical art. See HYDROPHOBIA.

As foon as the furface of a contufed or lacerated wound has thrown off its floughs, fuppurated, became clean, and evinced a tendency to form granulations, the poultices are to be difcontinued, and fimple dreffings employed. Thefe are afterwards to have their quality altered, according to the appearances which the fore may affume; but any further directions refpecting the management of the cafe, after it has arrived at this ftage, muft be quite fuperfluous here, as ample inftructions will be found in the article ULCER.

Some contufed and lacerated wounds would inevitably be followed by the rapid mortification of the limb, and the patient run the greateft rifk of lofing his life, were amputation not to be performed immediately after the receipt of the injury. Thefe are generally examples in which the foft parts are extenfively and deeply wounded, and large blood-veffels and nerves alfo injured. The fize, however, of the wound feems of itfelf fometimes to be a caufe of gangrene; for we remember a brewer's fervant, who, when fitting on the fore-part of a dray-cart, met with an injury, by which the fkin covering the front of the tibia was torn from the knee to the ankle, and though no other mifchief appeared to have been received, the whole limb and even the fcrotum rapidly mortified, and the man loft his life. It fhould be known, that thefe are cafes of what M. Larrey calls traumatic gangrene, in which he and fome other modern furgeons conceive that amputation may often be done with fuccefs, though the mortification has not ceafed to fpread at the time of the operation. (See SURGERY.) This practice had alfo its advocates in former days; but fince the time of Mr. S. Sharp and Mr. Pott, the rule of never attempting amputation before a line of feparation has formed between the dead and living parts, has been acknowledged, taught, and refpected, in every fchool of furgery. For an account of the treatment of contufed and lacerated wounds which have ended in mortification, the reader muft turn to the article GANGRENE.

Of Gun-fhot Wounds. — Strictly thefe cafes ought, perhaps, to be claffed with other wounds, attended with much contufion and laceration of the parts; but the injuries which are received in modern warfare from the employment of fire-arms are fo numerous, complicated, and various, that the fubject undoubtedly merits feparate confideration. A general defcription of thefe accidents, and of the method of treatment, will be found under the head of GUN-SHOT *Wounds*. Since that article was written, however, fo much valuable information has been laid before the public by feveral diftinguifhed army and navy furgeons, that it becomes neceffary for us to avail ourfelves of the prefent opportunity to notice fome practical points of the firft-rate importance in military furgery.

Amongft the obfervations on the fubject of *Gun-fhot Wounds* in a former volume, the reader will find a ftatement of fome of the fentiments which were entertained by the late Mr. Hunter concerning the treatment of thefe injuries. It will there be found, that this celebrated furgeon, as well as a few other eminent practitioners, was far from being an advocate for immediate amputation, even in cafes in which he acknowledged that there was no poffibility of ultimately faving the injured limb. It was his opinion, that more patients died when the operation was done early, than when it was performed in a later ftage, after inflammation had fubfided, and fuppuration had been fairly eftablifhed. Such precepts, however, do not coincide with the refults of modern experience; and, as in numerous inftances, the decifion for amputation or for delay involves the queftion of life or death, we think that every opportunity ought to be taken of refuting this part of Mr. Hunter's writings.

According to the united obfervations of all well-informed experienced army furgeons, it may now be fet down as an eftablifhed rule in military furgery, *that in every cafe in which a limb is fo fhattered and injured, that no probability of its being finally faved prefents itfelf, amputation ought to be done at once, without any delay.* For nearly the laft two hundred years, there have always been fome men of talents and experience, who not only recommended, but actually adopted this judicious practice. Du Chefne, who wrote in 1625, advifes the performance of amputation in cafes of fevere injuries of the limbs; and it is worthy of remark, that *he directs the operation to be performed before inflammation and other conftitutional fymptoms have fupervened.* (See Traité de la Cure générale et particulière des Arcbufades, Paris, 1625, p. 143.) Wifeman, the father of Englifh furgery, not only recommended and practifed immediate amputation, but the fame thing was not unfrequently done by the military furgeons of his time. (Chirurgical Treatifes by R. Wifeman, 3d edit. London, 1696, p. 410.) The celebrated Le Dran, in his excellent little manual of military furgery, declared himfelf an advocate for *immediate* amputation in all cafes in which that operation from the firft appears to be indifpenfable. (See Traité ou Réflexions tirées de la Pratique fur les Plaies d'Armes à feu, Paris, 1737.) Ranby, who was ferjeant-furgeon to king George II., entertained opinions fimilar to thofe of Le Dran, with regard to to the advantages and neceſſity of immediate amputation, whenever the injury is ſuch as to remove all reaſonable hope of ultimately ſaving the limb. See Ranby's Method of treating Gun-ſhot Wounds, edit. 3. p. 29. London, 1781.

The following account of this intereſting ſubject is principally abſtracted from the third edition of Cooper's Dictionary of Practical Surgery, publiſhed in the year 1818 :— After the battle of Fontenoy, in the year 1756, the Royal Academy of Surgery in France offered a prize for the beſt diſſertation on the gun-ſhot injuries requiring immediate amputation, and on other caſes of the ſame nature, where the operation, though deemed inevitable, might be delayed. The prize was adjudged to the diſſertation of M. Faure, the main object of whoſe paper was to recommend delaying the operation. The ſide of the queſtion eſpouſed by M. Faure has found ſome modern advocates of diſtinguiſhed talents and celebrity. Suffice it to mention the names of Hunter, baron Percy, and Lombard. It is, however, only juſtice to M. Faure to ſtate in this place, that though he regarded immediate amputation as full of danger, he admitted that there were ſeveral kinds of injuries of the extremities in which it was indiſpenſably and immediately required. "The enumeration," ſays Dr. Thomſon, "which this author has given of theſe injuries is more full and diſtinct than any which had been publiſhed before his time; and, what may appear ſingular, *it does not differ in any eſſential reſpect from the enumerations given by later writers*, who in combating his opinions have repreſented him as an enemy to amputation in almoſt all injuries of the extremities." See Report of Obſervations made in the Military Hoſpitals in Belgium, p. 169.

Although in France the academy of ſurgery thought proper to decree the prize to M. Faure, whoſe doctrine thus received the higheſt approbation, yet in that country very oppoſite tenets were ſet up by ſome men of diſtinguiſhed talents and extenſive military practice. Thus Le Dran, conſulting ſurgeon to the French army, in his work on gun-ſhot wounds, publiſhed in 1737, expreſsly ſtates, "that when the amputation of a limb is indiſpenſably neceſſary in the caſe of a gun-ſhot wound, it ought to be done without delay." (Aphoriſm 9.) M. La Martinière, in particular, wrote ſome excellent arguments in reply to M. Bilguer; arguments which would do honour to the moſt accompliſhed ſurgeon of the age in which we live. (See Mémoire ſur le traitement des plaies d'armes à feu, in Mém. de l'Acad. de Chirurgie, tom. xi. p. 1. edit. in 12mo.) M. Boucher, of Liſle, was an advocate for the ſame ſide of the queſtion. (See Obſ. ſur des plaies d'armes à feu, &c. in Mém. de l'Acad. de Chirurgie, tom. v. p. 279, &c. edit. in 12mo.) Schmucker, who was many years ſurgeon-general to the Pruſſian armies, publiſhed in 1776 an eſſay on amputation, in which he particularly mentions, that during his ſtay at Paris in 1738, the ſurgeons of the Hôtel-Dieu had been in the habit of performing immediate amputation in ſevere injuries of the extremities. *He alſo declares himſelf an advocate for operating immediately, in all caſes in which amputation from the firſt appears to be neceſſary*, and inſiſts, in a particular manner, on the increaſed danger which he had ſeen ariſe from the operation during the ſecond period. He gives, as Dr. J. Thomſon has obſerved, a minute and circumſtantial enumeration of thoſe injuries, both of the upper and lower extremities, in which he conceived amputation to be neceſſary, and in many of which he had actually performed it with great ſucceſs. Schmucker appears to Dr. Thomſon to have given a better account than any preceding military ſurgeon of the injuries of the thigh; and from the reſults of his experience, he was led to believe, that *though compound fractures of the lower part of the thigh-bone might, in favourable circumſtances, be cured without amputation, yet that this operation is peculiarly neceſſary in all caſes in which the fracture is ſituated in or above the middle of that bone.* (See Unterſuchung über die Abnehmung der Glieder von J. L. Schmucker. Vermiſchte Chirurgiſche Schriften, band i. Berlin, 1785.) With the foregoing high authority we have to join one of not leſs celebrity, namely, that of M. Larrey, who has proved moſt convincingly, that when amputation is to be done in caſes of gun-ſhot wounds, nothing is ſo pernicious as delay. See Mémoires de Chirurgie Militaire, tom. ii. p. 451, &c.

The principles inculcated by M. Larrey are, in point of fact, the ſame as thoſe which were ſo ſtrenuouſly inſiſted upon by Mr. Pott, in his remarks on amputation. Mr. Pott, indeed, was not an army ſurgeon, and what he ſays was not particularly deſigned to apply to military practice, but he has repreſented, as well as any body can do, the propriety of immediate amputation for injuries, which leave no doubt that ſuch operation cannot be diſpenſed with.

Mr. John Bell, amongſt the moderns, alſo defended the propriety of early amputation, long before the ſentiments of later writers were ever heard of. He diſtinctly ſtates, that "amputation ſhould, in thoſe caſes where the limb is plainly and irrecoverably diſordered, be performed upon the ſpot." (See Diſcourſes on the Nature, &c. of Wounds, p. 488. edit. 3.) Indeed, notwithſtanding all the modern pretenſions to novelty upon this intereſting topic, we muſt acknowledge, with Dr. Thomſon, that the evidence in favour of the advantages of immediate amputation has always preponderated over that for delay. See Report of Obſ. made in the Military Hoſpitals in Belgium, p. 225.

The ſtrongeſt body of evidence upon this matter, however, is adduced by M. Larrey, whoſe ſituation at the head of the medical department of the French armies has afforded him moſt numerous opportunities of judging from actual experience.

"If we are to be told," ſays he, "that the amputation of a limb is a cruel operation, dangerous in its conſequences, and always grievous for the patient, who is thereby mutilated; that, conſequently, there is more honour in ſaving a limb, than in cutting it off with dexterity and ſucceſs; theſe arguments may be refuted by anſwering, that amputation is an operation of neceſſity, which offers a chance of preſervation to the unfortunate, whoſe death appears certain under any other treatment; and that if any doubt ſhould exiſt of amputation being abſolutely indiſpenſable to the patient's ſafety, the operation is to be deferred, till nature has declared herſelf and given a poſitive indication for it. We are alſo juſtified in adding, that this chance of preſervation is at the preſent day much greater than at the epoch of the academy of ſurgery. We learn from M. Faure, that of about three hundred amputations performed after the battle of Fontenoy, only thirty were followed by ſucceſs, whilſt, on the contrary, ſays M. Larrey, we have ſaved more than three-fourths of the patients on whom amputation has been done, and ſome of whom alſo had two limbs removed. This improvement is aſcribed by M. Larrey, 1ſt, to our now knowing better how to take advantage of the indication and favourable time for amputating; 2dly, to the dreſſings being more methodical; 3dly, to the mode of operating being more ſimple, leſs painful, and more expeditious, than that formerly in vogue."

To the preceding authorities againſt delaying amputation, in caſes of gun-ſhot wounds requiring ſuch operation, we have to add that of Mr. Guthrie, deputy inſpector of military

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tary hofpitals, whofe opportunities of obfervation, during the late war in Spain, were particularly extenfive. Mr. Guthrie, however, does not recommend amputation to be done immediately, if the patient be particularly depreffed by the fhock of the injury directly after its receipt. "If a foldier, at the end of two, four, or fix hours after the injury, has recovered from the general conftitutional alarm occafioned by the blow, his pulfe becomes regular and good, his ftomach eafy, he is lefs agitated, his countenance revives, and he begins to feel pain, ftiffnefs, and uneafinefs in the part: he will now undergo the operation with the greateft advantage, and if he bears it well, of which there will be little doubt, he will recover in the proportion of nine cafes out of ten, in any operation on the upper extremity, or below the middle of the thigh, &c. If, on the contrary, the operation be performed before the conftitution has recovered itfelf, to a certain degree, from the alarm it has fuftained, the additional injury will moft probably be more than he can bear, and he will gradually fink under it and die." (On Gun-fhot Wounds, p. 24. London, 1815.) As far as our experience goes, however, all delay is improper when the neceffity of amputation is undoubted, at leaft all delay beyond the fhort period, during which the faintnefs immediately arifing from the injury ufually lafts. In the campaign in Holland, in 1814, the moft fuccefsful amputations were thofe done in the field hofpitals directly after the arrival of the patients. On this point, however, hardly any difference of fentiment prevails, becaufe all naval and military furgeons agree, and mean, that amputation is not to be performed till the faintnefs and depreffion of the powers of life, directly following the wound, have been fufficiently obviated for the patient to bear the operation well. The feeming difference, therefore, on this matter, between Mr. Guthrie and Mr. Hutchifon, is not very material. (See Hutchifon's Practical Obf. on Surgery, 1817.) It appears from fome returns, collected by Mr. Guthrie, that in the peninfula, the comparative lofs, in fecondary or delayed operations, and in primary or immediate amputations, was as follow:

	Secondary.		Primary.
Upper extremities - -	12	to	1
Lower extremities - -	3	to	1

The great fuccefs attending amputation on the field of battle was alfo convincingly proved after the battle of Touloufe. Here of 47 immediate amputations, 38 were cured, while of the 51 delayed operations, on that occafion, 21 had fatal terminations. P. 42—44.

Laftly, we have to notice, amongft the advocates for immediate amputation, Mr. Hennen, a furgeon employed with our army in Spain and the Netherlands. "The queftion," fays he, "of immediate amputation has of late attracted an attention, which its great importance naturally calls forth; but it appears to me, that an idea has been impreffed upon the minds of practitioners in civil life, that doubts as to the propriety of the practice had exifted among the Britifh army furgeons. For my own part, I have never known any differences of opinion on the point. In books, it is true, it has been moft amply difcuffed before the prefent generation were in exiftence; but in Britifh practice all doubts have long been at an end. It is but juftice to Britifh furgeons, both naval and military, to declare, that immediate amputation is neither a new doctrine nor a recent practice among them, &c." See Hennen's Obf. on fome important Points in the Practice of Military Surgery, p. 45. Edinb. 1818.

If, however, military furgeons have definitively fettled the great queftion, that in all cafes in which a limb cannot be faved, the fooner amputation is done the better, they neither have, nor probably will ever be able pofitively to fettle and define the exact degrees of injury which, in every inftance, ought to be followed by putting the former rule in practice. In fact, no part of furgery is more difficult, than that in which the queftion of the poffibility or impoffibility of faving wounded limbs is fubmitted to the judgment and determination of the practitioner. Some injuries, indeed, are fo bad, that no difficulty in making a decifion is experienced; but there are other cafes, in which the damage done to the parts is lefs violent and extenfive, and in which the exact degree of mifchief is not at firft apparent. There are, in fhort, numerous doubtful examples, in which the formation of a right judgment is equally difficult and important.

The annexed remarks will convey the fentiments of fome of the lateft writers on the fecond great queftion in military furgery. What are the exact cafes in which amputation fhould be done immediately, and what are thofe in which the operation may be deferred?

Of Cafes in which Amputation fhould be done immediately.— Firft cafe. A limb carried away by a cannon-ball, or the explofion of a howitzer, or bomb, requires amputation without any lofs of time: the leaft delay puts the patient's life in danger.

In this cafe, the neceffity of the practice is inculcated by M. Faure himfelf, as well as by Schmucker, Richter, Larrey, Dr. Thomfon, and every modern writer upon gunfhot wounds.

If the operation be not fpeedily done, pain commences, fever occurs, and the functions become difordered; the irritation then increafes, and convulfive motions take place. If the patient fhould not be a victim to thefe firft fymptoms (continues Larrey), gangrene of the ftump is occafioned, the fatal confequences of which it is extremely difficult to prevent.

Second cafe. When a body propelled by gunpowder ftrikes a limb, in fuch a manner as to fmafh the bones, violently contufe, lacerate, and deeply tear away the foft parts, amputation ought to be immediately performed. If this meafure be neglected, all the injured parts will foon be feized with gangrene: and befides, as M. Larrey has explained, the accidents which the gravity of the firft cafe produces will alfo here be excited. It is only doing juftice to the memory of M. Faure to ftate, that this fecond cafe was one which he alfo particularly inftanced as demanding the immediate performance of amputation. See Prix de l'Acad. Royale de Chirurgie, tom. viii. p. 23. edit. 12mo.

Third cafe. If a fimilar body were to carry away a great mafs of the foft parts, and the principal veffels of a limb (of the thigh for inftance), without fracturing the bone, the patient would be in a ftate demanding immediate amputation; for, independently of the accidents which would originate from a confiderable lofs of fubftance, the limb muft inevitably mortify. Mr. Guthrie alfo fays, "a cannon-fhot deftroying the artery and vein on the infide (of the thigh), without injuring the bone, requires amputation." (P. 185.) When, however, the femoral artery or vein is injured by a mufket-ball, or fmall cannifter-fhot, this gentleman recommends tying the veffel above and below the wound in it, if the nature of the cafe be evinced by hemorrhage. But he believes, that when both vein and artery are injured, amputation is neceffary. (P. 186.) An injury of the femoral artery, obferves Mr. Guthrie, requiring an operation, and accompanied with fracture of the bone of the moft fimple kind, is a proper cafe for immediate amputa-

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tion; for although many patients would recover from either accident alone, none would furmount the two united, and the higher the accident is in the thigh, the more imperious is the neceffity for amputation.

Fourth cafe. A large bifcayen ftrikes the thick part of a member, breaks the bone, divides and tears the mufcles, and deftroys the large nerves, without, however, touching the main artery. According to M. Larrey, this is a fourth cafe requiring immediate amputation.

Mr. Guthrie alfo fays, that "if a cannon-fhot ftrike the back part of the thigh, and carry away the mufcular part behind, and with it the great fciatic nerve, amputation is neceffary, even if the bone be untouched, &c. In this cafe, I would not perform the operation by the circular incifion, but would preferve a flap from the fore part or fides, as I could get it, to cover the bone which fhould be fhort." Guthrie on Gun-fhot Wounds of the Extremities, p. 184.

Fifth cafe. If a fpent cannon-fhot, or one that has been reflected, fhould ftrike a member obliquely, without producing a folution of continuity in the fkin, as often happens, the parts which refift its action, fuch as the bones, mufcles, tendons, aponeurofes, and veffels, may be ruptured and lacerated. The extent of the internal diforder is to be examined; and if the bones fhould feel through the foft parts as if they were fmafhed, and if there fhould be reafon to fufpect from the fwelling, and a fort of fluctuation, that the veffels are lacerated, amputation ought to be immediately practifed. We learn from M. Larrey, that this is alfo the advice of M. Percy, an eminent French army furgeon. Sometimes, however, the veffels and bones have efcaped injury, and the mufcles are almoft the only parts difordered. In this circumftance, we are enjoined to follow the council of M. La Martinière, who recommended making an incifion through the fkin. By this means, a quantity of thick blackifh blood will be difcharged, and the practitioner muft await events. According to M. Larrey, fuch incifion is equally neceffary in the preceding cafe before amputation, in order to afcertain the extent of the mifchief which the parts have fuftained.

It is to fuch injury done to internal organs, that we muft afcribe the death of many individuals, which was for a long while attributed to the commotion produced by the air put in motion by the ball, when this, in grazing upon different parts of the body, alters them, or cuts off the column of air which is to ferve for refpiration, juft at the moment when it is about to enter the cheft. See Ravaton's Traité des Plaies d'Armes à Feu.

But to return to the object of our prefent confideration. M. Larrey expreffes his belief, that what have been erroneoufly termed *wind contufions*, if they are attended with the mifchief above fpecified, require immediate amputation. The leaft delay makes the patient's prefervation extremely doubtful. The internal injury of the member may be afcertained by the touch, by the lofs of motion, by the little fenfibility retained by the parts which have been ftruck, and, laftly, by practifing an incifion, as already recommended.

Sixth cafe. When the articular heads are much broken, efpecially thofe which form the joints of the foot or knee, and the ligaments, which ftrengthen thefe articulations, are broken and lacerated by the fire of a howitzer or by a bifcayen, or other kind of ball, immediate amputation, fays M. Larrey, is indifpenfable. According to this experienced writer, the fame indication would occur, were the ball lodged in the thicknefs of the articular head of a bone, or were it fo engaged in the joint as not to admit of being extracted by fimple and ordinary means. (See alfo Guthrie on Gun-fhot Wounds, p. 197.) Putting out of confideration cafes in which the injury has been done by a clean cutting inftrument, or in which a fmall ball has paffed near or partially injured a joint, another experienced army furgeon alfo lays it down as a law in military furgery, that *no lacerated joint, particularly the knee, ankle, or elbows, fhould ever leave the field unamputated, where the patient is not obvioufly finking, and confequently where certain death would follow the operation.* (Hennen's Military Surgery, p. 42.) And in another place he tells us: "In my own practice, I have met with only two cafes, where the limb was faved after a ferious injury of the knee-joint; and in one of them only was the perfect ufe of it reftored. I never met with an inftance where the ankle or elbow-joint was perfectly reftored after fevere injury, though fome where the limb has been faved. Of the fhoulder-joint the recoveries are more frequent." P. 159.

Fractures extending into the joints, and accompanied with great laceration of the ligaments, were cafes of gun-fhot injuries pointed out by M. Faure as indifpenfably requiring immediate amputation. (See Prix de l'Acad. de Chir. tom. viii.) Thus we fee, that this author was not fo averfe to early amputation as feveral modern writers have reprefented.

It is only in this manner, that the patients can be refcued from the dreadful pain, the fpafmodic affections, the violent convulfions, the acute fever, the confiderable tenfion, and the general inflammation of the limb, which, M. Larrey obferves, are the invariable confequences of bad fractures of the large joints. But, adds this author, if the voice of experience be not liftened to, and amputation be deferred, the parts become diforganized, and the patient's life is put into imminent peril.

It is evident, fays he, that, in this cafe, if we wifh to prevent the patient from dying of the confequent accidents, amputation fhould be performed before twelve or at moft twenty-four hours have elapfed: even M. Faure himfelf profeffed this opinion, in regard to certain defcriptions of injury. Mém. de Chir. Militaire, tom. ii.

With refpect to wounds of the knee, the fentiments of Mr. Guthrie nearly coincide with thofe of M. Larrey. "I moft folemnly proteft (fays Mr. G.) I do not remember a cafe do well, in which I knew the articulating end of the femur, or tibia, to be fractured by a ball that paffed through the joint, although I have tried great numbers, even to the laft battle of Touloufe. I know that perfons wounded in this way have lived; for a recovery it cannot be called, where the limb is ufelefs, bent backward, and a conftant fource of irritation and diftrefs, after feveral months of acute fuffering, to obtain even this partial fecurity from impending death; but if one cafe of recovery fhould take place in fifty, is it any fort of equivalent for the facrifice of the other forty-nine? Or is the preferving of a limb of this kind an equivalent for the lofs of one man?" On Gun-fhot Wounds, p. 196.

Mr. Guthrie admits, that fractures of the patella, without injury of the other bones, admit of delay, provided the bone is not much fplintered.

Seventh cafe. According to M. Larrey, if a large bifcayen, a fmall cannon-fhot, or a piece of a bomb-fhell, in paffing through the fubftance of a member, fhould have extenfively denuded the bone, without breaking it, amputation is equally indicated, although the foft parts may not appear to have particularly fuffered. Indeed, the violent concuffion produced by the accident has fhaken and diforganized all the parts; the medullary fubftance is injured, the veffels

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are lacerated, the nerves immoderately ſtretched, and thrown into a ſtate of ſtupor; the muſcles are deprived of their tone; and the circulation and ſenſibility in the limb are obſtructed. Before deciding, however, M. Larrey cautions us to obſerve attentively the ſymptoms which characterize this kind of diſorder. This caſe can be ſuppoſed to happen only in the leg, where the bone is very ſuperficial, and merely covered at its anterior part with the ſkin.

The following are deſcribed as the ſymptoms: the limb is inſenſible, the foot cold as ice, the bone partly expoſed, and on careful examination, it will be found that the integuments, and even the perioſteum, are extenſively detached from it. The commotion extends to a conſiderable diſtance; the functions of the body are diſordered; and all the ſecretions experience a more or leſs palpable diſturbance. The intellectual faculties are ſuſpended, and the circulation is retarded. The pulſe is ſmall and concentrated, the countenance pale, and the eyes have a dull moiſt appearance. The patient feels ſuch anxiety, that he cannot long remain in one poſture, and requeſts that his leg may be quickly taken off, as it incommodes him ſeverely, and he experiences very acute pain in the knee. When all theſe characteriſtic ſymptoms are conjoined, ſays M. Larrey, we ſhould not heſitate to amputate immediately; for the leg would be attacked with ſphacelus the ſame day, and the patient would certainly periſh.

M. Larrey next adduces ſeveral intereſting caſes in ſupport of the preceding obſervations.

Eighth caſe. When a large gynglimoid articulation, ſuch as the elbow, or eſpecially the knee, has been extenſively opened with a cutting inſtrument, and blood is extravaſated in the joint, M. Larrey deems immediate amputation neceſſary. In theſe caſes, the ſynovial membranes, the ligaments, and aponeuroſes, inflame, the part ſwells, and erethiſmus rapidly takes place; and acute pains, abſceſſes, deep ſinuſes, caries, febrile ſymptoms, and death, are the ſpeedy conſequences. M. Larrey has ſeen numerous ſubjects die of ſuch injuries, on account of the operation having been poſtponed with a hope of ſaving the limb. In his Mémoires de Chirurgie Militaire, tom. ii. ſome of theſe are detailed.

Although a wound may penetrate a joint, yet if it be ſmall and unattended with extravaſation of blood, M. Larrey informs us, it will generally heal, provided too much compreſſion be not employed. This gentleman believes in the common doctrine of the pernicious effect of the air on the cavities of the body; yet, in this place, a doubt ſeems to affect him: ſpeaking of the leſs danger of ſmall wounds of joints, he ſays, "a quoi tient cette différence, puiſque l'air pénètre dans l'articulation dans l'un comme dans l'autre cas?"

When two limbs have been at the ſame time ſo injured as to require amputation, we ſhould not be afraid of amputating them both immediately, without any interval. We have, ſays M. Larrey, ſeveral times performed this double amputation with almoſt as much ſucceſs as the amputation of a ſingle member. He has recorded an excellent caſe in confirmation of this ſtatement. Mém. de Chirurgie Militaire, tom. ii. p. 478.

When a limb is differently injured at the ſame time in two places, and one of the wounds requires amputation, (ſuppoſe a wound of the leg with a ſplintered fracture of the bone, and a ſecond of the thigh, done with a ball, but without any fracture of the os femoris, or other bad accident,) M. Larrey recommends us, firſt to dreſs the ſimple wound of the thigh, and amputate the leg immediately afterwards, if the knee be free from injury. When it is neceſſary to amputate above this joint, the leſs important wound need not be dreſſed till after the operation, provided it can be comprehended in the ſection of the member, or be ſo near the place of the inciſion as to alter the indication. When the wound demanding amputation is the upper one, the operation of courſe is to be done above it, without paying any regard to the injury ſituated lower down.

M. Larrey, however, approves of deferring the operation, when delirium, convulſions, and inflammation, prevail on the firſt receipt of the injury. In this circumſtance, we are adviſed to take meaſures for appeaſing theſe accidents; the progreſs of nature is to be carefully obſerved; and the firſt moment of quiet is to be taken advantage of for the performance of the operation. See Larrey's Mém. de Chirurgie Militaire, tom. ii. p. 451, &c.

Ninth caſe. To the foregoing ſpecies of gun-ſhot wounds, pointed out by M. Larrey as urgently requiring immediate amputation, are to be added compound fractures of the thigh from gun-ſhot violence.

"Gun-ſhot fractures of the thigh," ſays Dr. J. Thomſon, "have been univerſally allowed to be attended with a high degree of danger; indeed, till of late years, very few inſtances have been recorded of recovery from theſe injuries. Ravaton acknowledges, that in his long and extenſive experience, he had never ſeen an example of recovery from a gun-ſhot fracture of the thigh; and Bilguer, in his calculations with regard to thoſe who recover from gun-ſhot fractures, ſets aſide thoſe of the thigh-bone, as being of a nature altogether hopeleſs. In the preſent improved ſtate of military ſurgery, inſtances not unfrequently occur of recovery from this fracture; but of theſe, the number will be found, I believe, to be exceedingly ſmall, in compariſon with thoſe who die, particularly when the fracture has had its ſeat above the middle of the bone, &c."

According to the obſervation of Percy, ſcarcely two of ten recover of thoſe who have ſuffered gun-ſhot fractures of the thigh-bone. Mr. Guthrie ſays, that "upon a review of the many caſes which I have ſeen, I do not believe that more than one-ſixth recovered ſo as to have uſeful limbs; two-thirds of the whole died either with or without amputation; and the limbs of the remaining ſixth were not only nearly uſeleſs, but a cauſe of much uneaſineſs to them for the remainder of their lives." See Guthrie on Gun-ſhot Wounds, p. 191.

"In fractures by muſket-bullets of the lower part of the thigh-bone (ſays Dr. Thomſon), recovery not unfrequently takes place; and both Schmucker and Mr. Guthrie conceive, that they are injuries in which amputation may be delayed with ſafety. It would be very agreeable, that this opinion ſhould be confirmed by future experience; but it appears to me, that before it can be received as a maxim in military ſurgery, much more extenſive and accurate obſervation than we yet poſſeſs will be required, with regard to the proportion of thoſe who recover without amputation, or after ſecondary operations, and of thoſe who recover after primary amputation. Of thoſe who had ſuffered this injury, we ſaw, comparatively, but a ſmall number recovering in Belgium, and they had been attended with ſevere local and conſtitutional ſymptoms." See Report of Obſervations made in the Military Hoſpitals in Belgium, p. 247, *et ſeq.*

Balls often produce fiſſures of ſeveral inches in length in the thigh-bone. This is a ſtate, obſerves Dr. Thomſon, which muſt be very unfavourable to recovery; and his concluſion is, that in general, even in fractures of the lower part of the thigh-bone, a greater number of lives will be preſerved in military practice by immediate amputation,

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than by attempting the cure without that operation. " When the bone appears, on a careful examination, to be broken without being much fplintered, and when the patient can be removed eafily to a place of reft and fafety, it may be right to attempt to preferve the limb; but if the bone be much fplintered, or if the conveyance is to be long or uncertain, it will, in moft inftances, I am convinced, be a much fafer practice, even in fractures of this part of the thigh-bone, to amputate without delay.

" Mufket-bullets, in paffing through the femur, near to the knee-joint, produce fiffures of the condyles, which generally communicate with the joint. Thefe cafes, like thofe in which the bullets have paffed directly through the joint, require immediate amputation.

" The writings of military furgeons contain but few hiftories of cafes in which the thigh-bone had been fractured above its middle by the paffage of mufket-bullets. Thefe are cafes, I believe, which have generally had a fatal termination; and the danger attendant upon the amputation which they require, feems long to have deterred furgeons from attempting to afcertain what advantages might be derived from the employment of that operation. Schmucker recommends and ftates, that he had practifed with fuccefs immediate amputation in thofe cafes, in which a fufficient fpace was left below the groin for the application of the tourniquet. It is curious to remark, in the hiftory of amputation, how long furgeons were in difcovering the eafe and fafety with which the femoral artery may be compreffed by the fingers, or pads, in its paffage over the brim of the pelvis. Boy, from the immediate danger, protracted fuffering, and ultimate want of fuccefs, which he had obferved to follow this kind of injury, urges ftrenuoufly the propriety of immediate amputation: Mr. Guthrie's opinion, with regard to the dangerous nature of thefe injuries, and the advantages to be derived in them from immediate amputation, coincides in every refpect with thofe of Schmucker and Boy. He obferves, that thofe whofe thigh-bone has been fractured in its upper part by a mufket-bullet, generally die with great fuffering before the end of the fixth or eighth week; and that few even of thofe efcape, in whom that bone has been fractured in its middle part. Of the few whom we faw, who had furvived gun-fhot fractures in the upper part of the thigh-bone in Belgium, fcarcely any one could be faid to be in a favourable condition. In all, the limbs were much contracted, diftorted, and fwollen, and abfceffes had formed round and in the neighbourhood of the fractured extremities of the bones. In fome inftances, thefe abfceffes had extended down the thigh; but more frequently they paffed upwards, and occupied the region of the hip-joint and buttocks. In feveral inftances in which incifions had been made for the evacuation of matter, the fractured and exfoliating extremities of the bones fometimes comminuted, and fometimes forming the whole cylinder, could be felt bare, rough, and extenfively feparated from the foft parts which furrounded them. In other inftances, thefe extremities were partially inclofed in depofitions of new bone, which, from the quantity thrown out, feemed to be prefent in a morbid degree. It was obvious, that in all of thefe cafes, feveral months would be required for the re-union of the fractured extremities; that in fome much pain and mifery were ftill to be endured from the proceffes of fuppuration, ulceration, exfoliation, and ejection of dead bone; that in fome cafes, the patients were incurring great danger from hectic fever, and from diarrhœa; that the ultimate recovery in moft of them was doubtful; and that of thofe in whom this might take place, there was but little probability that any would be able to ufe their limbs! The fight of thefe cafes (fays Dr. Thomfon) made a deep impreffion upon my mind, and has tended to increafe my conviction, that this is, of all others, the clafs of injuries in which immediate amputation is moft indifpenfably required." See Report of Obfervations made in the Military Hofpitals in Belgium, p. 254—258.

Dr. Thomfon adds, that what has been faid of the danger of fractures produced by mufket-bullets in the upper part of the femur is true, in a ftill greater degree of thofe which have their feat in the neck or head of that bone. In fuch inftances, Dr. Thomfon joins the generality of modern army furgeons, in ftrongly recommending amputation at the hip-joint.

Of Gun-fhot Wounds in which Amputation may be deferred.—If, fays M. Larrey, it be poffible to fpecify the cafes in which amputation ought to be immediately performed, it is impoffible to determine *à priori* thofe which will require the operation fubfequently. One gun-fhot wound, for example, will be cured by ordinary treatment, while another, that is at firft lefs fevere, will afterwards render amputation indifpenfable, whether this be owing to the patient's bad conftitution, or the febrile complaints which are induced. However this may be, the fafe rule for fulfilling the indication that prefents itfelf, is to amputate confecutively only in circumftances in which every endeavour to fave the limb is manifeftly in vain. Upon this point, M. Larrey's doctrine differs from that of M. Faure.

The latter practitioner admits cafes, which he terms *cafes of the fecond kind*, in which he delays amputation, not with any hope of faving the limb, but in order to let the firft fymptoms fubfide. The operation done between the fifteenth and twentieth day, appears to him lefs dangerous than when performed immediately after the receipt of the injury. At the above period, according to M. Faure, the commotion occafioned by the gun-fhot injury is difpelled; the patient can reconcile himfelf to amputation, the mere mention of which fills the pufillanimous with terror in a greater or leffer degree; the debility of the individual is no objection; and it is laid down as an axiom, " that the confequences of every amputation, done in the firft inftance, are in general extremely dangerous." In fupport of this theory, M. Faure adduces ten cafes of gun-fhot injuries, in which, after the battle of Fontenoy, the operation was delayed, in order that it might afterwards be performed with more fuccefs; a plan which, according to the author, proved completely fuccefsful. See Prix de l'Acad. de Chirurgie, tom. viii. edit. in 12mo.

This divifion of the cafes for amputation into two claffes, not confiftent with nature, obferves M. Larrey, has been the caufe of a great deal of harm. Very often the partifans of M. Faure have not dared to refort in the firft inftance to amputation, the dangers of which they exaggerate; while, on other occafions, they amputate confecutively, without any fuccefs.

The effects of commotion, inftead of increafing, gradually diminifh and difappear after the operation. It is proved, fays he, that the commotion, fo far from being a counter-indication to immediate amputation, is a reafon that fhould incline the furgeon to operate. Such was the fentiment of La Martinière and Boucher.

Neither ought the patient's alarm to be a reafon for poftponing the operation; for according to M. Larrey, the patient juft after the accident will be much lefs afraid of the rifk which he has to encounter, than after the expiration of the firft four-and-twenty hours, when he has had time to reflect upon the confequences of the injury, or of amputation. This remark has been made by the illuftrious Paré.

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" Experience," ſays M. Larrey, " has proved, both to the army and navy ſurgeons, that the bad ſymptoms which ſoon follow ſuch gun-ſhot injuries as muſt occaſion the loſs of a limb, are much more to be dreaded than thoſe of immediate amputation. Out of a vaſt number of the wounded, who ſuffered amputation in the courſe of the firſt four-and-twenty hours after the memorable naval battle of the firſt of June, 1794, a very few loſt their lives."

M. Larrey next acquaints us, that when he was ſent to the army of Italy in 1796, he had alſo the pain of ſeeing in the hoſpitals great numbers of the wounded fall victims to the confidence which many of the ſurgeons of that army placed in the principles of M. Faure. General Bonaparte ſaw, that the *ambulance volante* was the only thing that, in the event of freſh hoſtilities, could prevent ſuch accidents; and in conſequence of his orders, M. Larrey formed the three diviſions d'ambulance, which are deſcribed in his Mémoires de Chirurgie Militaire.

Since this period, it has always been cuſtomary in the French armies, on the day of battle, to make every preparation for performing amputation as ſpeedily as poſſible. The mere ſight of theſe *ambulances*, (always attached to the advanced guard,) ſays M. Larrey, encourages the ſoldiers, and inſpires them with the greateſt courage.

M. Larrey deſires us to interrogate the invalids who have loſt one or two of their limbs, and nearly all will tell us, that they ſuffered amputation a few minutes after the accident, or in the firſt four-and-twenty hours.

" If M. Faure now retains any partiſans," ſays M. Larrey, " I recommend them to repair to the field of battle the day after an action; they would then ſoon be convinced, that without the prompt performance of amputation, great numbers of ſoldiers muſt inevitably loſe their lives. In Egypt, this truth was particularly manifeſted."

Admitting, ſays M. Larrey, that by a concurrence of fortunate circumſtances, which are not always to be calculated upon, ſome patients eſcape the danger of the firſt ſymptoms, this proves nothing in favour of doing the operation afterwards: it muſt be ſeen what nature will do towards the event of the caſe.

If at the end of twenty or thirty days the prognoſtic is as bad as it was previouſly, amputation cannot be avoided. Thus all the ſufferings which the patient has endured have been undergone for nothing, and the operation will now be attended with conſiderable riſk, inaſmuch as the patient may lie in a dangerouſly weakened ſtate.

If nature revives at all, no doubt the ſucceſs of the operation becomes more probable; but in this caſe, the ſurgeon, inſtead of having recourſe to amputation, ſhould redouble his efforts to preſerve the limb.

Caſes demanding Amputation conſecutively.—M. Larrey gives us the annexed information upon this ſubject.

Firſt caſe. *A ſpreading Mortification.*—If the diſorder be owing to an internal and general cauſe, it would then be raſhneſs in the ſurgeon to amputate before nature had put limits to the diſeaſe. This kind of gangrene, according to M. Larrey, is diſtinguiſhed from that which is named *traumatic*, by the ſymptoms which precede and accompany it. Theſe ſymptoms are ſimilar to thoſe which are obſerved in nervous ataxia, or adynamia. Here the operation ought to be deferred, and endeavours made to combat the general cauſes with regimen and internal medicines.

But when the gangrene is *traumatic*, the limb, ſays M. Larrey, ſhould be immediately cut off above the diſorganized part. Several facts in ſupport of this advice are related by this experienced ſurgeon in his Mémoire ſur la Gangrene Traumatique. See Surgery.

How contrary this advice to that inculcated by Sharp, Pott, and nearly all eminent ſurgeons of the preſent time!

A particular caſe of gangrene has been pointed out by Mr. Guthrie as demanding the early performance of amputation, and a deviation from the old rule of waiting till the mortification has ceaſed to ſpread. It is when gangrene occurs after wounds of the large blood-veſſels of a limb. See Guthrie on Gun-ſhot Wounds of the Extremities, p. 63, &c.

Second caſe. *Convulſions of the wounded Limb.*—Amputation of the member, performed immediately the firſt ſymptoms of tetanus manifeſt themſelves, more eſpecially thoſe of chronic tetanus, was propoſed and even practiſed by Larrey with partial ſucceſs. He ſuppoſed, that all communication between the original injury, and the reſt of the body being thus cut off, the general diſorder might ceaſe.

Third caſe. *Bad State of the Diſcharge.*—It often happens, that in gun-ſhot wounds, complicated with fractures, notwithſtanding the moſt ſkilful treatment, the diſcharge becomes of a bad quality; the fragments of bone lie ſurrounded with the matter, and have not the leaſt tendency to unite; the patient is attacked with hectic fever, and a colliquative diarrhœa. Under theſe circumſtances, life may ſometimes be preſerved by amputation.

Fourth caſe. *Bad State of the Stump.*—In hoſpitals, ſays M. Larrey, the cure of amputations is ſometimes prevented by a fever of a bad character. The ſtump ſwells, the integuments become at firſt retracted, and then reverted and diſeaſed a good way upward. The wound changes into a fungous ulcer, the cicatrization of which is hindered by the deep diſorder of the bone, and the ulceration of the ſoft parts. The extremity of the bone projects. In order to remedy this laſt evil, it has been propoſed to ſaw off the projecting part of the bone, and with this even to amputate all the fleſh beyond the level of the ſkin. M. Larrey condemns ſuch practice, as unneceſſary and dangerous, and he recommends giving nature time to effect the exfoliation of the diſeaſed projecting part of the bone, and heal the wound.

Of poiſoned Wounds.—Theſe injuries are eſſentially different from every other deſcription of wound, their great particularity depending upon the introduction of a venomous matter into the wounded parts, or its depoſition upon the ſurface of the injury; and, in general, the poiſon is inſerted by the weapon with which the ſolution of continuity is produced. Sometimes, however, the contrary happens, when previous cuts, or ſcratches of the fingers, which are not healed, become infected with a virus, in the diſſection of bodies, or in the dreſſing of venereal ulcers. Nay, there has lately been recorded in the public papers a remarkable inſtance, in which a nobleman's ſervant died, as is alleged, from the effects of the poiſon of a torpid viper, the fangs and poiſoned apparatus of which he had been handling and exhibiting to ſome viſitors, at a time when he happened to have a ſlight cut upon one of his fingers. The caſe is extraordinary, not only on account of the way in which the infection was contracted, but alſo on account of the fatal event, which is very uncommon in animals of the magnitude of the human ſubject, as we ſhall hereafter notice.

Pricks with the point of a diſſecting-knife, when the inſtrument is covered with putrid, infectious, irritating matter, may be conſidered as a claſs of poiſoned wounds. Sometimes, however, ſuch accidents are followed by no injurious effects; and when the ſubject is ſtrong and robuſt, a little inflamed tumour occurs in the ſituation of the puncture, the part feſters, burſts, and then heals up. But, as Richerand obſerves, obferves, when the accident befals a young man, who has been much weakened by hard ftudy, any kind of excefs, or fome previous difeafe, it frequently happens that no local fymptoms are feen. At the end of 24 or 36 hours, fometimes rather fooner, fometimes later, the axillary glands become affected with fwelling, and a painful phlegmonous inflammation takes place in them. The wound afterwards fefters; the parts around it exhibit appearances of a flow fort of inflammation, and the confequent fwelling of the hand is rather œdematous than inflammatory. Next often fucceed naufea and propenfity to vomit, proftration of ftrength, a fmall accelerated pulfe, and all the ufual fymptoms of typhus fever. Under thefe circumftances, if, inftead of a tonic plan of treatment, which is ftrongly indicated, the evacuating method be adopted, the patient very foon falls a victim.

Experience fully proves, that in ftrong vigorous habits, nature refifts with energy the introduction of poifons into the fyftem.

In the cafes under our confideration, tonic and cordial remedies are to be given in moderation. At the fame time, care is to be taken to clear out the primæ viæ, when they appear to be difordered. Abroad, it is the common practice alfo to apply a grain of cauftic potaffa, or a drop of the liquid muriate of ammonia, to the little wound itfelf.

The ftings of venomous infects, fuch as the bee, wafp, hornet, &c. are commonly treated of with poifoned wounds. The pain of the injury is alleged to depend lefs upon the introduction of the fting, which fometimes breaks and is left behind, than upon the infertion of a venomous fluid into the part. It is faid indeed, that the experiments made by profeffor Dumeril prove, that when the little cyft, fituated at the bafe of the fting, is removed, the introduction of the fting itfelf into the flefh caufes no particular pain. At the bafe of the fting there is a kind of veficle, or refervoir, for containing the poifonous fecretion, which is expelled and flows out along the fting, at the inftant when the latter penetrates the parts which are ftung. The venom of the bee is ftated to be neither of an acid nor of an alkaline nature. When applied to mucous furfaces, and even to the tunica conjunctiva of the eye, it produces no difagreeable fenfation; but if the point of a needle, after being dipped in it, be introduced into the flefh, a very acute pain is immediately excited. Various kinds of oil, honey, ammonia, fpirit of wine, and feveral other reputed fpecifics, appear to deferve no fuch character, fince they are found, after unprejudiced trials, to have no power of neutralizing the venom, nor of appeafing the actual pain arifing from the fting.

When, therefore, a perfon has been ftung by one or feveral bees, we are recommended to begin with extracting the ftings, taking care, however, previoufly to cut off with a pair of fciffars the little veficle at their bafe containing the venomous fecretion. This is to be done, left in the endeavours to remove the fting more of the venom fhould be compreffed out of the little refervoir into the wound. The part is afterwards to be covered with fnow, or bathed with ice-cold water, or fome cooling fedative lotion. In fhort, the cafe is to be treated on common antiphlogiftic principles, experience having fully proved that no fpecific has yet been difcovered for the fting of the bee, and other venomous infects. For other opinions and obfervations on this fubject, fee the article Bee.

Bite of the Viper.—Of all the venomous reptiles which are met with in Europe, there are none which inflict fo dangerous a bite as the viper or adder. Its upper jaw is furnifhed with two moveable fangs, which are very fharp-pointed, grooved longitudinally, and at their root are connected with a veficle which contains the venomous fluid. When the animal is irritated, the fangs become raifed, and the poifon flows along the grooves in them into the bitten part. The danger of the injury is in fome meafure proportioned to the fury of the animal; for when it is very much exafperated, it clofes its jaws with greater force, and more of the venom is compreffed into the wound. The degree of danger is alfo influenced confiderably by the greater or lefs fpace of time that has elapfed fince the reptile emptied the receptacles of its venom, by biting another perfon or animal. The injury likewife is generally found to produce lefs ferious confequences, in proportion to the greater fize of the animal which has been bitten. The experiments of Fontana prove, that the bite of a fingle viper will kill a moufe, a pigeon, or any other fmall animal; but that it muft be the bites of feveral to kill a man, and of a ftill larger number to deftroy an ox. It is alfo fuppofed by many writers on this fubject, that in all animals, whatever may be their fize, the degree of danger is confiderably greater, if they fhould be much frightened on the occafion, the proftration of ftrength produced by fear being conjectured to facilitate in a peculiar manner the pernicious operation of the venom. When a dog is bitten fuddenly and unexpectedly, he is, *cæteris paribus*, much lefs hurt than when he has received the injury in a conteft with the reptile, whofe very afpect has more or lefs alarmed him. The bite of the viper is thought to prove generally more or lefs fevere, in proportion to the heat of the weather.

The danger of the injury depends lefs upon the laceration of the parts, which, however, is confiderable, than upon the kind of venomous inoculation with which it is attended. The fymptoms which are excited come on almoft immediately. The perfon who has received the bite fuffers acute pain, and an inflammatory fwelling fpreads up the limb with remarkable rapidity, accompanied with a tendency to gangrene, as is indicated by the appearance of livid fpots. Affections of the heart, attended with great weaknefs and vertigo, denote that the action of the poifon extends to the whole fyftem. But thefe general effects do not arife, as Fontana wrongly imagined, from the venom having a power of coagulating the blood in the veffels, but in all probability from its operation upon the nervous fyftem.

The beft plan of counteracting the baneful effects of the bite of the viper confifts in introducing a few drops of the fluid muriate of antimony into the wound, and a fmall hair pencil may be ufed for the infertion of the cauftic, if the punctures fhould happen to be deep. Indeed, when the bottom of the wound cannot be cauterized without dilating it, the latter ftep is deemed proper by the generality of furgical writers. The furrounding parts may be rubbed with a liniment compofed of hartfhorn and olive-oil; and cordial medicines are to be exhibited, efpecially ammonia.

The amputation of the bitten part is rather too fevere a mode of preventing the ufual ill confequences of the bite of a viper to deferve recommendation. The ancients, with a view of counteracting the introduction of the poifon into the body, were accuftomed to apply a ligature round the limb above the injury; but it is a painful expedient, becaufe it cannot hinder the abforption of the venom, and the general conftitutional affection, unlefs the band be put on with fufficient tightnefs to impede the circulation. This, however, is the method which was adopted by Ambroife Paré, after he had been accidentally bitten by an adder.

The moft important object in the treatment is the prompt application of remedies; for the introduction of the virus into

into the conftitution ought to be prevented, if poffible. This is more likely to be accomplifhed than any aim at neutralizing the venomous fluid, after its effects have extended to the whole animal economy.

Even when the bite of a viper is entirely neglected, it very rarely proves fatal to the human fubject. In many cafes, the patients have recovered favourably under the mere ufe of olive-oil and of ammonia. Thefe two medicines have been recommended as fpecifics both in the Tranfactions of the Royal Society, and by the celebrated Bernard de Juffieu; and amongft the cafes in proof of their efficacy, authors ftill continue to quote the example of a dealer in vipers, who was quite indifferent about being bitten by thefe animals. He ufed to bathe the part in olive-oil, and at the fame time drink feveral ounces of this fluid. And in another inftance, which is frequently cited, a ftudent of botany, while herborizing, was bitten by a viper in a place where no medicine was at hand, except the eau de luce. Juffieu, who was prefent, introduced a few drops of this remedy into the wound, and adminiftered a tea-fpoonful of it internally in a glafs of water. The eau de luce is nothing more than the liquor ammoniæ, containing a fmall quantity of the oleum fuccini.

In France, and in other parts of the continent, the eau de luce is ftill looked upon as the internal medicine, on which moft reliance can be placed.

In this country, arfenic, in ftrong dofes, has been particularly recommended for its beneficial effects in counteracting the operation of the poifon of fnakes. The Tanjore pill, which has long been famous in India for its virtues in preventing the fatal fymptoms arifing from the bites of ferpents in hot countries, was known to have arfenic as one of its ingredients. Mr. Ireland, an army furgeon, happened to be at St. Lucia, in the Weft Indies, when feveral men of the 62d regiment were bitten by the coluber carinatus of Linnæus, the bite of which had already proved quickly fatal to feveral men of the fame corps. Mr. Ireland immediately adminiftered Fowler's folution of arfenic in ftrong dofes, and the refults of the cafes, in which he had an opportunity of trying it, were highly favourable to the practice, as the men's lives were preferved by it. (See Medico-Chir. Tranf. vol. ii. p. 393, &c.) Perhaps the prompt excifion of the bitten part, or the free ufe of the actual cautery, fhould alfo be invariably put in practice, for the bites of the more deadly kinds of ferpents, in conjunction with the exhibition of arfenic. But the ordinary confequences of the bite of a common adder are not ferious enough to require fo fevere a proceeding as the excifion or amputation of the parts would often be. Some obfervations on the ftructure of the viper will be found in the article Coluber, and other remarks on the bite of this animal will be feen in the articles Poison and Viper.

The worft poifoned wounds ever met with in this climate are thofe produced by the bite of a mad dog, and other rabid animals; but for a particular account of this highly interefting fubject, we muft refer to Hydrophobia.

Wounds of different Parts of the Face, Eye, Eye-lids, Ears, &c.—The countenance being the part in which any deformity is peculiarly confpicuous, it is always a great defideratum, in cafes of wounds of the forehead, cheeks, nofe, lips, &c. to prevent as much as poffible the formation of ugly fcars. Hence it is an invariable maxim to endeavour to heal wounds of the face by the firft intention.

As cuts of the face can hardly be very deep, adhefive plafter is generally fufficient for holding their oppofite edges together; but when the wound is fituated in the lips, thefe parts are fo inceffantly in motion, that furgeons find it beft to maintain the fides of the divifion in contact by means of the twifted future, a defcription of which is given in the article Harelip.

When the edges of a wound of the lips are much contufed and lacerated, fome authors recommend them to be pared off, in order to increafe the chance of union, and leffen the disfigurement of an uneven cicatrix.

Punctures of the tranfparent cornea of the eye are in themfelves much lefs ferious accidents than fimilar injuries of the fclerotic coat, which are almoft unavoidably combined with a wound of the choroides and retina. Hence, the latter cafes are frequently followed by a confiderable degree of inflammation. Sometimes the cryftalline lens itfelf is injured, and afterwards grows opaque.

Incifions made in the tranfparent cornea with very fharp inftruments may not give rife to any ferious confequences; and notwithftanding the efcape of the aqueous humour, the cryftalline lens and vitreous humour may remain in their natural fituation. The form, thicknefs, and denfity of the cornea are circumftances which produce a fpontaneous approximation of the edges of the wound to each other, and which, in fact, are extenfively in contact. But the coaptation is rendered very exact, and a quick re-union much promoted, by drawing down the upper eye-lid, fo as to fhut the eye; in which ftate, the cartilaginous tarfus of the upper eye-lid makes an uniform compreffion on the cornea, in a manner which is extremely ufeful. Cuts of the fclerotica are not in general fo fimple. The choroides and retina may be at the fame time either divided or expofed. In the firft cafe, the expulfion of the whole of the vitreous humour, and a total diforganization of the eye, are to be apprehended from the immediate fpafmodic contraction of the mufcles of this organ; and, in the fecond, a violent and dangerous ophthalmy is to be expected. When, in the inftance of a large wound of the fclerotica, choroides, and retina, the contents of the eye-ball are difcharged, the organ inflames, and gradually fhrinks into a much fmaller mafs, which is moveable, and capable of fupporting an artificial eye.

Contufed wounds of the eye-ball are moftly followed by a deftruction of the functions of the organ, either in confequence of the concuffion of the retina, or of the inflammation to which thefe injuries ufually give rife. However, in a few cafes, even contufed wounds of the eye have united very favourably, and without the lofs of vifion. Sometimes the folution of continuity extends through the fclerotica, while the conjunctiva itfelf is not ruptured. Delpech affirms, that he has feen feveral fuch cafes, in which the latter membrane prefented the appearance of an ecchymofis oppofite the divifion of the fclerotica, and confined the humours of the eye, which otherwife would have been loft. Précis des Maladies Chir. tom. i. p. 349.

Nothing is more likely than gun-fhot wounds to produce a violent concuffion of the retina, and an incurable paralyfis of this nervous expanfion. The fmalleft particle of lead, which either ftrikes or penetrates the eye-ball, may occafion thofe effects. Every other fevere contufion of the eye may act in the fame way. When the extravafation of blood originating from an accident of this kind is not attended with a ferious concuffion of the retina, the effufed blood will be abforbed, and the functions of the eye reftored.

In all cafes of wounds of the eye, fays M. Delpech, there are three fundamental indications; firft, to prevent the expulfion of the vitreous humour and cryftalline lens; fecondly, to promote the quick re-union of the wound by placing its edges very accurately together; and thirdly, to do every thing in our power to avert inflammation. The two firſt objects cannot be fulfilled without keeping the eye-lids continually cloſed. The prompt re-union of the wound is one of the moſt effectual means of preventing inflammation; but when this affection cannot be entirely hindered, it is to be reſiſted by the kind of treatment which is explained in the article OPHTHALMY.

Wounds made with pointed inſtruments may paſs through the eye-lids into the orbit, and thence through the thin bones which compoſe this cavity into the brain; or the weapon may penetrate directly between the eye-ball and ſide of the orbit into the brain. Injuries of this deſcription generally prove fatal on the ſpot, though ſometimes the patient lingers for a few hours.

In many inſtances, an injury by a ball, inflicted in the neighbourhood of one eye, produces paralyſis of the other. "Pierre Rouſſillier, of the 25th regiment of the line, in the ſervice of Napoleon, (ſays Mr. Hennen,) was wounded on the 18th of June, at Waterloo. The ball entered the right eye; the left, though not in the ſlighteſt degree injured to appearance, was completely blind. Rare, however, are the caſes where death does not follow all wounds, particularly ſmall punctured ones, going directly forward into the orbit, as this did. I felt under the zygoma, and all along the neighbourhood of this poor fellow's wound; but in the puffy ſtate of the parts could not detect the courſe of the ball. He himſelf was confident it had gone into his brain. He returned to France convaleſcent. Garengeot (Traité des Operations, vol. iii. obſ. 20.) gives us an intereſting caſe from the lectures of Petit, in which a ſoldier received a wound towards the great angle of the eye. It was deemed but of little conſequence, and healed under the common hoſpital treatment. The man expreſſed a wiſh to leave the hoſpital, although cautioned by the ſurgeon, and had ſcarcely reached the door when he was ſeized with rigors, obliged to return, and died in two days. On diſſection, the ball was found lodged under the ſphenoid cells and the hole of the optic nerve. The effect on this man's ſight is not mentioned." Hennen's Obſ. on Military Surgery, p. 360.

Wounds of the lower part of the forehead, or eye-brow, are ſometimes followed by the diſorder named *ptoſis*, in which the upper eye-lid hangs down more or leſs over the eye; but more commonly they give riſe to an oppoſite complaint, called *lagophthalmus*, in which, from a contraction of the cicatrix, the ſkin is drawn up, and the upper eye-lid cannot be made to cover the eye. See thoſe terms.

Wounds of the eye-brows ſometimes cauſe a ſpecies of blindneſs named the gutta ſerena. This conſequence is commonly thought to be owing to an injury of the nervous filament, which comes out of the orbit at the notch in the ſuperciliary ridge. It is very probable, however, that the affection of the eye is not altogether dependent on the injury of the nerve; for the blindneſs very often occurs when the cut is not ſituated near the track of the nerve, and frequently does not occur when the nerve is known to be wounded. According to Richter, it is when the wound is nearly or quite healed that the event is moſt likely to happen.

Scarpa has ſet down the gutta ſerena, ariſing from an injury of the ſupra-orbitary nerve, as abſolutely incurable; but we know that this ſtatement is not altogether correct; for Mr. Hey has recorded in the Med. Obſ. and Inquiries, vol. v. an example of amauroſis which got well, though it originated from a wound of the eye-brow. See GUTTA *Serena*.

Mr. Hennen ſays, he has met with one or two caſes of amauroſis from wounds of the ſupra-orbitary nerve. The perfect diviſion of the nerve did no good; but after ſome time the eye partially recovered. On Military Surgery, p. 366.

Wounds of the eye-lids ſcarcely admit of an effectual application of adheſive plaſter, and their edges are generally brought together with a ſuture. There are ſome practitioners, however, and amongſt them is M. Delpech, who conſider the uſe of ſutures, even in theſe caſes, quite unneceſſary. Précis des Maladies Chir. tom. i. p. 346.

Sabre-ſtrokes, directed obliquely downward againſt the face, very often produce a wound with a flap, which ſhould be immediately laid down in its proper ſituation again. When the flap is large and muſcular, Richter thinks it beſt to uſe a ſuture at one or two points, as the ſtrips of adheſive plaſter are apt to become diſplaced, eſpecially if the patient is reſtleſs, and then the flap of ſkin, not being ſufficiently retained, ſlips downwards, and the part is not healed without deformity. However, it certainly has always appeared to us that a ſuture in this inſtance may be diſpenſed with, if care be taken to aſſiſt the effect of the adheſive plaſter with a compreſs and bandage. Firſt Lines of the Practice of Surgery, p. 291. edit. 3.

Sabre-wounds ſometimes break and ſplinter the bones of the face. The fracture, however, ſeldom extends far, becauſe moſt of theſe bones are ſoft and ſpongy. Notwithſtanding ſuch injury of the bones, the wound of the ſoft parts frequently admits of being united, if care be taken to extract all the ſplinters, and put the ſurfaces of the diviſion of the bones as evenly together as poſſible. Unleſs the fragments are quite detached they ſhould never be taken away, but be replaced as well as circumſtances will permit. Their removal is not an eaſy matter, it occaſions an unpleaſant disfigurement, and experience proves that all diviſions of the bones of the face heal with particular readineſs. (Anfanſgr. der Wundarzneykunſt, b. ii. p. 244. edit. 3.) A very terrible ſabre-wound of the face is recorded by Mr. Hennen. The weapon ſtruck an officer nearly acroſs the eyes, one of which it deſtroyed; it then divided the parts downwards and inwards to ſuch an extent, that the pharynx could be ſeen. Yet the injury healed in a very favourable manner, as indeed do all wounds of the face, owing to its great vaſcularity. See Obſ. on Military Surgery, p. 370.

In ſome horrid caſes, where the lower jaw is ſwept away by a cannon-ſhot, life is preſerved; but, in general, the patient ſinks under the accumulated tortures of his ſituation. "It is ſtill, however, our duty," as Mr. Hennen obſerves, "to try every expedient; and after the ragged parts and ſplinters of bone are removed, the veſſels within reach ſecured, and the ſuppurating proceſs fairly eſtabliſhed, we may endeavour to aſſiſt nature, faithfully following any effort ſhe may make to fill up the chaſm, but without allowing ourſelves to count upon a ſhowy or complete cure." (Op. cit. p. 373.) This gentleman ſaw a horrid-looking caſe, in which nearly one half of the face was carried away by a round ſhot at Waterloo, in a very fair progreſs of contraction. Larrey has likewiſe recorded a ſimilar cure; and the writer of this article once witneſſed in Holland a moſt extraordinary recovery of the ſame nature. It was the caſe of a ſoldier, wounded at the aſſault of Bergen-op-Zoom, in 1814, who was afterwards brought into one of the military hoſpitals of Oudenboſch. All the lower jaw, and a large part of the upper, were in this inſtance completely torn away. There was very little hemorrhage, and no veſſels required the ligature.

For ſome obſervations on wounds of the tongue, we beg to refer to the article TONGUE.

When a part of the noſe is divided, but not entirely detached, it is the duty of the ſurgeon to replace it as expeditiouſly as poſſible. When adheſive plaſter does not appear to be be capable of securing the part in its proper situation, a suture may be employed. Writers usually advise keeping the nostrils pervious with soft flexible tubes, chiefly with a view of giving vent to the mucus which is secreted by the inflamed Schneiderian membrane, and which, if it could not readily escape, might prove exceedingly annoying to the patient. Putting out of the question Garengeot's extraordinary case, and a few others to which we have already adverted in a previous part of this article, we have many facts on record, proving not only that most incised wounds of the nose admit of union, but also that contused ones, attended with an almost complete detachment of the part, may often be united. In one instance, the cartilaginous portion of a young man's nose was nearly bit off by a horse, the separated piece only hanging by a thin portion of skin; yet after being replaced, and three stitches made, the part was united without any material deformity. Richter's Chir. Bibliothek, 6 band, seite 538, and Cooper's First Lines of Surgery, p. 282. edit. 3.

As the parotid duct passes beneath the integuments of the cheek over the masseter muscle, it is much exposed to wounds, which, if not properly treated, end in what are termed salivary fistulæ. Having considered this subject in a separate article, (see *Salivary* FISTULA,) we shall not dwell upon it at present. A late writer informs us, that in injuries of the parotid duct he has sometimes derived advantage from making the division complete by a clean incision across the duct into the mouth, and closely bringing together the edges of the wound on the outside of the cheek. The natural flow of saliva into the mouth kept the wound from healing up on the inside of the cheek. Hennen's Military Surgery, p. 374.

With respect to wounds of the external ear, experience has fully proved that they are cases which usually terminate favourably. Incised wounds and sabre-cuts of the ear mostly heal extremely well. Ravaton has recorded a case in which the ear united again, although it had been nearly separated from the head; and another instance of such success is mentioned in Cooper's Dict. of Surgery, art. *Wounds*. These and many other facts which might be quoted leave no doubt of the propriety of always making an attempt to unite parts, whenever the least connection between them remains.

Surgical authors differ in their statements about the effects of the total loss of the external ear upon the power of hearing. Thus it is asserted by M. Richerand, that the external ear, which is a sort of instrument calculated for concentrating the rays of sound, may be totally cut off without deafness being the consequence. For a few days after the loss, he says, the hearing is rather hard; but the infirmity gradually diminishes, the increased sensibility of the auditory nerve compensates for the imperfection of the organic apparatus, and the acuteness of the sense is entirely restored. (Richerand, Nosographie Chirurgicale, tom. ii. p. 122. edit. 2.) However, if we are to credit the statement of other writers, the recovery is far less complete than M. Richerand represents it to be. Thus Leschevin notices, that they who have lost the external ear, or have it naturally too flat, or ill-shaped, have the hearing less subtile. The defect can only be remedied by an artificial ear, or an ear-trumpet, which receiving a large quantity of the sonorous rays, and directing them towards the meatus auditorius, thus does the office of the external part of the ear. Prix de l'Acad. Royale de Chirurgie, tom. ix. p. 120. edit. 12mo.

Wounds of the external ear, whatever may be their size and shape, do not require a different treatment from that of the generality of other wounds. The re-union of the divided part is the only indication, and it may be in most instances easily fulfilled by means of methodical dressings. Such writers as have recommended sutures for wounds of the ear, (says Leschevin,) have founded this advice upon the difficulty of applying to the part a bandage that will keep the edges of the wound exactly together. The cranium, however, affords a firm and equal surface, against which the external ear may be conveniently fixed. Certainly, it is not more easy to secure dressings on the nose than the ear; and yet cases are recorded in which the cartilaginous part of the nose was wounded, and almost entirely separated, and the union was effected without the aid of sutures. See Mem. de M. Pibrac sur l'Abus des Sutures, in Mem. de l'Acad. de Chir. tom. iii.

In wounds of the ear, then, we may conclude that sutures are generally useless and unnecessary. As examples may occur, however, in which the wound may be so irregular and considerable as not to admit of being accurately united, except by this means, it should not be absolutely rejected. An enlightened surgeon will not abandon altogether any curative plans; he only points out their proper utility, and keeps them within the right limits. When sticking-plaster, simple dressings, and a bandage, that makes moderate pressure, appear insufficient for keeping the edges of a wound of the ear in due contact, the judicious practitioner will not hesitate to employ sutures.

When a bandage is applied to the external ear, it should only be put on with moderate tightness, since much pressure gives considerable uneasiness, and may induce sloughing of the part. In order to prevent these disagreeable effects, M. Leschevin advises us to fill the space behind the ear with soft wool or cotton, against which the part may be compressed without risk. Op. cit. p. 119.

In the application of sutures, the ancients have cautioned us to avoid carefully the cartilage, and to sew separately, one after the other, the skin of both sides of the ear. They were fearful, that pricking the cartilage would make it mortify, "ce qui est souvente-fois arrivé," says Paré. But notwithstanding so respectable an authority, the moderns make no scruple about sewing cartilages. In wounds of the nose, Verduc expressly directs the skin and cartilage to be pierced at once in applying sutures, and the success of the plan is put out of all doubt by a multitude of facts. The same treatment may also be safely extended to the ear. See Leschevin's Obs. in Op. cit., and Cooper's Dict. of Pract. Surgery, art. *Ear*.

Wounds of the Throat.—As Mr. John Bell has observed, there are several anatomical points which should be well remembered by the surgeon in all cases of wounds about the throat. First, it is to be recollected, that the arch of the aorta lies in the upper part of the chest in front of the trachea; and that where the carotid arteries come out of the chest to go up along the neck, they are scarcely at the sides of the trachea; they rather run before it. But, that as the arteries mount up the neck, they incline more to the side of the trachea; and that at the upper part of the neck, they are entirely behind that tube; for they incline towards the angle of the lower jaw, and having reached it, they begin there to give off their branches both to the head and neck. Hence we see the reason why a wound at the lower part of the neck is very often fatal, while a wound higher up is generally less dangerous. The suicide seldom strikes at the lower part of the neck; and it is from the accidental circumstance of his cutting very high up, near the chin, that the carotids escape.

Secondly, as the same author has explained, it should be remembered, that the carotid artery, the great jugular vein, and the par vagum, or eighth pair of nerves, lie very closely

 connected

connected with each other, being all inclosed in one mass of cellular substance, which forms something like a sheath for them. Now, says Mr. John Bell, since this eighth pair is one of the greatest nerves of the viscera, and since, by experiments upon animals, we know well that a wound of it is more fatal than a wound of the brain itself, this puts an end at once to all questions about the way of managing wounds of the carotid artery, or of the great vein. No doubt these may sometimes be partially wounded and the nerve escape; but, in general, the nerve will be cut along with them; and, at all events, the fatal consequences which would arise from including this nerve in a ligature, make it absolutely necessary that whenever the carotid is tied, it be first carefully separated from every other part. See John Bell's Discourses on Wounds, p. 415. edit. 3.

That the internal jugular vein, or the carotid artery itself, may sometimes be partially injured, without a wound of the par vagum, or the patient instantly perishing, has now been fully proved. The writer of this article knew of a case, which happened in the campaign in Holland in 1814, where the internal jugular vein was ruptured by the passage of a musket-ball down the neck; and yet the patient lived more than an hour after the accident, and when he died it was from suffocation, in consequence of the pressure of a large mass of extravasated blood upon the trachea. M. Larrey has related a very singular case: an officer received a gun-shot wound, which cut the external carotid at its separation from the internal, and in its passage through the parotid gland. Pressure made by an intelligent soldier at the moment, and subsequent bandages, saved the patient. (See Mémoires de Chir. Militaire.) This case is singular, because it is very uncommon for hemorrhage from so large a vessel as the external carotid to be permanently stopped by simple pressure, nor should we recommend the method to be imitated; for there is not in all surgery a better rule than that of trusting only to the ligature in every wound of a great artery. Mr. Hennen, however, informs us, that he knew of an English officer, who was also saved in India from the effects of an arrow wound in the carotid by the same means. (Obs. on Military Surgery, p. 180.) Such a mode of treatment we believe would fail a thousand times in succession; and the alleged cures would be more valuable, if it were always quite impossible to mistake hemorrhage from a branch for a bleeding from the trunk itself.

The writer of this article is acquainted with an army surgeon, in whose veracity he perfectly confides, who states, that he was once called to a soldier who had wounded the trunk of the carotid with a bayonet. The vessel was instantly taken up, and the man's life saved. In a modern publication may also be found another example, in which the carotid burst, and was taken up on the spot by Mr. Fleming, a naval surgeon. See Medico-Chir. Journal, vol. iii. p. 2.

Without positively maintaining, as Mr. J. Bell does, that it is impossible to cut through the trachea so as to open the œsophagus, without wounding the carotid artery, the jugular vein, and the eighth pair of nerves, we join him in believing that such an accident must be exceedingly rare. How then are we to explain the many alleged cures which are said to have been effected, notwithstanding the windpipe and œsophagus are stated to have been both cut through? We are to account for these extraordinary narratives in the manner so well pointed out by Mr. John Bell. "The fact is (says he), that neither the œsophagus nor the trachea is touched in the least degree, but the wound is much above them; for a suicide always strikes immediately under the chin. This wound, as far as I have observed, commonly falls in the line which divides the neck from the chin; that is, the place where the os hyoides lies, and he commonly cuts the os hyoides away from its connection with the thyroid cartilage, or pomum Adami. In that case, the thyroid cartilage, forming the uppermost part of the larynx, is not touched; the rima glottidis lies below the wound quite safe. The wound indeed separates the epiglottis from the glottis; but it leaves the glottis and the larynx quite safe. It only separates the larynx from the root of the tongue; it is properly a wound in the root of the tongue; it is rather a wound of the mouth than of the throat; and when the food comes out, along with spittle and froth, it is by rolling over the root of the tongue." On Wounds, p. 417.

That, however, the trachea and œsophagus may be both cut in a few cases, without immediate death from hemorrhage, we decidedly believe, because there are too many facts on record to admit of any doubt on the subject. See Default's Journal and Saviard, obs. 58. Hennen's Military Surgery, p. 386.

In these high wounds of the throat, it is the superior thyroid artery which is most frequently cut. This vessel, after quitting the external carotid at the angle of the jaw, passes along the side of the upper part of the trachea, inclining forward towards the thyroid gland in its descent, and being therefore much exposed to the edge of the razor. The bleeding from this artery is profuse, and if not speedily stopped is as fatal as hemorrhage from the carotid itself. In some of these cases, the bleeding also proceeds from branches of the lingual artery.

Wounds of the carotid artery, or jugular vein, commonly prove immediately fatal from loss of blood, before any assistance can be obtained. If a surgeon, however, were to arrive in time to render aid, it would be his duty immediately to apply a ligature both below and above the wound of the vessel. This is the only plan which affords any chance of saving the patient's life, and, as we have already noticed, it has actually been done with success in a few uncommon instances, in which the surgeon was not too late. In passing the ligatures beneath either of those vessels great caution is requisite; for the eighth pair of nerves lies close to it, included in the same sheath of cellular substance, and the inclusion of so important a nerve in the ligature would have fatal consequences. Its situation on the outside of the artery, between it and the jugular vein, should therefore be always carefully remembered. According to Richter, the internal jugular vein has actually been tied with success. Small wounds of the same vessel, if we are to credit the accounts of this author, may sometimes be healed by means of a graduated compress, which must be retained on the part with a bandage, or, if that prove irksome, with the finger. One thing, however, is essential; namely, the pressure must on no account be remitted, until the wound in the vessel is closed. Richter's Anfangsgr. der Wundarzn. b. iv. p. 173., and Cooper's First Lines of Surgery, p. 386. edit. 3.

M. Pelletan once saw a wound of the throat, which proved fatal in consequence of hemorrhage from the external jugular veins; and the same eminent surgeon met with another curious instance, in which a boy, who was convalescent after a cut of his throat, suddenly fell down in a state of suffocation and died: on examining the parts after death, it was discovered, that the left side of the epiglottis had been detached from the glottis and root of the tongue, and that in this loose unconnected state it had fallen upon the rima glottidis, and closed it so completely as to cause instantaneous suffocation. See Leveillé's Nouvelle Doctrine Chir. tom. i. p. 342, 343.

Wounds of the trachea are either fimple or complicated. In both defcriptions of cafes, the ufual fymptoms are, an emiffion of air between the lips of the wound, lofs of the voice, and fometimes emphyfema. Such injuries of the windpipe as are not complicated either with hemorrhage, emphyfema, or lofs of fubftance, may for the moft part be eafily cured by means analogous to thofe which are employed for the cure of wounds in general. The re-union is ftill more eafily accomplifhed, when the trachea is divided longitudinally, than when it is cut tranfverfely. If the wound be of a certain fize, and attended with hemorrhage, the firft indication is to tie the bleeding veffels, and, in particular, to obviate the inconvenience and danger which would refult from the infinuation of the effufed blood into the windpipe; an occurrence which has fometimes proved fatal. (Wilmer's Cafes and Remarks in Surgery, p. 92.) In order to prevent fuch an unfavourable event, fome furgical writers recommend the external wound not to be clofed while any oozing of blood continues, fo that this fluid may readily find an external outlet, inftead of falling into the trachea. (Laffus, Pathologie Chir. tom. ii. p. 291.) To us it appears, that the beft mode of preventing the occurrence is to bring the edges of the wound of the trachea into contact by a fuitable pofition of the patient's head, and, if requifite, even by a future.

The greater fenfibility of the larynx, its complicated ftructure, and the number and fize of its blood-veffels, *ceteris paribus*, render wounds of it much more dangerous than thofe of the trachea. In the firft volume of the Mémoires de l'Acad. de Chirurgie in 4to. many cafes may be confulted which furnifh proofs of this obfervation. In general, however, wounds of the thyroid cartilage heal very favourably, when not accompanied with injury of other important parts.

Tranfverfe wounds, dividing only the anterior half of the upper part of the trachea, ufually have a favourable termination, and when the cafes are of this defcription, the carotids and jugular veins for the moft part efcape injury. Gun-fhot wounds of the trachea are more dangerous, but experience proves that they alfo frequently end well.

The greater number of tranfverfe wounds of the trachea, which have not divided this tube completely through, readily admit of cure by the ftrict obfervance of a proper pofition. When the patient's chin is brought downward and forward towards the fternum, and the head is maintained in this pofture with pillows, the edges of the wound in the trachea become fpontaneoufly approximated to each other, and in time will grow together.

The manner in which the employment of futures aggravates the cough, and inflames the wound, often neceffitates the furgeon to withdraw them when they have been applied. It may alfo be truly afferted, that befides the irritation which they create in the trachea as extraneous fubftances, they are (to fay the beft of them) very unneceffary. Nothing has a greater tendency to impede the union of a wound of the trachea than the difturbance of a frequent convulfive cough; and the irritation of futures always increafes this hurtful fymptom in a much greater degree than they can do good by maintaining the edges of the wound in contact. In fact, unlefs the greater portion of the diameter of the trachea be divided, there never can be fuch a fpace between the edges of the wound, that they cannot be brought together with the affiftance of a judicious pofture of the head.

When the patient is much afflicted with inceffant coughing, and the inflamed ftate of the wounded parts appears to operate as the caufe of this difagreeable fymptom, relief is to be obtained from bleeding, and the exhibition of foothing and aperient medicines. In cafes in which no particular local irritation can be fufpected of giving rife to the cough, the furgeon may prefcribe the almond emulfion, fpermaceti mixture, and opium, which will frequently be found remedies of the moft decided efficacy.

In order to prevent the entrance of the difcharge and blood into the trachea in particular inftances, the plan has been tried of making the patient lie on his fide, with his face turned downwards. (See Mém. de l'Acad. de Chir. tom. i. p. 581.) But, although the cafe here referred to ended well, we believe, as already explained, that nothing prevents the entrance of blood or matter into the trachea fo effectually as keeping the edges of the wound of this tube accurately in contact, which is to be principally effected by bringing the chin down towards the breaft. This is an object which is far more difficult of accomplifhment, where the patient lies on his fide, than when he remains, as is moft ufual, upon his back.

When a wound has detached the upper portion of the trachea from the lower one, and it is not immediately fatal from the injury of other important parts, the bleeding veffels are firft to be tied, and the two ends of the trachea are then to be brought into contact. In this fort of cafe, we believe that the employment of a future is warrantable, on account of the immenfe feparation of the divided parts, and the inefficacy of pofition alone to prevent it. But, even in fuch a cafe, one ftitch will be quite enough when the chin is properly approximated to the fternum, and the needle fhould never be introduced through the membranous lining of the windpipe, as it is very fenfible, and much difpofed to inflammation.

The hoarfenefs and weaknefs of the voice, fometimes remaining after the wound is healed, often gradually difappear.

Many furgical writers recommend the patient to refrain from making forcible expirations, and from drawing the head fuddenly backwards, for a certain time after the wound is healed. By fuch caufes, it is afferted, the recent coalefcence of the wound may be eafily deftroyed.

Wounds made with bullets, which ftrike the fide of the neck and lacerate the trachea, have frequently been obferved to terminate well. (Mém. de l'Acad. de Chir. tom. iii. p. 151, &c. edit. 12mo.) Ravaton mentions feveral inftances, which not only got well, but were alfo followed by a recovery of the voice.

Sutures are not applicable to thefe cafes. A ftrict adoption of the pofition recommended above, and the application of an emollient poultice contained in a fine linen bag, are the chief local chirurgical meafures. The ufe of leeches, venefection, faline medicines, and antiphlogiftic remedies of every defcription, will alfo be generally proper. (See Firft Lines of Surgery, p. 387. edit. 3.) Opium is likewife not to be forgotten as an extremely ufeful medicine in cafes of wounds about the throat: it not only appeafes the cough with which fuch injuries are often accompanied, but tends to quiet the great mental and nervous anxiety which in examples of attempted fuicide exifted previous to the infliction of the wound, and generally continues for fome time afterwards in a very aggravated degree. Indeed, many of the unhappy perfons who attempt to deftroy themfelves by cutting their throats, ftill retain for a good while after the failure of the firft attempt, a determination to take another opportunity of accomplifhing their fatal purpofe; hence fuch patients cannot be too clofely watched, and nothing like a razor or a knife fhould ever be put within their reach. The neceffity of a conftant vigilant attendant is alfo

alfo neceffary, in order to hinder the dreffings from being pulled off, and the wound torn open again, by the reftlefs movements or actual violence of the patient.

In cafes in which the whole diameter of the trachea is cut through, the French furgeons have propofed the introduction of a flexible catheter from one of the noftrils into the larynx and trachea, in order to infure a paffage for refpiration, which, they fay, without this means is liable to be completely intercepted when the outer wound is clofed, in confequence of the two portions of the windpipe being drawn away from each and not correfponding. (Richerand, Nofogr. Chir. t. iv. p. 170. edit. 4.) This, however, would not be the practice to which we fhould give a preference; firft, becaufe the introduction of a flexible catheter is a thing which cannot always be accomplifhed with facility; fecondly, becaufe its ufe in this way is conftantly productive of confiderable irritation; and, thirdly, becaufe we deem the employment of a future the beft means of hindering one part of the trachea from becoming feparated far from the other, and thus of infuring a paffage for refpiration.

With refpect, however, to the introduction of a flexible catheter from one of the noftrils into the œfophagus, for the purpofe of giving food and medicines to the patient, without any motion or difturbance of the wounded parts, we confider the method entitled to the higheft praife in all cafes of ferious wounds, either of the larynx, the trachea, or the œfophagus. When a perfon fwallows, the mufcles concerned in the elevation and depreffion of the larynx act in a fudden convulfive kind of manner, and caufe a moft injurious difturbance of the wound. But when nourifhment and medicines are injected into the ftomach through a flexible tube, introduced from one of the noftrils down the œfophagus, this hurtful action of the mufcles is entirely prevented; the inftrument may be kept there without any annoyance or irritation, and the requifite quantity of aliment, and whatever internal remedies may be indicated, can be given with the utmoft convenience. We confider this ufe of flexible catheters as conftituting a very material improvement in the treatment of fevere wounds of the throat. The military furgeon, in particular, fhould never be without thefe inftruments; and whoever has read the relations of M. Larrey, in his Mémoires de Chirurgie Militaire, will fee, that fometimes in bad wounds of the throat, the patient's chance of recovery depends almoft entirely upon the aid to be derived from the fkilful employment of an elaftic gum tube.

Wounds of the œfophagus may either amount to a total or partial divifion of that tube; they may be either with or without a total divifion of the trachea; and with or without injury of other important parts in the vicinity. Hence fuch wounds are fometimes abfolutely fatal; and, in general, when they admit of cure, nature has a greater fhare than art in bringing it about. Some benefit, however, is to be derived from good furgery, and infinite harm may refult from bad.

A total divifion of the œfophagus muft prove immediately fatal. The inevitable fimultaneous injury of other important parts would render fuch a cafe at once mortal. The celebrated Pruffian furgeon, Schmucker, has treated fmall wounds of the pharynx and upper part of the œfophagus with fuccefs. Wounds dividing half or even two-thirds of the tube are alfo ftated to have been cured. (Mém. de l'Acad. de Chir. tom. iii. p. 151. edit. 12mo.) The poffibility or impoffibility of a cure muft obvioufly depend upon what other parts of confequence are injured.

Incifed wounds, which divide the front of the œfophagus, muft derive additional danger from the fimultaneous divifion of the whole circle of the trachea; and, indeed, fo much would the internal jugular vein, par vagum, and carotid artery, be expofed to the edge of the knife in a cut of this kind, that it is difficult to conceive how they can ever efcape. Mr. John Bell, as we have feen, believed that they never could; and were it not for the many examples publifhed, fome of them by fuch a man as Default, and for an inftance which was lately in St. Bartholomew's hofpital, we fhould have joined Mr. J. Bell in thinking, that all reports of this kind were miftakes, arifing from the wound extending through the root of the tongue into the mouth, and not actually injuries of the œfophagus itfelf.

A punctured wound, penetrating the fide of the œfophagus, may not be complicated with injury of the trachea, and therefore may not be attended with fo much peril as an incifion. But although ftabs injuring the œfophagus are not regularly and certainly mortal, they are always to be regarded as dangerous cafes.

Should the cafe be one of thofe fortunate incifed wounds which leave the great veffels uncut, though the injury of the œfophagus be complicated with a complete divifion of the trachea, the furgeon can leffen the fpace between the edges of the wound in the œfophagus by bringing the divided portions of the trachea together. This effect muft refult from the manner in which the pofterior part of the windpipe is connected with the œfophagus. But for this purpofe, a future is only to be ufed in fuch a ftate of the wounded trachea as amounts to a total divifion of the tube; for in all other cafes, a proper pofition of the head, and the ufe of adhefive plafter to the external wound, fhould be the means with which the furgeon ought to be content, with a view of bringing the margins of the wound of the trachea near to each other.

In cafes of wounds of the œfophagus, it was recommended, as long fince as the time of Ravaton, to inject nourifhment and medicines into the ftomach, through a fmooth tube of a fuitable fize, introduced down the pharynx. In one cafe of paralyfis of the œfophagus, which occurred in this country, a fmall frefh eel-fkin was paffed down this canal, by means of a whale-bone probang, in order that medicines and food might be injected into the ftomach. (Hunter, in Tranf. for the Improvement of Med. and Chirurgical Knowledge.) The many cafes, however, in which Default advantageoufly employed an elaftic gum catheter for the fame objects had a principal influence in eftablifhing the practice. The inftrument was introduced through one of the noftrils, and was often left in the œfophagus for feveral days together. (See Œuvres Chir. de Default par Bichat, tom. ii.) The introduction of elaftic gum catheters down the pharynx and œfophagus is not only highly neceffary in examples of paralyfis, and wounds of thofe paffages, but it is an exceedingly ufeful practice in wounds of the trachea, where the convulfive action of the mufcles in deglutition would otherwife create a very hurtful difturbance of the injured parts. (Firft Lines of Surgery, p. 38, 39. edit. 3.) The practice is alfo fometimes abfolutely neceffary in many complicated wounds about the face, fuch as thofe produced by the difcharge of a piftol into the mouth, and attended with extenfive laceration of the tongue, cheeks, and fauces, and a comminuted fracture of the lower and upper jaw-bones. We believe, indeed, that in all fractures of the lower jaw, the introduction of a flexible catheter from one of the noftrils into the œfophagus is an extremely judicious meafure, becaufe the action of deglutition has a greater effect in difplacing the broken bone and difturbing the procefs of union than any other circumftance.

Gun-ſhot wounds of the neck ſometimes occaſion an immediate loſs of the uſe of the arm on the affected ſide; a circumſtance which may in general be accounted for by the injury of ſome of the cervical nerves, in their deſcent to and from the axillary plexus. See Hennen's Military Surgery, p. 378, and Thomſon's Report of Obſervations made in the Military Hoſpitals in Belgium, p. 75, 76.

Wounds of the Thorax, or Cheſt.—Some of theſe injuries penetrate the cavity of the thorax; others are more ſuperficial, only affecting the ſkin and muſcles, and not extending through the pleura coſtalis. When the latter caſes are produced by ſharp-cutting inſtruments, and the only indication is to accompliſh an union of the divided parts, as happens in inciſed wounds of the ſkin, latiſſimus dorſi, pectoralis major, &c. ſuch injuries are not materially different from any ſimple wounds of other parts of the body, and require a ſimilar mode of treatment.

But where much violence has been applied to the parietes of the cheſt, and the concuſſion has operated ſo forcibly as to affect the heart, lungs, and other important organs, the wound, although ſimple in appearance and not penetrating the cheſt, may nevertheleſs be followed by alarming ſymptoms, either at firſt or conſecutively; ſuch as inflammation of the lungs, ſpitting of blood, and difficulty of breathing, as is frequently obſerved in contuſed and gunſhot wounds of the parietes of the cheſt. A violent blow on the dorſal vertebræ is alſo ſaid to have given riſe to a dilatation of the heart, and an aneuriſm of the aorta. Laſſus, Pathologie Chir. tom. ii. p. 305.

Thus profeſſor Thomſon, in his account of the wounded whom he obſerved after the battle of Waterloo, remarks, "We ſaw more inſtances than one in which a ball, in paſſing acroſs a portion of the parietes of the thorax, without penetrating that cavity, had excited an alarming and dangerous degree of inflammation of the pleura. In one of theſe, the ball had taken an oblique direction along the lower part of one of the ſides of the cheſt. In another it had ſtruck againſt a ſtrong leathern belt that was ſuſpended over the right ſhoulder, made a deep indentation in this belt without penetrating it, and produced a ſeverely contuſed wound at the inner extremities of the firſt and ſecond ribs of the right ſide. This patient ſuffered much from inflammation. The injured portions of the ribs had exfoliated and come out, and the motion of the lungs in inſpiration and expiration was perceptible from the ſinking and riſing of that part of the parietes which had been deprived of its bony ſupport. In another remarkable caſe, the ball entered above the middle of the clavicle, and paſſed out at a point directly behind. Neither at the firſt, nor at the time we ſaw this caſe, was there any reaſon to believe that the ball had wounded the pleura. Inflammation, however, of this membrane came on, which terminated in ſuppuration. The operation for empyèma was performed, and about four pints of pus evacuated." Reports of Obſ. in the Mil. Hoſpitals in Belgium, p. 82.

In wounds of the cheſt, it is often difficult to pronounce with certainty whether they penetrate into the ſac of the pleura; but all doubts with regard to this point are removed the moment we obſerve air coming out of the wound upon coughing. That the lungs have been wounded may be inferred with nearly equal correctneſs in every caſe, in which a perſon ſpits blood immediately or ſoon after receiving a wound of the cheſt.

It rarely happens that a wound penetrates the cavity of the thorax without producing more or leſs injury of the lungs, and the danger of the latter accident is in proportion to its depth, its ſituation, and the ſize of the weapon with which it was inflicted. A wound of the lungs with a ſmall ſword ſeldom gives riſe to much effuſion of blood in the cheſt, unleſs ſome of the large veſſels of thoſe organs happen to be hurt. Putting this circumſtance out of preſent conſideration, the uſual ſymptoms which the patient ſuffers are, a ſpitting of blood, cough, and difficulty of breathing, ſucceeded by a good deal of ſymptomatic fever.

"To diſcover whether the wound has injured the lungs or not, (ſays a late writer,) is a point which has given to the older ſurgeons great room for employment of their ingenuity in deviſing poſſible caſes, and has occaſioned no ſmall waſte of time and wax-tapers in aſcertaining the exit of air through the paſſage. A practical ſurgeon will require but little inveſtigation; bloody expectoration *immediately* on receiving the wound, and the terrible ſymptoms of dyſpnœa, ſenſe of ſtricture and ſuffocation, inſupportable anxiety and faintneſs which ſucceed, ſoon enough diſcover the fact; and if by good fortune no intimation is given in this way, happy is the ſurgeon, and thrice fortunate the patient.

"The immediate danger in wounds of the lungs is either from debility from hemorrhage, or ſuffocation from the blood flowing into the air-cells and cavity of the thorax. The effuſion of air forming emphyſema is alſo a troubleſome, but (as Mr. Hennen believes), taking it abſtractedly, is not a dangerous ſymptom of thoſe injuries; neither (ſays he) is it by any means ſo frequent as has been ſuppoſed. The ſymptoms that I have now enumerated, whether ſingle or in combination, may be deemed the primary effects of wounds of the thorax. Violent inflammatory affections of the lungs and the membranes ever ſubject to relapſe; long and tedious ſuppurations and exfoliations of the bones are the ſecondary, and though not ſo rapidly fatal are often as certainly ſo as the others. Diſeaſes which, although we cannot ſtrictly call them pulmonary conſumption, agree with it in many points, particularly in cough, emaciation, debility, and hectic, are often the conſequences." Obſ. on Military Surgery, p. 395.

When the weapon is broad, and it has entered the ſubſtance of the lung, the hemorrhage is conſiderable; blood is immediately extravaſated in the cavity of the thorax, and alſo flows out of the external wound; the patient has a violent paroxyſm of coughing, in which ſome of the blood is ejected from the mouth; the air comes out of the cheſt with a hiſſing noiſe; and if the outer wound be not parallel to that of the lungs, emphyſema takes place. As we have already ſtated, the danger of ſuch an injury depends upon the depth of the wound, and the ſize of the veſſels which are opened. Some patients recover, while others die inſtantly, or in a very ſhort ſpace of time.

As an intereſting author remarks, it is a thing really wonderful, "that the thorax, containing the heart, lungs, and great veſſels, ſhould be ſo often wounded with ſo little danger. Many no doubt die, but numbers eſcape; for a wound of the ſubſtance of the lungs is far from being mortal. The blood may ſuffocate the patient; the fever and pain may waſte him; he may die of the inflammation, or of the oppreſſion of the lungs; or there may be time for a large ſuppuration, or a lingering hectic to cut him off; but ſtill, if his wound be only in the edges of the lungs, he is in ſome degree ſafe. He is only in danger when the thick ſubſtance of the lungs is perforated, and falls into abſceſs, or when the root of the lungs is wounded; for there the large veſſels of the lungs being opened, the great effuſion of blood, like that from a wound of the heart itſelf, muſt kill, even by the quantity of blood loſt to the general ſyſtem. But beſides, this blood, being thrown into the

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trachea, deluges the lungs; the patient fpits up a frothy blood; blood, inftead of air, occupies the bronchiæ; fo that he ftruggles for breath but a few moments, and then expires." John Bell's Difcourfe on the Nature and Cure of Wounds, p. 257. edit. 3.

We fhall next confider the treatment of penetrating wounds of the cheft. In thefe cafes, the patient may die inftantaneoufly of internal hemorrhage and fuffocation; or he may be cut off by the effects of inflammation within the cavity of the thorax. If (fays Mr. John Bell) the patient be fpitting blood and breathing high, but not much oppreffed, or his oppreffion increafing very flowly, there are hopes that he may be faved. If there be no great veffel wounded in the lungs fo as to fuffocate him at once, it is probable that the fmaller veffels which are opened by the wound will gradually ceafe to bleed; and after four or five days of alarming cough, with bloody expectoration, that fymptom will ceafe; and in order that he may the fooner be relieved from his danger, *he muft be bled very freely*. Let it be the intention to reduce him very low by quick bleedings; and let thefe bleedings (fays Mr. John Bell) have the effect of continued internal hemorrhage, without the dangers of it. Let them deprefs him to the fame low condition to which the inward bleeding would moft likely have brought him; and the fyftem being emptied in this direction, there will be lefs danger of immediate fuffocation in the lungs, and but little fear of the fucceeding inflammation rifing too high. It is only by thefe repeated bleedings that the patient can be faved: the vafcular fyftem muft be kept low in action, and fo drained as to prevent the lungs from being oppreffed with blood.

One thing (continues the fame author) is very clear, that if the furgeon bleed only when the cough and bleeding from the lungs return, he never can do wrong. The patient, lying ftruggling before him, is to lofe a given quantity of blood; if it be allowed to flow out into the lungs he may be fuffocated; if it be drawn from the arm, this fuffocation is prevented. If he be kept low enough by bleeding, there will be no blood to fpare for this extravafation into the lungs, &c. (Op. cit. p. 259, 260.) We repeat, in all cafes of penetrating wounds of the cheft, and efpecially in injuries of the lungs, the free ufe of the lancet is the only thing which can be depended upon in the early part of the treatment. By it, internal hemorrhage is reftrained; and by it, the dangers of the fubfequent inflammation of the thoracic vifcera are to be averted. The records of furgery furnifh abundant proof of the neceffity of fuch practice, and the extent to which the bleeding muft be carried is fometimes furprifing. Thus, in a cafe in which a mufket-ball had entered the left fhoulder, paffed through the lungs, and come out below the left nipple, a profufe hemorrhage of arterial blood took place from the mouth, and threatened immediate fuffocation. This hemorrhage was checked by repeated bleedings, which were reforted to on every frefh attack of the hemorrhage, and pufhed till relief was obtained. Leeches were applied to the fide in great numbers, and the antiphlogiftic plan of treatment was ftrictly purfued. Two hundred and fifty ounces of blood were in this cafe drawn off by the lancet in eighteen days. (See Thomfon's Reports of Obf. made in the Military Hofpitals in Belgium, p. 86.) In every inftance of a penetrating wound of the cheft, and more particularly when the lungs are injured, the firft bleeding fhould be copious. As Mr. Hennen recommends, from thirty to forty ounces of blood fhould be taken from the arm by a large orifice. If the patient fhould faint, we ought not to adminifter cordials to him, but allow him to revive gradually. We fhould avail ourfelves of this opportunity of extracting without pain all foreign bodies within reach, whether cloth, ball, iron, wood, fplinters of bone, &c. Should there be reafon to think that fuch extraneous fubftances are lodged, and that by an enlargement of the orifice of the wound they might be extracted, the practice ought to be immediately adopted.

The next object is to drefs the wound itfelf. "If it is a gun-fhot (fays Mr. Hennen), a light mild dreffing will be fufficient; but if incifed, the lips of it fhould be clofed at once, and this treatment will be found to afford the moft certain preventive to emphyfema (fee EMPHYSEMA), future hemorrhage, and collections of matter. (See EMPYEMA.) I fcarcely recollect an inftance where it was neceffary to remove the adhefive ftraps, or (where it was a gun-fhot) the ufual dreffings. We now lay the man down, and let him remain as quiet as poffible, and in as cool and airy a fpot of the barn, church, or hofpital, as we can find. He will often require no farther aid; but if the cafe is very fevere, he will probably lie for fome hours in a ftate of comparative eafe, till the veffels again pour forth their contents, and induce frefh fpitting of bloody froth, and a repetition of all the fymptoms of approaching fuffocation. The lancet muft again be had recourfe to; and if by this management, repeated as often as circumftances demand, the patient furvives the firft twelve hours, hopes may begin to be entertained of his recovering from the immediate effects of hemorrhage. In the after-treatment of a wound of the nature here defcribed, we fhall be confiderably affifted by the aid of medicine; but until the danger of immediate death from hemorrhage is over, we muft not think of employing any thing except depletion by the lancet: it, and it only, can fave the life of the wounded man." Hennen's Obf. on Military Surgery, p. 398.

When the paroxyfms of pain, the fenfe of fuffocation, and return of hemorrhage, fays Mr. Hennen, have become more moderate, and recur at longer intervals, we may have recourfe to means of lefs immediate influence, and fpare the lancet. In this view, the moft powerful medicine that we can adminifter is the different preparations of digitalis, in fuch form as may beft agree with the patient; and if the pain and efforts to cough are fevere and fpafmodic, we muft have recourfe to the aid of opiates. To this courfe of medicine fhould be added a rigour of diet, amounting to the total prohibition of every thing folid, and admitting of fluids only of the mildeft nature and leaft irritating quality; and even thofe in fmall quantities, and duly acidulated. Should we be fortunate enough to preferve our patient during the firft fix or feven days, a relaxation in this rigour may be cautioufly admitted; but a departure from the general plan, or an omiffion of bleeding on the rifing of the fymptoms, can only tend to accelerate the event that our efforts are defigned to counteract. Mild faline purges, and an emollient enema, fhould be occafionally adminiftered if required, and the patient kept in a ftate of the utmoft quiet and feclufion from all external impreffions, and in a cool atmofphere. (Op. cit. p. 400.) The plan of exciting a counter-irritation on the furface of the cheft, by means of blifters, fhould alfo never be omitted, when much cough and pain in the breaft continue after bleeding has been fully practifed. In fome examples, the inflammation occafioned by penetrating wounds of the cheft terminates in fuppuration within the lungs, or the fac of the pleura. The fymptoms, however, which indicate fuch an occurrence, and the mode of treatment, are fo amply explained in another part of this work (fee EMPYEMA), that we fhall not enter into the fubject again.

There is one circumftance which fometimes deceives the furgeon,

furgeon, and leads him to fuppofe that the cafe is a penetrating wound of the thorax when it is not fo. We allude to the occafional examples in which a mufket-ball pierces the fkin and mufcles on the outfide of the cheft, runs round the ribs, and makes its exit nearly oppofite the point of entrance. Here the abfence of bloody expectoration and other fymptoms of injured lungs, together with the direction of the commencement of the track of the ball, will fometimes convey ufeful information to the difcerning practitioner.

There is alfo another fource of deception as to the actual penetration of balls into the cavities of the body: this is when they ftrike againft a handkerchief, linen, cloth, &c. and are drawn out of the wound unperceived in a fold or pouch of thofe materials. M. Larrey, Mr. Hennen, &c. have publifhed examples of the occurrence.

Wounds of the cheft are fometimes complicated with the lodgment of extraneous fubftances in that cavity, and this fometimes without occafioning fatal confequences, either immediately or fubfequently. Thus Mr. Hennen informs us, that in examining the bodies of foldiers who have died from thofe injuries, he has frequently found pieces of wadding, of clothes, fpiculæ of bone, and balls, and, in one cafe, fome charpie ufed as a dreffing, either loofe in various parts of the lungs, or lying in facs, formed by a depofition of coagulating lymph. In fome more fortunate patients who recovered, fuch matters were difcharged or extracted from the wounds; and in certain other lucky examples they were ejected by the convulfive efforts to cough, which their irritation had excited. (Obf. on Military Surgery, p. 390.) The fame author relates the following interefting cafe, to prove that a much larger mafs than a bullet may pafs even through the lungs, without doing away all chance of recovery.

A foldier of the guards was wounded through the thorax at Waterloo, between the third and fourth ribs of the right fide. On his arrival at Bruffels, he was placed in an hofpital and dreffed. Nothing remarkable occurred for the firft five days; and the only fingularity in the appearance of the wound was its large fize, capable of admitting three fingers conically placed. Blood and air were freely difcharged from it. On turning the man to examine him, and renew the dreffings, a tumour was difcovered on the fcapula, from which was extracted his breaft-plate, about two-thirds of which were rolled up by the force of the blow into a figure fomewhat refembling a candle-extinguifher, with the mufket-bullet contained within it. The other third was broken off; but it had alfo paffed through the wound, and was extracted. The man furvived the injury three weeks, and afforded great hopes of his perfect recovery; but in a guft of paffion, he one night tore the dreffings off his wound, and was found dead the next morning. The body was not examined. Op. cit. p. 392.

Balls have been found in the fubftance of the lungs twenty years after their entrance, the patient being all that time in perfect health, without any fymptom characterizing the peculiar fituation of fuch foreign bodies. There are alfo on record inftances in which a ball has rolled about in the cavity of the thorax on every motion of the body. (See Baron Percy's Manuel do Chirurgien d'Armée, p. 25; Magatus's Bibliotheca Chirurgica; and Hennen's Military Surgery.) In general, however, balls lodged in the thorax become as it were encyfted and fixed by the depofition of coagulable lymph around them, and the formation of a fort of fac.

Several authors have noticed, that when a penetrating wound of the cheft is of a certain fize, a portion of the lungs fometimes forms a protrufion between the ribs. In the majority of fuch cafes, there can be no doubt of the propriety of immediately reducing this fort of hernia, and keeping it fo replaced by means of a fuitable apparatus. We learn, however, from the obfervations which have been collected on this fubject, that the protruded part of the lung has fometimes been tied, or cut away, without any ill confequences. Fabricius Hildanus records the cafe of a man who was wounded with a fword between the fifth and fixth ribs, near the fternum, and in whom a piece of lung protruded. On examination it prefented a livid appearance, and the difcoloured part was therefore cut away with a heated knife. The reft was reduced, after feparating the two ribs, from each other, as far as poffible, by a wooden wedge. Notwithftanding this extraordinary method of treatment, the patient foon recovered, and lived without experiencing any oppreffion in refpiration. See Centur. 2. Obf. 32. p. 108.

The livid appearance of the lung, as M. Laffus obferves, arifes from its expofure to the air, and the manner in which it is ftrangulated between the two ribs. It affords no proof either that the protruded part is gangrenous, or that it ought to be cut away. (Pathol. Chir. tom. ii. p. 309.) A writer (fays he) who is very little known, and whofe cafe we fhall relate, confeffes his having miftaken this livid difcolouration for a fign of mortification. A man received a ftab between the third and fourth ribs, on the right fide of the cheft, and by the way in which the fword had been withdrawn, the wound was rendered very large. A portion of the lungs protruded, fwelled confiderably, and remained in this ftate three or four days without any attempt being made to reduce it. The part then became fhrunk and quite dry, when the whole of what was exterior to the ribs was cut off. On dipping the piece of lung in water, however, it immediately refumed its natural colour, which, no doubt, it would alfo have done had it been reduced inftead of being amputated. The patient neverthelefs got quite well, and fuffered afterwards no difficulty, notwithftanding the hard laborious life which he was obliged to lead. Obf. Medicinales et Chirurgicales par Loyfeau, p. 25.

A fimilar miftake was made on a patient who had received a wound which penetrated the anterior and inferior part of the cheft. A fmall bit of the lungs protruded, which was fuppofed to be a piece of omentum, and was immediately included in a ligature. Ruyfch being confulted, perceived the miftake, and he recommended dreffing the wound, and leaving things as they were, until the tied portion of lung had become detached. No bad fymptoms followed, and the patient perfectly recovered. (Obf. Anat. Chir. obf. 53.) We met with a protrufion of a long piece of the lungs in a foldier, who had been wounded with a lance at the battle of Waterloo. The part was at leaft four inches in length, and fhaped like a tongue. As it was confiderably contufed and torn, we doubted the prudence of returning it in that ftate into the cheft. We thought, therefore, of cutting it off, but fearful that it might bleed freely, we firft made a fmall incifion into it, in order to afcertain the fact; and as a good deal of blood began to flow from this little incifion, we firft tied the protruded part clofe to the ribs, and then removed all that was exterior to the ligature. The patient was fo well on the day of the operation, and alfo the next morning, that he would not remain in bed; but we were informed that he did not ultimately recover.

A wound of one of the intercoftal arteries immediately produces a degree of hemorrhage, which is manifeft externally, and often confiderable. The blood flows out of the wound, and alfo into the cavity of the cheft. It iffues

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per saltum, like that of all wounded arteries, and it gushes out both in inspiration and expiration, but without any hissing noise, and not blended with mucus and air, like the blood which is discharged from a deep wound of the lungs.

We should not have expected much hemorrhage from the intercostal artery when wounded by a ball, much less should we have expected that it was ever possible to take up that vessel with a tenaculum. Yet a late writer observes, "whenever the tenaculum can be used to an intercostal artery injured by a ball, it should at once be applied, and the vessel secured by ligature." (See Hennen's Obs. on Military Surgery, p. 401.) Professor Thomson heard only of one hemorrhage from the intercostal artery after a gun-shot wound received at Waterloo, and this was a secondary bleeding on the fifteenth day. It was stopped by a compress. See Obs. on the Military Hospitals, &c. p. 83.

This sort of bleeding can only be stopped by compression, and in order that the plan may be effectually practised, it is sometimes necessary to enlarge the wound by an incision. When the finger is put under the wounded artery the bleeding ceases, which obviously proves that there is no occasion for needles, nor for any particular inventions for stopping the hemorrhage. According to M. Lassus, it will be quite enough to introduce between the ribs a tent, or dossil of charpie, which is to be kept in the wound four or five days. The bleeding having stopped, the wound will discharge for some days a reddish purulent fluid, and if the lung be not perceptibly injured, the cure will be speedily effected by ordinary treatment.

The method which has been tried for stopping hemorrhage from a wound of the internal mammary artery is analogous to the foregoing. A man was stabbed with a sword, which entered obliquely between the cartilages of the ribs. The wound was not extensive; but the effusion of blood in the cellular membrane of the lateral and anterior part of the thorax was considerable. An incision was made in the integuments covering the mass of blood, and several coagula were removed. The hemorrhage was then stopped by introducing some agaric, which was fastened to a spatula, and by means of this instrument, pressed from within outward, under the cartilage of the rib, near the side of the sternum. The wounded artery was thus very exactly compressed, and the plan was continued several days and nights successively under the direction of a surgeon. Lassus, Pathol. Chir. tom. ii. p. 312.

An extravasation of a considerable quantity of blood in one of the cavities of the pleura is followed by such a train of alarming and urgent symptoms, that the patient dies of suffocation unless the fluid be discharged. This may be accomplished either by making the patient lie on his wounded side, if the wound can thus be made depending, and it be sufficiently ample, or enlarging it with a bistoury, when it is too narrow, or by making another opening in the thorax when the wound is situated too high up. (See EMPYEMA.) If the hemorrhage still continue, and be considerable, after the first extravasated blood has been discharged, the patient generally perishes; but when the bleeding ceases, and the lungs are not extensively injured, he may recover. Nothing but the urgency of the symptoms of suffocation, arising from a dangerous degree of pressure upon the lungs and diaphragm, can justify a hasty determination to make an opening for the evacuation of the extravasated blood, or the equally pernicious plan of leaving the original wound open for the same purpose. If the surgeon require arguments in support of this remark, they are to be derived from the equivocal, uncertain, and irregular character of the symptoms of an extravasation of blood in the thorax, and from the effect which even the discharge of such blood may have in renewing the hemorrhage, and making room for another effusion, in cases where the injured vessels are large. The blood, however, must be discharged when the symptoms of suffocation are urgent, and evidently owing to the pressure of the extravasation on the organs of respiration. The practice of making an opening will always be unsuccessful, when the wound of the lungs, besides being deep enough to give rise to an extravasation, is also complicated with emphysema of those organs, and the effusion of a considerable quantity of blood into their cellular and parenchymatous texture. In short, in a wound of this serious description, it does not constantly happen, that the only curative indication is to discharge the extravasated blood. The degree of danger depends upon the nature of the wound of the lungs, which is invisible, and of which it is sometimes difficult to form a correct judgment. Frequently an extravasation of blood in the pericardium, without injury of the heart, but a case which is always fatal, has been mistaken for an extravasation in the cavity of the left pleura. Sometimes, also, we may be deceived, and believe in the existence of an extravasation, while the symptoms of suffocation under which the patient labours may be owing to the substance of the lungs being changed as it were into a solid mass, by the effusion of blood and coagulating lymph in their texture, and the consequent compression of the air-cells.

Although it must be acknowledged, that the diagnosis of an extravasation of blood in the chest is not free from difficulties, the following are usually regarded as the symptoms which characterize the case, either in the primary or secondary form. In the first place it is obvious, that there must generally be a wound of the lungs, which is indicated by the issue of frothy blood from the wound, by the passage of air through the wound into and out of the chest, and by the patient spitting blood, or coughing it up in large quantities. If, however, the blood come from the intercostal artery, no blood will be coughed up. At the moment of receiving the wound, the patient falls into a state of syncope, and though the bleeding may not be very considerable, he is affected with cold sweats, and his pulse is feeble and small. In the course of a few days, notwithstanding a low diet, repeated bleedings, and perfect quietude, respiration becomes short, difficult, and laborious, and inspiration is observed to be performed more easily than expiration. The patient usually lies upon the side in which the extravasation is; and this side seems rather larger and broader at its lower part than the opposite side, on which the patient cannot lie without an aggravation of all his sufferings. When he tries to sit up in bed, he cannot remain in this position, unless he bends his body very much forwards, in order to facilitate respiration. About the xiphoid cartilage and the lateral parts of the chest, he feels a weight, attended with a frequent cough, and a sensation of suffocation. According to Valentin, a large ecchymosis, or violet-coloured spot, makes its appearance in some individuals in a later stage of the case about the angles of the false ribs; but this symptom is far from being constant, and it did not occur in an instance of extravasation of blood in the thorax recorded by Dr. Thomson. (Reports of Observations made in the Military Hospitals in Belgium, p. 85.) In general, blood escapes from the wound, unless the opening be very small, or situated in the upper part of the chest. Lastly, it is remarked, that the symptoms of suffocation proceeding from inflammation of the lungs subside, or are evidently lessened by venesection, which is not the case when they depend upon an extravasation.

If it be true that some patients have had their breathing very little oppressed, notwithstanding an extravasation of blood in one of the cavities of the pleura, and that others have been able to lie with equal ease either on the sound or diseased side (see Thomson's Report, p. 87.), which is not common, we must conclude from these unusual cases, that we ought not to form our opinion from any one symptom in particular, but from the assemblage of a great many. Lassus, Pathol. Chir. tom. ii. p. 319.

On the subject of extravasations of blood in the thorax, the following are the sentiments of a distinguished writer: "Whatever may be the cause of this inward bleeding, the surgeon should attend to the following directions. He should first put his finger into the wound; perhaps it may discover the cause, or may evacuate the blood. If the blood do not follow the finger, then some tube must be introduced, and the tube for so simple an operation need not be a nice one. If he cannot get the tube into the thorax, and the breathing continue oppressed, he must enlarge the wound, and enlarge it freely. To be afraid of exposing the lungs to air when they are already torn with a bullet and loaded with blood is childish and useless theory, very unlike the proper management of such wounds. If the wound in the thorax be not too high above the third or fourth rib, and if no posture of the patient, however willing or able to turn himself, will bring the blood easily in that way, or if the wound be contused, oblique, and difficult to dilate, an operation must be performed, which, as it is commonly practised for pus in the breast, is called the operation of *Empyema* (see this word); that is, a very free incision must be made in the line betwixt two of the ribs; then the pleura must be punctured with a lancet, and a tube introduced. Or, in plain language, whenever it is found that the natural wound will not empty the thorax, a new wound should be made in what is called the chosen point, or the point of election, *i. e.* low, betwixt the seventh and eighth ribs, that there may be an easy flow. But whenever the wound is about the middle of the thorax, it should rather be dilated, which both changes the nature of the wound and gets out the blood. When this blood proceeds from a wound of the intercostal artery, such free incisions are the more necessary; they allow us to see the artery, to feel the jet of its warm blood by putting in the finger, and this allows us to press it with a compress, or tie it with the needle and thread." (See John Bell's Discourses on Wounds, p. 263, 264. edit. 3.) However, notwithstanding this author, and a few other surgeons thus talk of taking up the intercostal artery, we much doubt the possibility of the thing, nor do we know of any well-authenticated case on record where it has actually been done.

The propriety of some other parts of this advice is also questionable, especially that relating to thrusting tubes into the cavity of the thorax. The necessity of cutting into the chest at all in order to let out extravasated blood, in an early stage of a wound of the thorax, is positively denied by Scarpa, as we shall find from an extract we shall have to make from his work in speaking of wounds of the belly. On the contrary, Scarpa, Larrey, Assalini, Hennen, &c. all agree, that wounds of the chest should be closed, and superficially and lightly dressed. At all events, we may safely assert, that in these cases nothing but the urgency of the danger, unequivocally arising from the pressure of the mass of extravasated blood on the organs of respiration, can ever justify the practice of either making another opening into the chest, or of enlarging the original one. Of the method of keeping the wound open with tubes or tents, we have a very unfavourable opinion.

In every case of extravasation of blood in the chest, the discharge of it when respiration is dangerously oppressed is not the only indication. There is another one of at least equal importance: we allude to the adoption of a rigorous antiphlogistic treatment, in order to avert and diminish the dangers arising from inflammation of the pleura and lungs.

Besides extravasation of blood in the cavity of the pleura, there is another complication which sometimes attends wounds of the chest, and is particularly deserving of the attention of the practitioner. We mean the case of emphysema, or what Mr. John Bell calls "the tumour formed by air blown out from the lungs into the common cellular substance, or confined within the thorax, and oppressing the lungs." It is not, however, our wish to detain the reader long on this interesting disorder, because by turning to the article Emphysema, he will find a statement of all the principal knowledge which exists upon the subject.

Emphysema arises from the air escaping, first from the lungs into the thorax; then from the thorax through the wound in the pleura costalis into the cellular substance on the outside of the chest; and afterwards, the air inflates the cellular membrane over the whole body. As Mr. John Bell has related, emphysema is frequent after a fractured rib, because there is a wide laceration of the lungs, and no exit for the air; while it is less frequent in large wounds with a knife or broad-sword, because in such cases the air has an open and unimpeded issue. It is very common after deep stabs with the bayonet or small-sword; and it sometimes arises in gun-shot wounds, though, as far as our experience extends, it is not so frequent in these particular instances, as Mr. John Bell describes. Mr. Hennen thinks it does not occur in more than one case out of fifty (p. 402.), which is, perhaps, a calculation considerably below the real state of things.

When the lungs are wounded, the air escapes from them at every inspiration into the cavity of the pleura, whence the next expiration it is compressed, and forced through the breach of continuity in the pleura into the cellular substance on the outside of the chest; for it cannot return into the wounded lung, because this is already full. Every new inspiration draws more air from the wounded lung, and every new expiration drives more air out into the cellular substance. There is no other outlet for the air, which spreads under the skin with wonderful rapidity. The emphysematous crackling tumour makes its first appearance over the broken rib, or over the wounded point of the thorax; it then extends over the whole chest, and next over the neck and face, filling particularly the eye-lids, so that the eyes are absolutely closed. It afterwards extends itself over the belly, down the thighs, and to the private parts, and no part escapes this tumour, except the palms of the hands and the soles of the feet. More air is every moment drawn out from the wound of the lungs, and driven under the skin; and the patient is every moment more and more oppressed, till at last the breathing is quite interrupted, the pulse flags, the extremities grow cold, and the patient, if he be not relieved by some operation, must die. John Bell, p. 267, 268.

The moment that the lungs are wounded, (says this author,) they fall down, and continue in this collapsed state until the wound heals, which it does in the course of a very few days; but from the moment in which lungs are wounded, the use of the wounded lobe is lost, so that if the wound be in the right side of the lungs, the breathing is performed entirely by the left; only half the quantity of air is inspired, and the breathing is difficult.

If the lungs, when wounded, were to continue in perpetual

tual motion, (fays Mr. J. Bell,) I do not know how we fhould expect a cure; for the air would be continually ftreaming through the wound, and the wound itfelf alternately dilating and contracting, like that in an artery, could not heal. But as the wounded lung lies in a collapfed ftate, the edges of the wound are in contact with each other. P. 269.

That the lung of one fide, which remains unhurt, is fufficient to fupport the fyftem, we learn from various accidents; from thofe cafes in which, either owing to the incifions made by the furgeon, or to the nature of the wound, the cheft has been freely opened, the lungs of one fide have collapfed, and yet the patient has lived with tolerable eafe, and ultimately recovered. We learn it alfo from cafes of emphyfema, where the lungs are oppreffed with air, and from cafes of empyema, or pus, within the cavity of the cheft, obftructing the expanfion of the lungs. (See EMPYEMA.) And efpecially, (fays Mr. J. Bell,) we are fure of it from the very gradual decay of thofe who die with large fuppurations within the cheft, in whom we find after death, that on one fide there remains nothing but one fmall knob or tubercle of the lungs. Koelpen de Empyemate Obf. p. 135.

That the breathing fhould be eafier in a free and open wound of the cheft than in a punctured wound, or that in the cafe of a punctured wound the patient fhould be relieved by a free incifion, no one need wonder; for in a punctured wound there is no way for the blood or air to efcape from the thorax, while yet at every ftroke of refpiration, more and more blood and air is drawn out from the lungs, till at laft the blood, and efpecially the air, are fo condenfed, that they not only oppres that fide of the lungs, but by hindering the free play of the diaphragm, and loading the mediaftinum, they opprefs alfo the other lung, the difficulty of breathing increafes, the extremities grow cold, and the patient dies.

Whatever danger then depends altogether upon emphyfema itfelf depends upon the manner in which the confinement of air in the cheft oppreffes not only the wounded, but alfo the oppofite lung, the diaphragm, &c. The extenfive inflation of the cellular membrane in other parts of the body is a circumftance which creates a terrible disfigurement, but perhaps very little peril in itfelf. Sometimes, however, it proceeds to fuch a pitch, that even the interftitial cellular fubftance of the lungs themfelves becomes inflated, and then fuffocation is inevitable.

On the treatment of emphyfema we fhall merely remark at prefent, that the chief means, both of relieving the organs of refpiration from compreffion, and of hindering the further increafe of the diffufion of air in the cellular membrane, confifts in practifing an incifion in the thorax at the part where the air firft efcapes from that cavity. For other practical obfervations we refer to the article EMPHYSEMA.

The exiftence of adhefions between the pleura coftalis and pleura pulmonalis, previoufly to the receipt of a wound of the cheft, muft make an important difference with regard to the fubfequent ftate of the lungs, and particularly with regard to their condition in the cafe of emphyfema. Such adhefions muft of courfe render a collapfe of thefe organs impoffible, and alfo prevent the air from infinuating itfelf between the furface of the lungs and the infide of the cheft. Whether thefe occurrences can be perfectly prevented will of courfe depend upon the extent of the adhefions. They would, however, be certainly averted altogether, were the wound to happen juft at a part of the cheft where the pleura coftalis and pleura pulmonalis happened to be adherent.

From fome remarks which have been delivered, the reader will fee, that wounds opening both cavities of the cheft, unlefs fuch adhefions exift, muft produce immediate fuffocation, in confequence of both lungs becoming collapfed. That this would really happen is the belief of the majority of the beft modern writers, and there are feveral facts reported which tend to confirm the accuracy of the opinion. A late author, however, conceives, that the finking of the lung is not an uniform confequence of a penetrating wound of the thorax. He obferves, that we have fometimes ocular proof of this, not only by the clofe contact in which the lungs lie to the wound difcoverable at firft fight, but by protrufions which occafionally happen. From experiments on brutes, fays he, we derive no fatisfactory elucidation; for in fome, where incifions on each fide have been made through the intercoftal mufcles, much greater than the natural paffage of the air, the lungs, fo far from collapfing, have expanded again, the animal has lived, and in ten days run about as well as ever. And in our own fpecies, the recoveries from wounds of the thorax on both fides, larger than the orifice of the glottis, dangerous as they are, are not few. Hennen's Obf. on Military Surgery, p. 404, 405.

Wounds of the heart generally prove immediately fatal, though it is true there are to be found in the records of furgery many curious exceptions to this obfervation. A foldier received the thruft of a fword, which entered one of the cavities of that organ, as was afcertained after death; yet he lived nine days after the accident. (Rhodius, Obf. Medic. centur. ii. obf. 39.) A young man, twenty-fix years of age, was ftabbed with a fword in the right fide, between the third and fourth true ribs. He became exceedingly weak, had great difficulty of breathing, and died in four or five days. On opening the body, it was difcovered that the heart had been completely transfixed, the weapon having paffed from the right into the left ventricle, through the feptum. The cavity of the cheft was full of blood, and it was thought that the prolongation of life had been owing to the clofure of the wound with coagula. (Saviard, obf. 113.) Haller, as Mr. Hennen obferves, has recorded in his Bibliotheca Chirurgica, vol. ii. p. 378. an example in which a needle was found in the heart of an ox; and through the kindnefs of Mr. Hammick, furgeon of the royal naval hofpital at Plymouth, Mr. Hennen was lately fhewn a preparation, in which a pin was lodged in the human heart, but without any trace of the mode in which it got there. The patient had complained of a pain in his cheft, about three months previoufly to his death, and died of carditis. (Obf. on Mil. Surgery, p. 429.) Ploucquet gives inftances in which a ball was lodged in the heart of a ftag, in the heart of a healthy dog, and in the anterior ventricle of the human heart, where it is ftated to have remained for years. Another inftance has alfo been recently publifhed, in which a ball was found lodged in the right ventricle of the heart, near its apex, included in a great meafure in the pericardium, and refting upon the feptum. See the article *Cas Rares*, Dict. des Sciences Medicales.

Guattani mentions a cafe in which a patient lived eight years after a wound of the aorta (De Aneurifmatibus); and in the Medical Records and Refearches, 1798, is the extraordinary cafe of a penetrating wound, in which a bayonet paffed through the colon, ftomach, diaphragm, part of the lungs, and the right ventricle of the heart, and yet the patient furvived the accident for upwards of nine hours. Mr. Hennen alfo refers to another inftance, related by M. Chaftenet, of a wound of the right ventricle, which did not prove fatal till the 15th day after the injury. (See Journ. de Med. Militaire, Paris, 1782, tom. ii. p. 359.) For additional obfervations on this fubject, however, we muft be content with referring to Mr. Hennen's publication.

 As

As wounds of the diaphragm can hardly happen without the fimultaneous injury of feveral other important parts, thefe cafes muft neceffarily be attended with confiderable danger; and indeed, when the tendinous centre of the diaphragm is injured, the accident is deemed by feveral writers of modern date as inevitably fatal. (Laffus, Pathol. Chir. tom. ii. p. 321. Callifen, Syft. Chir. Hodiernæ, Pars ii. p. 696.) The following are faid to be ufual fymptoms of a wound of the diaphragm:—The patient is immediately feized with exceffive anxiety and agitation. He feels acute pain in the hypochondria, and is obliged to keep himfelf bent forwards; and he is further afflicted with a cough, hiccough, convulfive fpafms, and great difficulty of breathing. Delirium enfues, the mufcles of the face are convulfed, the fingultus grows worfe and worfe, and the cafe terminates fatally in the courfe of a few days.

Dangerous, however, as wounds of the diaphragm muft generally be, on account of their being for the moft part complicated with injury of fome of the abdominal or thoracic vifcera, there is no doubt that the danger has been exaggerated. "Wounds of the thorax (fays Dr. Thomfon) are not unfrequently complicated with wounds of the abdomen. In various inftances of this kind (which this gentleman faw in the Netherlands after the battle of Waterloo), there exifted undoubted proofs of the fact that wounds of the diaphragm are not neceffarily fatal; for it muft have been perforated once, if not twice, in feveral of the cafes we faw, in which balls had paffed acrofs the lower part of the cheft, and the fame thing muft have happened alfo, I conceive, in moft of the cafes in which the liver had been wounded. In one cafe, the ball had entered the right hypochondriac region, under the edge of the falfe ribs, and come out on the right fide of the fpine, on a level with the fuperior edge of the os ilium. This patient fpit blood for fome days, and voided it alfo by ftool. On the examination after death of a patient who died thirty days after receiving the wound, and in whom a ball had entered the cheft on the lower and outer part of the right papilla, and had come out of the abdomen on the left fide of the umbilicus, the right lobe of the lung was found wounded, and the diaphragm and the upper part of the right lobe of the liver perforated. But neither in thefe cafes, nor in feveral others of wounds of the diaphragm which we faw, did any peculiar fymptoms, fuch as the rifus fardonicus, or convulfive motions of the cheft, prefent themfelves to our notice." See Report of Obf. made in the Mil. Hofpitals in Belgium, p. 93.

In the treatment of wounds of the diaphragm, abftractedly confidered, very little can be done; bleeding and antiphlogiftic remedies appear the only means which promife any effectual good. With thefe, however, we may fometimes ufefully conjoin opiates.

Extenfive wounds and lacerations of the diaphragm occafionally give rife to a particular and incurable fpecies of rupture, in which fome of the abdominal vifcera form a protrufion in the cavity of the cheft. This accident is termed a phrenic hernia, and fome account of it will be found in the article HERNIA.

Wounds of the Belly, or Abdomen.—Wounds of the abdomen are divided into two principal claffes: in one the folution of continuity is confined to the integuments, mufcles, &c. exterior to the peritoneum; in the other this laft membrane is penetrated, and frequently fome of the vifcera alfo which are included in it. Wounds affecting the parietes of the abdomen, but not extending through the peritoneum, whether of the punctured, incifed, or contufed kinds, have no effential difference from wounds of other parts, and the obfervations which have been offered on the fubject of wounds in general are in every refpect applicable to all fuperficial wounds of the belly. It is worthy of remark, however, that the parietes of the abdomen are always weakened in confequence of wounds, and difpofed to allow the vifcera to form protrufions. Strong as the cicatrix may be, the point where it is fituated continues fubject to a hernia, which feldom fails to occur, unlefs the weakened part be properly fupported with a belt or bandage. This accident may follow a fimple punctured wound; but it invariably takes place in every inftance where, in confequence of a fevere contufion, the parietes of the abdomen have loft their tone, and yield to the impulfe made againft them by the parts which they contain. It was thus that a cooper's wife, whofe hiftory is given by Sennertus, after being violently ftruck on the abdomen by a piece of green elaftic wood, which flipped out of her hufband's hands, fuffered fuch a relaxation of the contufed part, that the anterior parietes of the abdomen yielded fo as to form an enormous pouch, containing, during pregnancy, the gravid uterus itfelf.

After accomplifhing the re-union of a fuperficial wound of the belly by means of an eligible pofition, adhefive plafters, and a bandage, we fhould therefore recommend the patient to wear a belt, or any other means of making preffure on the part which muft be fupported. Should the wound have been confined to the fkin, however, and the mufcles not have been at all divided, there would be no rifk of a hernial protrufion afterwards, and of courfe the ufe of a belt, or any fort of bandage, would then be unneceffary.

If fuperficial wounds of the abdomen are unattended with any particular danger or peculiarity, the fame obfervation cannot be made with refpect to penetrating wounds, or thofe which pafs through the peritoneum. We have feen that penetrating wounds of the cheft give rife to a variety of dangers, fometimes depending upon the effufion of blood into the bronchiæ and air-cells of the lungs, or into the cavity of the pleura; fometimes upon the confequences of that extraordinary complication emphyfema; but more efpecially upon the great tendency of the pleura and lungs to inflammation. The principal dangers of penetrating wounds of the belly arife alfo partly from internal hemorrhage within the cavity of the peritoneum; partly from the irritation which is produced by the occafional extravafation of the contents of the vifcera; but in a ftill greater degree, from the ftrong difpofition of the peritoneum to become affected with violent and extenfive inflammation, in confequence of any injury or irritation. There are, fays Mr. John Bell, a thoufand occafions on which this delicacy of the peritoneum may be obferved. The wound of the fmall fword, and the ftab of the ftiletto, explain to us how quickly the peritoneum, and all its contained bowels, inflame from the moft minute wound, although it be almoft too fmall to be vifible on the outfide, and fcarcely within; for, upon diffection, no inteftines are feen wounded, and no feces have efcaped into the abdomen. In thofe who die after lithotomy, we find the cavity of the peritoneum univerfally inflamed. The operation of Cæfarean fection is fatal, not from any lofs of blood, for there is little bleeding, nor from expofure to the air, for they alfo die in whom the womb burfts, and where the air is not allowed to enter; but merely from that inflammation which fucceeds to wounds of the peritoneum, fmall as well as great, of which we have fometimes a melancholy proof in the operation of hernia, in which the ftitching the wound, according to the whimfical improvement of fome modern furgeons, or where the mere tying of the fac, as in the practice of the old rupture-doctors and caftrators, often raifed fuch inflammation as fpread very quickly over the abdomen, and ended in gangrene.

grene. This inflammation may, no doubt, come on from the flighteft fcratch in the peritoneum itfelf; yet, in general, it arifes rather from the wound of fome of the vifcera. If an inteftine be wounded, it may pour out its feces into the abdomen; if the liver, fpleen, or kidneys be wounded, thefe pour out blood; if the bladder, then the urine filters into the cavity of the belly. The extravafated food, feces, urine, blood, &c. act there as irritating extraneous fubftances, which no activity of the abforbents can remove, and which foon caufe a fatal inflammation of every peritoneal furface within the abdomen. See John Bell's Difcourfes on the Nature and Cure of Wounds, p. 310. edit. 3.

Apprized by melancholy experience of the vaft difference which the penetration of the peritoneum makes in the nature of a wound of the abdomen, furgeons have betrayed confiderable anxiety to be able to afcertain at firft, in every inftance, whether the injury partakes of this ferious defcription or not. But although the nature of the cafe is felf-evident, when the wound in the parietes of the abdomen is large, and attended with protrufion of the vifcera, it is often extremely difficult to judge whether the weapon has gone through the peritoneum or not, when the wound is a fimple ftab, unaccompanied with protrufion of the vifcera, or with any effufion of their contents.

The generality of furgical authors have laid down a variety of criteria for determining the queftion, whether the cafe is a penetrating wound? Some of thefe writers lay much ftrefs on comparing the direction of the wound with the natural thicknefs of the parietes of the abdomen at the injured part, and the breadth of the injury with that of the weapon. When the inftrument has acted perpendicularly upon a point, where the parietes are thin, and the wound, though made with a narrowifh weapon, like a fword, is yet of a certain breadth, there can indeed be little doubt of the cafe being a penetrating wound. But the impoffibility of knowing in what direction the thruft has been made, and of procuring the weapon, in order to compare its diameter with that of the wound, generally renders this mode of difcrimination ufelefs in actual practice.

If a probe (fay other writers) will readily enter perpendicularly to a certain depth, in a place where the parietes of the abdomen are thin, the circumftance is a proof that the cafe is a penetrating wound. But if the probe cannot be thus introduced, we are by no means juftified in concluding that the wound does not penetrate. As the layers of mufcles do not bear the fame relative pofition to each other which they did at the time of the accident, they foon ftop the paffage of the probe; and in whatever pofture we put the patient, it is next to impoffible to put the parts exactly in the fame pofition in which they were at the time of the receipt of the injury. Befides, when the wound is oblique, a probe which is not very flexible cannot eafily be made to follow its track. The employment of this inftrument is alfo not free from objections, founded on its creating pain and irritation, or even a renewal of hemorrhage and effufion of blood in the cellular membrane.

An abfurd propofal has been made to inject a mucilaginous fluid into the wound, the paffage of which into the belly would be a fure indication of the cavity of the abdomen being penetrated. It is obvious, however, that the injected liquid may not enter, though the cafe be a penetrating wound, owing to the change in the relative pofition of the layers of the abdominal mufcles. The fluid may alfo continue in the wound in confequence of its paffing into the cellular fubftance; and thus it may make the furgeon fuppofe that it enters the abdomen, when in reality it does not pafs down even to the peritoneum. Nor can the mildeft injection be thus thrown into the cavity of the peritoneum without the utmoft rifk of exciting that fatal kind of inflammation which we have already mentioned, as the danger moft to be dreaded in all wounds of the abdomen.

The figns then of a penetrating wound of the abdomen are fallacious, and the employment of fuch means as the probe and injections, with a view of afcertaining the real nature of the cafe, is not exempt from danger. Many fpafmodic affections, which occafionally follow the receipt of a wound of the belly, are only equivocal, as they are fometimes owing entirely to the great fenfibility of the patient. The protrufion of the abdominal vifcera, and the difcharge of fluids which they are known to contain, are the only fure figns of a penetrating wound. It is eafily conceivable at the fame time, that a wound may penetrate the cavity of the belly, and yet thefe fymptoms may not occur, either becaufe the external wound is too fmall to allow of the efcape of any of the vifcera or their contents, or becaufe the weapon or ball, after piercing the peritoneum, has actually touched none of the bowels, or has merely glided over their furface. But penetrating wounds, which are unattended with protrufion of the vifcera, or extravafation of any fluid in the cavity of the abdomen, are lefs alarming than feveral complicated wounds which do not penetrate. If in fuch cafe, fays Richerand, the patient or by-ftanders were to inquire about the nature of the injury, we fhould avoid giving a pofitive opinion, informing them of the infufficiency of the means formerly practifed, in order to afcertain the precife depth of the wound, and explaining the objections to the probe and injections. It fhould alfo be mentioned to them that the antiphlogiftic treatment, which is the beft in fimple wounds which do not penetrate, is the only plan which could be adopted, were it certain that the injury had extended into the cavity of the abdomen. Nofographie Chir. tom. iii. p. 327—335. edit. 4.

In the following defcription of the treatment requifite for the different cafes of penetrating wounds of the belly, we fhall follow the order chofen by M. Richerand, and confider,

Firft, the cafes in which the vifcera, though uninjured, protrude at the wound.

Secondly, the cafes which are complicated both with injury and protrufion of the vifcera.

Thirdly, penetrating wounds unaccompanied with protrufion, but yet attended with injury of one or more of the vifcera, as is indicated by particular fymptoms, and efpecially by the iffue of certain kinds of matter from the external wound.

And laftly, we fhall conclude with noticing the fubject of extravafations, and fome wounds of particular organs and vifcera.

1. *Of Wounds of the Belly, attended with Protrufion of the Vifcera.*—When, in confequence of a divifion of the parietes of the abdomen by a cutting inftrument, or their laceration by a bull's-horn, the inteftines protrude between the lips of the wound, the firft indication is to reduce the parts, and then to take meafures for preventing a recurrence of the protrufion. The reduction is generally eafy, if care be taken to relax the abdominal mufcles by a judicious pofture. In fome cafes, however, the wound is fo narrow that the thing is more difficult, and here, inftead of puncturing the bowel, in order to diminifh its fize by difcharging the air which it contains, (as advifed by many writers,) we decidedly recommend a moderate enlargement of the wound. This fhould be cautioufly executed with a probe-pointed curved biftoury, introduced along the groove of a director; or, if there be room, under the guidance of the left fore-

finger.

finger. In this manner, and with due care, the wound may always be fufficiently dilated without the protruded parts being cut. Authors alfo recommend the incifion for this purpofe to be directed upwards; for (fay they) the further the cut is from the lower part of the belly, the lefs liable will the patient afterwards be to hernia. The inteftines fhould invariably be returned without delay, in every inftance in which they are free from wound or gangrene. Should they even be flightly wounded or inflamed, no time fhould be loft in abfurdly applying fomentations, &c. to them in their protruded ftate. The natural warmth and moifture of the cavity, into which they are to be replaced, will be far more congenial than any topical remedies. Should the parts, however, have any dirt or fand upon them, the moft which ought to be done before their reduction is to wafh them with warm milk and water.

The reduction having been effected, the patient is to lie upon his back, with the thighs bent upon the pelvis, and he muft ftrictly avoid making any exertion, left it bring on another protrufion. The wound is to be clofed with adhefive plafter, and the uniting bandage; but if the wound fhould be large, and thefe means ineffectual, it would alfo be proper to employ futures. The ftitches, however, fhould always be as few as poffible. This method of fewing up wounds of the belly made a long fubject in all the old works on furgery, under the appellation of *Gaftroraphe* (fee that article); but at the prefent day, futures are comparatively fpeaking almoft rejected from practice, or are only employed when the oppofite furfaces of wounds cannot be kept in contact without them. Nor are they then ever ufed, except the chance of union by the firft intention ftill forms a temptation for the trial of the plan; for when a wound muft heal by the granulating procefs, ftitches can never be of the leaft utility.

When the omentum protrudes through a penetrating wound, and is ftrangulated by the narrownefs of the opening, it foon contracts adhefions. Richerand recommends us to cut off all this membrane which exceeds the level of the integuments, and to leave in the wound the reft, which, he afferts, will act like a ftopper, and hinder future herniæ. Were the wound, however, quite recent, fo that adhefions could not yet have formed, the propriety of dilating the opening, and reducing the piece of omentum, would be unqueftionable. Whenever, alfo, the omentum is found, and free from conftriction, it fhould be reduced. In cafes where a portion of this membrane is not only protruded, but gangrenous, writers authorize the excifion of the dead part, and reducing the reft after the cut veffels have been tied fingly with fmall filk ligatures. We apprehend, however, that in general, whenever the omentum has been out fo long as to flough, adhefions within the wound have had time to form; an event which would embarrafs the operator, and even render the fafety and propriety of the attempt to reduce the living portion of the protruded membrane very queftionable. Should the omentum, or inteftine, however, be not adherent to the neck of the hernial fac, though gangrenous, (as occurred in an inftance cited by Scarpa, Traité des Hernies, p. 268.) the propriety of trying to reduce it would be undeniable.

2. *Wounds of the Belly, with Injury and Protrufion of the Vifcera.*—Penetrating wounds of the abdomen, attended with protrufion of the inteftines, are always to be regarded as dangerous cafes; but the danger is much more ferious, if, befides being protruded, the bowels are alfo wounded. Under fuch circumftances, we have the authority of numerous writers on furgery, as a fanction of the practice of fewing together the edges of the divifion in the protruded inteftine; a practice, however, which, as we fhall hereafter explain, does not meet with the approbation of that excellent modern furgeon, profeffor Scarpa, of Pavia. Every one, however, allows, that the attempt would be highly improper and rafh, were the bowel only wounded, without forming a protrufion. It is this laft occurrence which creates a material difference in eftimating the poffibility of the plan, the queftion of its neceffity being at prefent excluded from confideration. When the parts are protruded, no enlargement of the external wound is neceffary to render the application of a future practicable; the plan creates no difturbance and irritation of the peritoneum and contiguous vifcera; there is no doubt concerning the actual exiftence of the injury, no difficulty in immediately finding out its precife fituation.

But though many authors are fo generally agreed about the propriety of ufing a future in the cafe of a wounded and protruded bowel, they differ exceedingly, both as to the right object of the method, and the moft advantageous mode of making the ftitches. Some, having little apprehenfion of extravafation after the reduction of the gut, advife only one ftitch to be made, (frequently only through the mefentery,) and they employ the ligature chiefly with a view of confining the injured bowel near the external wound, fo that whatever part of its contents may be effufed, there will be a ready paffage for the matter outward. Other writers wifh to remove the poffibility of extravafation, by applying numerous ftitches, and attach little importance to the plan of ufing the ligature, principally for the purpofe of keeping the inteftine near the external wound.

When the wound of a bowel is fo fmall that it is clofed by the protrufion of the villous coat, the application of a future muft evidently be altogether needlefs; and fince the ligature could not fail to caufe irritation, as an extraneous fubftance, the employment of it ought unqueftionably to be difpenfed with.

Suppofing, however, the breach in the inteftine to be fmall, but yet fufficient to let the feces efcape, what method ought to be adopted? The following practice has been tried. As Mr. A. Cooper was performing the operation for a ftrangulated hernia, at Guy's hofpital, an aperture, giving iffue to the inteftinal contents, was difcovered in a portion of the found bowel, juft when the part was about to be reduced. The operator, including the aperture in his forceps, caufed a fine filk ligature to be carried beneath the point of the inftrument, firmly tied upon the gut, and the ends cut off clofe to the inteftine. The part was then replaced, and the patient did well. Mr. Travers, who has related this fact, approves of the plan of cutting away the extremities of the ligature, inftead of leaving them hanging out of the external wound. It appears that when the firft practice is followed, the remnant always finds its way into the inteftine, and is difcharged with the ftools, without any inconvenience. But when the long ends are drawn through the outer wound, and left in it, they materially retard the procefs of healing. See Travers's Inquiry into the Procefs of Nature in repairing Injuries of the Inteftines, &c. p. 112, 113.

Let us now inquire what ought to be the conduct of a furgeon, were he called to a patient, whofe bowel is divided through its whole diameter, and protruded at the external wound? Various have been the fchemes and propofals for the treatment of this fort of accident; and fince experience has furnifhed few practitioners with an opportunity of feeing fuch a cafe in the human fubject, a variety of experiments have been made on animals, in order to determine what treatment would be the moft fuccefsful. Ramdohr, indeed, is ſtated by Mœbius to have had occaſion to try on the human ſubject a plan, on which a vaſt deal has been ſaid and written. He cut off a large part of a mortified inteſtine, and joined the ſound ends together, by inſerting the upper within the lower one, and fixing them in this poſition with a ſuture; the ligature being alſo employed, to keep them at the ſame time near the external wound. The patient recovered, and the feces afterwards paſſed entirely by the rectum in the natural way. See Halleri Diſputat. Anat. vol. vi. Obſ. Med. Miſcellan. 18.

About a year after the operation, the patient died, when the anatomical preparation of the parts was ſent by Ramdohr to Heiſter. They were preſerved in ſpirits of wine, and exhibited, according to this laſt author, an union of the two ends of the bowels together, and their conſolidation with a part of the abdomen. Now it has been queſtioned by a late writer, whether the union here ſpoken of ever really happened. When the upper end of the bowel is introduced into the lower, the external ſurface of the former is put in contact with the inner one of the latter; a ſerous membrane is placed in contact with a mucous one. Theſe heterogeneous ſtructures, he alleges, are not diſpoſed to unite. The mucous membrane, when inflamed, more readily ſecretes a kind of mucus, which muſt be an invincible obſtacle to adheſion. He thinks it, therefore, more than probable, that, in the caſe related by Heiſter, the invagination was maintained by the union of the inteſtine with the correſponding part of the abdominal parietes. Several experiments on living animals have convinced him that this happens, and that the mucous membrane will not unite with the external peritoneal coat. This impoſſibility of producing an immediate union between mucous and ſerous membranes may, of courſe, be urged as an objection to Ramdohr's practice. (Richerand, Noſographie Chirurg. tom. iii. p. 344. edit. 4.) Another equally ſtrong objection is, that the upper end of the bowel cannot be put into the lower one, unleſs it be ſeparated from a part of the meſentery. Here the diviſion of the meſenteric arteries may cauſe a dangerous bleeding. In vain did Boyer tie ſeven or eight of theſe veſſels: his patient died with an extravaſation in the abdomen. (Op. cit. tom. iii. p. 343.) Mœbius attempted to repeat Ramdohr's operation on a dog; but he could not ſucceed in inſinuating the upper part of the divided bowel into the lower one, on account of the contraction of the two ends of the inteſtinal tube, and the ſmallneſs of the canal. Mœbius was, therefore, obliged to be content with merely bringing the ends of the bowel together with a ſuture: the animal died, however, of an extravaſation of the feces.

Dr. Smith, of the Philadelphia Medical Society, alſo tried to repeat Ramdohr's method; but could not ſucceed. He divided the inteſtine of a dog tranſverſely, and having inſerted a piece of candle into that portion of the bowel which was ſuppoſed to be uppermoſt, he endeavoured to introduce the ſuperior within the inferior; but the ends became ſo inverted, that it was found utterly impoſſible to ſucceed. The ſcheme was, therefore, given up, and only one ſtitch made, the ligature being then attached to the external wound, in the manner adviſed by Mr. John Bell. The dog died, and on examination there was found a conſiderable quantity of feces and water in the abdominal cavity.

Two more trials were made of Mr. John Bell's plan by Dr. Smith, on the inteſtines of dogs: in both inſtances the animals died, the inteſtines being much inflamed, and feces effuſed in the abdomen. See Dr. Smith's Theſis.

Mr. Travers likewiſe tried the ſame experiment. "I divided the ſmall inteſtine of a dog, which had been for ſome hours faſting, and carried a fine ſtitch through the everted edges, at the point oppoſite to their connection with the meſentery. The gut was then allowed to ſlip back, and the wound was cloſed. The animal ſurvived only a few hours.—*Examination.* The peritoneum appeared highly inflamed. Adheſions were formed among the neighbouring folds, and lymph was depoſited in maſſes upon the ſides of the wounded gut. This preſented two large circular orifices. Among the viſcera were found a quantity of bilious fluid, and ſome extraneous ſubſtances, and a worm was depending from one of the apertures. By the artificial connection of the edges in a ſingle point of their circumference, and their natural connection at the meſentery, they could recede only in the intervals, and here they had receded to the utmoſt." In another experiment, Mr. Travers increaſed the number of points of contact, by placing three ſingle ſtitches upon a divided inteſtine, cutting away the threads, and returning the gut. The animal died on the ſecond day.—*Examination.* Similar marks of inflammation preſented themſelves. The omentum was partially wrapped about the wound; but one of the ſpaces between the ſutures was uncovered, and from this the inteſtinal fluids had eſcaped. On cautiouſly raiſing the adhering omentum, the remaining ſtitches came into view. Here again the retraction was conſiderable, and the intervening elliptical aperture proportionally large. On the ſide next to the peritoneum, however, the edges were in contact, and adhered, ſo as to unite the ſections at an angle.

From ſuch experiments, the concluſion drawn by Mr. Travers is, that appoſition at a point or points is, as reſpects effuſion, more diſadvantageous than no appoſition at all; for it admits of retraction, and prevents contraction, ſo that each ſtitch becomes the extremity of an aperture, the area of which is determined by the diſtance of the ſtitches. (P. 116. 119.) This gentleman, therefore, maintains, *that the abſolute contact of the everted ſurfaces of a divided inteſtine, in their entire circumference, is requiſite to ſecure the animal from the danger of abdominal effuſion.* (P. 121.) The ſpecies of ſuture employed, ſays Mr. Travers, is of ſecondary importance, if it ſecures this contact. (P. 134.) And, among other obſervations, we find, "wounds amounting to a *direct* diviſion of the canal are irreparable, and, therefore, invariably fatal." P. 133.

In the Dictionary of Practical Surgery will be found ſeveral reaſons for not entirely agreeing with theſe concluſions. We cannot admit that a total diviſion of the inteſtinal tube is certainly and invariably fatal, becauſe we muſt then not only diſbelieve the mode of union in Ramdohr's caſe, which we undoubtedly do, but we muſt alſo diſbelieve the reſult of that caſe, and of ſome others which we would cite, were this a publication expreſsly allotted to ſurgery. Nor are we at all convinced of the utility of applying numerous ſtitches to a divided bowel, in order to keep the edges of the wound together. Were a caſe to preſent itſelf to us, in which a bowel was protruded, and partly cut through, we ſhould at moſt apply only a ſingle ſuture, made with a common ſewing-needle, and ſome fine ſilk; and even of the ſafety and utility of a ſingle ſuture we entertain doubts. If the bowel were completely cut acroſs, we would alſo attach its ends together merely by one ſtitch of the ſame kind; and we ſhould do ſo without feeling at all aſſured that the practice of a ſuture would be at all right. We perfectly coincide, however, with Mr. Travers reſpecting the advantage of cutting off the ends of the ligature, inſtead of leaving them in the wound, as we believe he is right in regard to the little chance there is of the injured inteſtine

teſtine receding far from the wound; and if the ends of the ligature are then of no uſe in keeping the bowel in this poſition, they muſt be objectionable as extraneous ſubſtances. Dict. of Pract. Surgery, edit. 3. art. *Wounds.*

The following is the proceſs by which, according to Mr. Travers, a divided inteſtine is healed, when ſutures are employed: "It commences with the agglutination of the contiguous mucous ſurfaces, probably by the exudation of a fluid, ſimilar to that which glues together the ſides of a recent fleſh wound, when ſupported in contact. The adheſive inflammation ſupervenes, and binds down the everted edges of tbe peritoneal coat, from the whole circumference of which a layer of coagulable lymph is effuſed, ſo as to envelope the wounded bowel. The action of the longitudinal fibres being oppoſed to the artificial connection, the ſections mutually recede, as the ſutures looſen by the proceſs of ulcerative abſorption. During this time, the lymph depoſited becomes organized, by which further retraction is prevented, and the original cylinder, with the threads attached to it, is encompaſſed by the new tunic.

"The gut ulcerates at the points of the ligatures, and theſe fall into its canal. The fiſſures left by the ligatures are gradually healed up; but the oppoſed villous ſurfaces, ſo far as my obſervation goes, neither adhere nor become conſolidated by granulation, ſo that the interſtice, making the diviſion internally, is probably never obliterated." Travers on Injuries of the Inteſtine, &c. p. 128.

The celebrated Scarpa publiſhed, a few years ago, ſome highly intereſting remarks on the proceſs employed by nature in repairing ſolutions of continuity in the inteſtinal canal, eſpecially in caſes of hernia with gangrene; and the reſults of his inveſtigations are alſo both curious and inſtructive, in relation to what happens, and what ought to be done, in wounds of the abdomen. (Sull'ernie Memorie Anatomico-Chirurgiche, &c. Milano, 1809.) He obſerves, that the leaſt fatal conſequence of a mortification of the bowel is the eſcape of the excrement through the wound, or *artificial anus;* an afflicting and diſguſting infirmity, but one which does not preclude all hope of a radical cure, even though a conſiderable portion of the inteſtinal canal may have been deſtroyed by ſphacelus. The recorded examples of ſuch cures are abundant, and yet, ſays Scarpa, nothing has yet been written which will ſerve to convey an exact idea of the ſimple and admirable means which nature employs in accompliſhing them. Surgeons generally ſuppoſe, that after the detachment of the dead parts, the two orifices of tbe bowel remain gaping, and acquire adheſions to the margins of the external wound; that afterwards, in proportion as this contracts, they come gradually nearer together, and in the end touch each other ſo accurately, that the feces are capable of paſſing directly from the ſuperior into the inferior portion of the gut. But this theory cannot ſatisfy thoſe who have attentively examined, in ſome caſes of mortified herniæ, the reſpective ſituation of the two orifices of the inteſtine, and their relation to the external wound. In fact, the two ends of the bowel are conſtantly found lying in a parallel manner by the ſide of each other: the upper with its orifice open, and directed towards the external wound by the feces which iſſue from it; the lower, on the contrary, as it gives paſſage to nothing, always has a tendency to become leſs capacious, and retracted into the cavity of the abdomen. The contraction of the external wound cannot have the leaſt effect in changing the direction of theſe two orifices, nor conſequently in applying them to each other. Even ſuppoſing there were ſome natural tendency to this approximation, the upper orifice, being wider than in the natural ſtate, and directed outwards, could never accurately coaleſce with the lower one, which is ſhrunk, and retracted within the belly. The feces then could never paſs from one into the other without the effuſion of a large part of them outwardly, and an incurable fiſtula, diſcharging the inteſtinal contents, would in every inſtance be the conſequence.

Scarpa had an opportunity of examining the body of a young man, who, in conſequence of eating a large quantity of indigeſtible food, died about ten months after having been operated upon for a congenital hernia, attended with mortification of the protruded bowels, at a period when he had recovered, with the exception of an occaſional diſcharge of a very ſmall quantity of feces from an inconſiderable fiſtulous opening. He alſo diſſected two other caſes. From all theſe it appears, that the breach in the inteſtinal canal is not repaired by the orifices of the upper and lower portions of the bowel re-uniting, coaleſcing, and running as it were into each other; nay, that they meet at a very acute angle, the axis of one not correſponding with that of the other, and they never lie laterally together. On the contrary, Scarpa's inveſtigations ſatisfactorily prove, that a funnel-ſhaped membranous canal (what he terms the *imbuto membranoſo*), compoſed of the remains of the hernial ſac, conſtitutes the medium of communication between the upper and lower orifices of the bowel, which, in an early ſtage of the caſe, becomes adherent to the peritoneum about the neck of the hernial ſac. The baſe of the funnel-ſhaped membranous cavity correſponds to the bowel, and its apex tends towards the wound or fiſtula. It farther appears, that the feces, in order to get from the upper into the lower part of the bowel, have to paſs through the funnel-ſhaped cavity in quite a ſemicircular track, and that between the orifices of the bowel, directly oppoſite to the aperture between the cavity of the inteſtine and that of the funnel-ſhaped membrane, a conſiderable projection or jutting angle is formed, which makes a material additional obſtacle to the direct paſſage of the feces, from the upper into the lower portion of the inteſtinal tube.

Scarpa thus explains the formation of the funnel-ſhaped membranous cavity, that conſtitutes the channel of communication betwixt one part of the bowel and the other: "The hernial ſac, as every ſurgeon knows, does not always partake of gangrene with the viſcera contained in a hernia: and even when it does ſlough, ſince the ſeparation of the dead parts happens on the outſide of the abdominal ring, there almoſt always remains in this ſituation a portion of the neck of the hernial ſac perfectly ſound. We may ſay, therefore, that in all caſes immediately after the detachment of the mortified inteſtine, whether it happen within or on the outſide of the ring, the two orifices of the gut are enveloped in the neck of the hernial ſac, which ſoon becoming adherent to them by the effect of inflammation, ſerves for a certain time to direct the feces towards the external wound, and to prevent their effuſion in the abdomen. In proportion as the outer wound diminiſhes, the external portion of the neck of the hernial ſac alſo contracts; but that part which embraces the orifices of the inteſtine gradually becomes larger, and at length forms a kind of membranous funnel or intermediate cavity, which makes the communication between the two parts of the bowel. This adheſion of the neck of the hernial ſac round the two orifices of the gut does not hinder the latter from gradually quitting the ring, and becoming more and more deeply placed in the cavity of the abdomen." Scarpa then cautions ſurgeons not to fancy from this account, that there is any occaſion to paſs a ligature through the meſentery for the purpoſe of fixing it near the ring, even were the gangrenous

grenous bowel perfectly free and inadherent to the neighbouring parts. The truth is, that the adhefive inflammation, which alfo commences immediately after the operation, fixes the parts near the wound before they can be drawn away by any retraction of the bowel or mefentery; and in the courfe of the firft 24 hours the two orifices of the divided inteftine are conftantly enveloped in the remains of the hernial fac. In a cafe of this kind, where the mortified bowel was not at all adherent to the neck of the hernial fac, Scarpa introduced a ligature through the mefentery in the ufual way, and on withdrawing it at the end of 24 hours, and paffing his finger to the bottom of the wound, he found the circumference of the two orifices of the bowel every where adherent. When a ligature through the mefentery had not been practifed, and no effufion, he alfo invariably difcovered the bowel adherent to the neck of the hernial fac, in every fubject who had died foon after the operation for a ftrangulated hernia, complicated with gangrene, and whom he examined after death. Certainly, he obferves, it muft be allowed that the orifices of the divided inteftine do retract, and become farther from the ring; but they do fo very flowly, and always draw along with them the neck of the hernial fac to which they contract early adhefions.

Our limits oblige us to pafs over many other interefting obfervations relative to the caufes which facilitate or retard the re-eftablifhment of the continuity of the inteftinal canal, and on the neceffity of the funnel-fhaped membrane as a fubftitute for the portion of bowel deftroyed by gangrene. We fhall next notice the comparifon of the artificial anus, arifing from a mortified hernia, with that which is the refult of a penetrating wound of the abdomen, as made by the intelligent Scarpa. "Why," he inquires, "is it fo common to fee the continuity of the inteftinal canal re-eftablifhed after a mortified inguinal or crural hernia, while the artificial anus is always incurable, when it is formed in confequence of a penetrating wound of the abdomen with protrufion of the inteftine, whether a part of the canal be deftroyed by gangrene, as in the inftance related by Mofcati (Mém. de l'Acad. de Chir. t. 8.), or whether it be totally or partially divided by the wounding inftrument, as in the examples recorded by Stalpart-Wander Wiel (Obf. Rar. t. ii. obf. 25.), Cabrole (Oper. Med. obf. 13.), Fabricuis Hildanus (Centur. 1. obf. 74.), &c.?" Scarpa will not even allow as an exception to this remark the cafe recited in the 2d vol. of the Œuvres Chir. de Default; becaufe he conceives the details are not fufficiently explicit.

In order to refolve this problem, fays he, we have only to compare a wound of the belly complicated with protrufion and mortification of the bowel, with a mortified inteftinal hernia, and draw a parallel between the circumftances which accompany the two cafes, and conftitute their chief differences. 1ft, In a hernia, the two extremities of the mortified gut are always enveloped in the remains of the hernial fac, which form in front of the two orifices a kind of funnel-fhaped canal. There is nothing like this at the extremities of a bowel divided either by a cutting inftrument which has penetrated the abdomen, or by mortification, which has complicated a wound of this defcription. 2dly, In thefe laft inftances, the wounded or burft inteftine becomes adherent to the edges of the external wound; confequently, it cannot retract into the abdomen, and the feces, which defcend out of the upper portion, being as it were on a level with the fkin, muft neceffarily all efcape out of the external wound. This is precifely what actually happens, it being known that artificial ani of this kind are always incurable. After a mortified hernia, on the contrary, it is upon the facility with which the bowel becomes fituated farther from the wound, drawing along with it the remains of the hernial fac, that the formation of an intermediate cavity between the two orifices of the gut depends, and which is to make the communication between them. What happens after penetrating wounds of the belly, with injury of the bowels, is alfo feen in ventral herniæ, which have formed under the cicatrix of a long-cured wound of the abdomen, when fuch herniæ are unfortunately attacked by mortification. Large, old, umbilical, and ventral herniæ, though furnifhed with a hernial fac, generally give rife to incurable artificial ani whenever they flough. Scarpa explains the caufe of this circumftance, by adverting to the very intimate adhefion which exifts in fuch herniæ between the fac and the aponeurofes and integuments of the abdomen, and which tends to hinder the formation of the funnel-fhaped membranous cavity in front of the orifices of the inteftine, and which alone can eftablifh a communication between them.

It follows, fays Scarpa, from the foregoing and other facts, that the retraction of the neck of the hernial fac, and of the two orifices of the bowel, is effential to the re-eftablifhment of the continuity of the inteftinal canal, when a breach has been made in it by mortification. Hence, he thinks, that in future every body will confider the plan of paffing a ligature through the mefentery, in order to keep the two ends of the gut near the outer wound, not only as ufelefs, but even as dangerous. The adhefions of the neck of the hernial fac to the inteftine, before the occurrence of gangrene, muft almoft always render the ligature ufelefs. And even when the adhefion does not exift at the period of cutting through the floughs, Scarpa afferts that the ligature is equally unneceffary. Indeed, fays he, immediately after the operation, while nature is effecting the feparation of the dead from the living parts, the latter invariably contract, in a very fhort time, clofe adhefions to the neck of the hernial fac, either on a level with a ring, or a little within it, and there is no danger of the feces being extravafated in the abdomen. If the latter accident has fometimes happened in fubjects who have died of hernia with gangrene in a few days, it has been becaufe the feces could not make their way outward quick enough, and therefore occafioned a burfting of the bowel in the abdomen, within the ring and beyond the extent of the hernial fac. If, in fome other cafes, the two orifices of the bowel have been found in the dead fubject not adherent to the neck of the hernial fac, and the feces extravafated, Scarpa thinks it has happened only after death, when the relaxation of the whole abdomen has let the ends of the bowel quit the neck of the hernial fac, to which it had not yet acquired any adhefions. But he conceives that nothing like this can ever happen in the living body, owing to the alternate action of the diaphragm and abdominal mufcles, which comprefs all the vifcera, and tend to propel them outward.

Hippocrates writes, "Si quod inteftinorum gracilium difcinditur, non coalefcit." (Sect. 4. Aphor. 24.) This aphorifm, fays Scarpa, taken in its true fenfe, is the expreffion of an inconteftible fact. It is very true, that wounds of the inteftinal canal follow in their cicatrization quite a different courfe from fimple wounds of the fkin, mufcles, or any other parts of the body. Their edges are never obferved to become immediately applied to each other, and therefore, ftrictly fpeaking, they do not re-unite. Their cure is altogether completed through the medium of the furrounding parts; that is to fay, by the adhefions which the inteftines contract with the great fac of the peritoneum lining the parietes of the abdomen, or with the productions of this membrane which compofe the external covering

covering of the greater part of the vifcera. Littre relates, that a lunatic ftabbed himfelf with a knife in eighteen places about the abdomen, eight of which wounds penetrated into this cavity, and evidently injured the bowels. The man, however, recovered in two months; but in another paroxyfm of mania he threw himfelf out of the window, and was killed. On opening his body, all the cicatrices of the inteftinal canal were found adherent to fome point of the furface of the adjacent vifcera or parietes of the abdomen. There was not a fingle one which feemed to be formed by the direct contact of the edges of the inteftinal wound with each other. Acad. Roy. des Sciences de Paris, 1705.

The peritoneum, when irritated by any caufe whatfoever, has a fingular difpofition to inflame round the point of irritation, and to contract adhefions with the parts which are contiguous to it in the fame fituation. Thus, when one or feveral convolutions of inteftines have been divided by a cutting inftrument, or pierced by a ball, they always become united for a certain extent to the furrounding parts, all of which are covered with the peritoneum. (See alfo Platner's Inftit. Chir. § 694.) Thefe adhefions, which are the only means employed by nature for blocking up accidental openings in the inteftinal canal, are promoted by the preffure which the abdominal mufcles and diaphragm alternately make upon the vifcera in the actions of infpiration and expiration.

In a fubfequent part of his work, Scarpa delivers his own fentiments on the different plans which have been propofed for effecting the re-union of a divided inteftine. If, fays he, we compare Ramdohr's operation with the fimple and effectual proceffes employed by nature for re-eftablifhing the continuity of the inteftinal canal after herniæ with mortification, we are compelled to acknowledge on this point, as well as on many others, that art continues very inferior to nature.

In the firft place, fays Scarpa, the introduction of one part of the bowel into the other is impracticable in a great many cafes of mortified herniæ, in confequence of the adhefions which the found part of the inteftine has contracted with the neck of the hernial fac, during the inflammatory period of the ftrangulation. Secondly, it is hardly ever poffible, without inconvenience, to draw a confiderable portion of the inteftinal canal out of the belly, for the purpofe of introducing, with all the requifite precautions, the upper end of the bowel into the lower. This cannot be done without handling for too long a time, and more or lefs roughly, the bowel, which is already irritated; which circumftance, together with the pricks of the needle, and the dragging of the ftitches, is more than an adequate caufe for the production of a fatal inflammation. The danger will be ftill farther increafed, if, according to the experiments of fome modern furgeons, the two ends of the bowel are fewed together over a piece of a calf's trachea, or a fmall hollow cylinder of tallow, or ifinglafs, a pafteboard tube, &c. Whatever may be the foreign body put within the bowel, it may, by obftructing the courfe of the feces, bring on violent inflammatory fymptoms, and deftroy the patient in the moft agonizing fufferings.

Scarpa then adverts to the experiments made on dogs by Dr. Thomfon of Edinburgh, and Dr. Smith of Philadelphia, which tend to prove that the two extremities of a divided bowel may be united by means of a future, and then returned into the cavity of the belly, without endangering the animal's life. (See alfo Boyer's experiments on this fubject, in the Mém. de la Societé de Médecine de Paris, tom. i.) It is alleged (fays Scarpa), that there is no rifk of the ligatures falling into the cavity of the abdomen after their detachment; but that by one of the operations of nature which cannot be explained, the threads are voided with the feces after the cure. Scarpa notices that the particulars of the way in which thefe futures were made is not given; and how (fays he) have the above gentlemen fucceeded in applying the orifices of the divided bowel accurately to each other, which is extremely difficult, efpecially in dogs? In whatever light the fubject is viewed (he obferves), "I doubt whether it be poffible to re-unite, by means of any future, the extremities of a divided bowel after mortification in hernia, or at leaft to do it with any probability of fuccefs. Such experiments, even when they fucceed in the beft poffible manner, merely prove that certain operations, which would moft frequently be ufelefs or fatal on man, may be fuccefsfully practifed on other animals."

On the contrary (fays Scarpa), in the circumftances which have been fuppofed, nature is daily obferved to fucceed in re-eftablifhing the continuity of the inteftinal canal, by means equally fimple and mild. She prepares herfelf (as it were) for this work before gangrene actually takes place, by forming adhefions between the ftrangulated bowel and the neck of the hernial fac. After the feparation of the mortified parts, fhe draws back into the abdomen the extremities of the divided bowel, and out of the remains of the hernial fac, fhe forms a fort of funnel-fhaped membrane, which ferves at firft for directing the feces outwards, and afterwards for tranfmitting them from the upper orifice of the inteftine into the lower, by making them follow a femicircular track from before backwards. For two or three inftances of the complete fuccefs of Ramdohr's operation, an almoft innumerable multitude of cures effected altogether by the powers of nature could now be cited. Thus, fays Scarpa, in the prefent ftate of our knowledge, we fhould congratulate patients who, in thefe unfortunate circumftances, fall into the hands of furgeons either incapable of undertaking an operation, or little folicitous about healing up the wound.

It may perhaps be imagined (continues Scarpa), that Ramdohr's operation is better calculated for certain cafes of penetrating wounds of the abdomen, as, for inftance, where the inteftine has been completely divided with a cutting inftrument, or by the effects of gangrene arifing from long expofure to the air. Scarpa here allows that it would be very defirable to find out fome operation which could be ufeful in thefe circumftances, which are the more unfortunate, becaufe they do not furnifh nature with the means of re-eftablifhing the continuity of the inteftinal canal, as in cafes of mortified herniæ. But he doubts whether in fuch inftances Ramdohr's operation could be undertaken with any probability of fuccefs; for the complete divifion of the inteftine is almoft always the refult of an enormous wound, which having interefted feveral vifcera leaves little or no hope of recovery. Suppofing the bowel fhould not have been divided with the cutting inftrument, but that it is protruded and gangrenous from long expofure, it muft be remembered, that in this cafe it will have contracted adhefions to the lips of the wound, even before the feparation of the mortified part; confequently, the bowel cannot be drawn farther out of the belly, fo as to allow one end of it being introduced into the other. To undertake fuch an operation then, would be to expofe the patient to much greater perils than that of an incurable artificial anus.

According to Scarpa, it is little to have proved that Ramdohr's operation is impracticable when the inteftine has been completely divided; he proceeds farther, and has no hefitation in afferting, that *in all cafes of penetrating wounds*

of

of the abdomen, attended with injury of the inteftine, whether the canal be opened longitudinally or tranfverfely, a future is always an operation not merely ufelefs, but even dangerous and fatal: In whatever manner it is practifed, one cannot avoid the evils which muft originate from the punctures, however few, and from the paffage of the ligatures through the coats of the inteftine; a part endued with exquifite fenfibility, and whofe external tunic is much difpofed to inflame, and rapidly to communicate the inflammation to all the other abdominal vifcera. It has been unfortunately proved, by the experience of feveral ages, that in moft of the cafes in which the inteftine has been ftitched in penetrating wounds of the belly, the patients have died in the greateft agony. If a few have efcaped the dangers of this operation, it has been becaufe in them the ftitches foon cut their way out, and were voided with the feces which continued to efcape from the wound until it was entirely healed.

All furgeons of experience, and particularly thofe of large hofpitals, have often feen wounds of the right or left iliac region accompanied with injury of the great inteftine. They may alfo have noticed, in thefe examples, that after the fubfidence of the local and general inflammatory fymptoms, the wound ftill continues to difcharge the feces for a certain time; but that afterwards it contracts, and the excrement refumes its ufual courfe. Thefe wounds almoft always heal completely: firft, becaufe the adhefion of the large inteftine to the parietes of the abdomen prevents the feces from being extravafated in the cavity of the peritoneum; and fecondly, becaufe the ample capacity of the fame bowel always prefents a ready paffage for the feces, notwithftanding the progreffive and fometimes quick clofure of the external opening.

If, in the inftance of a penetrating wound of the belly attended with a wound of the fmall inteftines, it were in the furgeon's power (as indeed it is) to return the bowel into the abdomen, fo that the opening in it may exactly correfpond with the wound in the abdominal parietes, there could not be a doubt of its quickly acquiring adhefions to the peritoneum, which lines the part around the internal orifice of the external wound: hence the feces would readily efcape through the outer wound, and at length it would happen, after a certain time, as in wounds of the large inteftines, that the artificial anus would gradually clofe up, and the feces refume their natural track. The narrow diameter of the fmall inteftines would not make an infurmountable obftacle to the paffage of the feces, provided they be, as they ufually are in this portion of the inteftinal canal, fufficiently fluid; and befides (fays Scarpa) is it not proved by experience, that they refume their natural courfe, after the cure of an artificial anus, even when a confiderable noofe of the fmall inteftines has been deftroyed by gangrene, and when the two ends form by their re-union a very acute angle? In all cafes, the patient's life would be faved, and the worft that could happen would be his being afflicted the reft of his days with a fiftula difcharging feces.

Encouraged by thefe principles, which are the natural deductions of a comparifon of wounds of the large inteftines with thofe of the fmall ones, Scarpa feels no hefitation in admitting the poffibility of curing the latter, without having recourfe to a future. He obferves, that it would not be difficult for him to quote examples of fuch cures. Amongft others, he has lately feen one which deferves to be mentioned here. A portion of fmall inteftine, protruded through a penetrating wound of the abdomen, happened to be punctured with a bodkin by a country furgeon, in his endeavours to return the part into the belly. The feces, however, were not extravafated in the cavity of the peritoneum, but were for a long while difcharged through the wound. The opening in the bowel always correfponded exactly to that in the parietes of the abdomen, although no future was practifed, nor any ligature put through the mefentery in order to keep it in this fituation. The feces afterwards gradually refumed their natural courfe, the wound at the fame time became fmaller, and in the end healed up. The young man, the fubject of this cafe, now enjoys very good health, and fuffers no inconvenience which can juftify a fufpicion of any obftruction in the paffage of the feces.

The inceffant preffure made by the abdominal mufcles and diaphragm upon all the vifcera, is a caufe why the wounded inteftine, inftead of quitting the external wound, enters it, and contracts adhefions to its lips. If, however, a too timorous furgeon were afraid of entirely trufting, on this point, to the wife providence of nature, he might (Scarpa thinks) without inconvenience pafs a ligature through the mefentery, behind the portion of wounded bowel, as is ufually and quite unneceffarily done in cafes of mortified hernia. Forty-eight hours, or thereabouts, would be time enough for the inteftine to contract adhefions, through the medium of the peritoneum, to the inner edges of the wound. After this period, the ligature would be completely ufelefs, and it ought to be withdrawn, as there would now be no chance of extravafation of the feces in the belly. At the fame time one fhould neglect no remedies, internal as well as external, which may be of ufe in moderating the patient's fufferings, diminifhing the energy of the circulation, and bringing the inflammation down to the degree requifite for the formation of adhefions. One ought alfo to keep open the external wound with the fame precautions, and according to the fame indications which are to be attended to in the treatment of an artificial anus. The principal object of thefe precautions is, to let the treatment be fuch that the wound may only diminifh in proportion as the evacuation from the lower part of the inteftinal canal increafes.

Here it may be *à propos* to obferve, that the conduct of a furgeon in the treatment of penetrating wounds of the abdomen, attended with injury of the fmall inteftines, is exactly the reverfe of what it ought to be in the treatment of penetrating wounds of the cheft, accompanied with injury of the lungs.

In the latter, fays Scarpa, phyfiology, agreeing with experience, teaches us that no means fhould be omitted for effecting the immediate union of the wound, (as it is termed, *by the firft intention,*) care being taken to check the force of the circulation by repeated bleedings and every antiphlogiftic remedy, in order to prevent or diminifh, as much as poffible, internal hemorrhage. If, notwithftanding all thefe means, blood fhould be extravafated between the pleura and lungs, it preffes equally upon every point of thefe vifcera, refifts their motion, and thereby contributes to ftop the bleeding. If, after the wound in the lungs is healed, the extravafated blood be not in too large quantity, it will be gradually removed by the abforbents. In the contrary cafe, it will form a fwelling beneath the external cicatrix, and prefent itfelf externally (fee Difcours fur les Principales Maladies obfervées à l'Hôtel Dieu de Lyon, &c. par M. Petit, p. 299.); or elfe a counter opening muft be practifed at the inferior part of the cheft. See Empyema.

We are to act quite differently in the treatment of a penetrating wound of the belly, with protrufion and injury of the inteftine; for in this cafe, the chief indication, that on which the patient's fafety mainly depends, confifts in keeping the external wound open, in order that the feces may find a ready outlet. The wounded bowel foon contracts adhefions

adhefions to the inner lips of the wound of the belly, and then we have nothing to fear from an extravafation of the inteftinal matter in the cavity of the peritoneum. Afterwards, in proportion as the feces refume their natural courfe, the external wound is to be allowed to diminifh, and entirely heal up. See Scarpa Sull'ernie Memorie Anatomico-Chirurgiche, &c. mem. 4.

In every inftance in which the abdomen has received a penetrating wound, attended with injury and protrufion of a portion of the inteftinal canal, the difplaced part is to be reduced, whether it be ftitched or not. This fhould be accomplifhed as fpeedily as poffible, before the bowel has fuffered much from expofure, conftriction, &c. and alfo before any adhefions have formed at the inner orifice of the external wound; adhefions which would render the reduction of the protruded part impracticable. Of courfe, if the wound fhould be too fmall to admit of the reduction being effected without handling and bruifing the bowel immoderately, it ought to be carefully enlarged with a curved biftoury, guided on a director. Indeed, according to Scarpa's principles, one would fuppofe that in every cafe of this kind the wound, if not free, fhould be dilated, as by this means the iffue externally of whatever efcapes from the breach in the inteftine after its reduction would be facilitated. The reft of the treatment confifts in the rigorous adoption of antiphlogiftic meafures, more efpecially a low diet, and copious and repeated venefections, with a view of counteracting the danger of peritoneal inflammation. With refpect to the dreffings, they cannot be too fimple, and they ought always to be light and fuperficial. A pledget of any common unirritating ointment is all that is requifite, and it muft be renewed as frequently as the quantity of the difcharge, &c. from the wound may render neceffary.

3. *Penetrating Wounds of the Belly, attended with Injury of the Bowels, but with no Protrufion.*—A wound of the inteftines is indicated by the difcharge of blood with the ftools, and fometimes by the efcape of fetid air, or of inteftinal matter from the external wound. Such an injury, however, when the wounded bowels lie concealed in the belly, does not always admit of being known with certainty immediately after occurrence. In the majority of examples, there is at firft no efcape either of air, or of the contents of the bowels, from the external wound; the quantity of blood voided per anum may be inconfiderable, and of courfe none at all will generally be difcharged for fome time after the accident. Wounds of the fmall inteftines, efpecially of the duodenum and jejunum, are indeed ufually followed by great anxiety, palenefs of the countenance, fyncope, cold perfpirations, a fmall intermitting tremulous pulfe; but then thefe fymptoms are only equivocal, and furnifh no pofitive information, becaufe feveral of them may happen in nervous fubjects, from a mere fuperficial unimportant cut or ftab. Our inability, however, to fay affuredly, in every cafe, whether the bowels are injured or not, is a thing of no practical importance; becaufe when the nature of the accident is not clearly manifefted by fome peculiarity or feverity of the fymptoms, the cafe fhould invariably be treated on common, fimple, antiphlogiftic principles; and alfo, when circumftances leave not the fmalleft doubt of the inteftines being hurt, the fame treatment is the only rational one which can be purfued. Wounds of the fmall inteftines are reckoned much more dangerous than thofe of the large; and the nearer the injury is to the pylorus, the greater, generally fpeaking, is the degree of danger. Such cafes are alfo much more frequently, than injuries of the large inteftines, the caufe of extravafation. In the latter examples, the fymptoms are commonly milder, and either the paffage of the inteftinal contents outward through the wound more eafy and certain, on account of the bowel being naturally lefs moveable than the other inteftines; or their paffage in their natural courfe more ready, by reafon of the greater capacity of that part of the inteftinal tube.

A wounded inteftine is faid to prefent fome particular appearances, to which the generality of writers have paid no attention. "If a gut be punctured, the elafticity of the peritoneum, and the contraction of the mufcular fibres, open the wound; and the villous or mucous coat forms a fort of hernial protrufion, and obliterates the aperture. If an incifed wound be made, the edges are drawn afunder and reverted, fo that the mucous coat is elevated in the form of a flefhy lip. If the fection be tranfverfe, the lip is broad and bulbous, and acquires tumefaction and rednefs from the contraction of the circular fibres behind it, which produces, relatively to the everted portion, the appearance of a cervix. If the incifion is according to the length of the cylinder, the lip is narrow, and the contraction of the adjacent longitudinal, refifting that of the circular fibres, gives the orifice an oval form. This everfion and contraction are produced by that feries of motions, which conftitutes the periftaltic action of the inteftines." Travers on Injuries of the Inteftines, p. 85.

According to this gentleman, fome of thefe appearances were defcribed by Haller, in Element. Phyfiol. lib. 24. fect. 2. and Opera Minora, tom. i. fect. 15.

Having witneffed the facility with which confiderable injuries of the inteftinal tube were repaired, Mr. Travers was defirous of afcertaining more fully the powers of nature in the procefs of fpontaneous reparation, and of determining under how great a degree of injury it would commence, as well as the mode of its accomplifhment. For thefe purpofes, he divided the fmall inteftine of feveral dogs as far as the mefentery. All thefe animals died, in confequence of the inteftinal matter being extravafated, if they had been lately fed, or if they had been fafting in confequence of inflammation, attended with a feparation of the ends of the divided bowel, everfion of the mucons coat, and obliteration of the cavity, partly by this everfion, and partly by a plug of coagulated chyle.

In one particular inftance in which Mr. Travers made a divifion of the bowel half through its diameter, a fort of pouch was formed round the injured inteftine. "A pouch, refembling fomewhat the diverticulum in thefe animals, was formed oppofite to the external wound, on the fide of the parietes, by the lining peritoneum; on the other fide, by the mefentery of the injured inteftine, that inteftine itfelf, and an adjacent fold, which had contracted with it a clofe adhefion. The pouch, thus formed and infulated, included the oppofed fections of the gut, and had received its contents, &c. The tube at the orifices was narrowed by the half everfion, but offered no impediment to the paffage of fluids." (P. 96.) Whether, under thefe circumftances, the functions of the alimentary canal could have been continued, Mr. Travers profeffes himfelf incapable of deciding. Among the inferences which this gentleman has drawn from the experiments detailed in his publication, the tendency of the two portions of a divided bowel to recede from each other, inftead of coalefcing to repair the injury, merits notice, inafmuch as it tends to fhew that the only means of fpontaneous reparation confift in the formation of an adventitious canal, by the encircling bowels and their appendages. The everted mucous coat, which is the part oppofed to the furrounding peritoneum, is alfo indifpofed to the adhefive inflammation.

When, however, the wound of the inteftine is fmaller, the

the obſtacles to reparation are not abſolutely inſurmountable. Here retraction is prevented, and the proceſſes of everſion and contraction modified by the limited extent of the injury. If, therefore, the adheſive inflammation unite the contiguous ſurfaces, effuſion will be prevented, and the animal eſcape immediate deſtruction. But union can only take place through the medium of the ſurrounding parts.

According to Mr. Travers, it is the retraction immediately following the wound that is a chief obſtacle to the reparation of the injury; for if the diviſion be performed in ſuch a way as to prevent retraction, the canal will be reſtored in ſo ſhort a time, as but ſlightly to interrupt the digeſtive function. In confirmation of this ſtatement, a ligature was tightly applied round the duodenum of a dog, which became ill, but entirely recovered, and was killed. "A ligature, faſtened around the inteſtine, divides the interior coats of the gut, in this effect reſembling the operation of a ligature upon an artery. The peritoneal tunic alone maintains its integrity. The inflammation, which the ligature induces on either ſide of it, is terminated by the depoſition of a coat of lymph, which is exterior to the ligature, and quickly becomes organized. When the ligature, thus encloſed, is liberated by the ulcerative proceſs, it falls of neceſſity into the canal, and paſſes off with its contents." P. 103, 104.

It appears alſo from Mr. Travers's experiments and obſervations, that longitudinal wounds of the bowels are more eaſily repaired than ſuch as are tranſverſe. In a dog, a longitudinal wound, of the extent of an inch and a half, was repaired by the adheſive inflammation. Here the proceſs of everſion is very limited; the aperture bears a ſmaller proportion to the cylinder of the bowel; and the entire longitudinal fibres reſiſt the action of the circular, which are divided, and can now only ſlightly leſſen the area of the canal. P. 108.

When the wounded bowel lies within the cavity of the abdomen, no ſurgeon of the preſent day would have the raſhneſs to think of attempting to expoſe the injured inteſtine, for the purpoſe of ſewing up the breach of continuity in it. In fact, the ſurgeon ſeldom knows at firſt what has happened; and when the nature of the caſe is afterwards manifeſted, by the diſcharge of blood per anum, an extravaſation of inteſtinal matter, &c. it would be impoſſible to get at the injured part of the bowel, not only becauſe its exact ſituation is unknown, but more particularly on account of the adheſions, which are always formed with ſurpriſing rapidity. But even if the ſurgeon knew to a certainty, in the firſt inſtance, that one of the bowels was wounded, and the preciſe ſituation of the injury, no ſuture could be applied, without conſiderably enlarging the external wound, drawing the wounded inteſtine out of the cavity of the abdomen, and handling and diſturbing all the adjacent viſcera. Nothing would be more likely than ſuch proceedings to render the accident, which might originally be curable, unavoidably fatal. We muſt agree upon this point with Mr. John Bell, who ſays, "When there is a wounded inteſtine, which we are warned of only by the paſſing out of the feces, we muſt not pretend to ſearch for it, nor put in our finger, nor expect to ſew it to the wound; but we may truſt that the univerſal preſſure, which prevents great effuſion of blood, and collects the blood into one place, that very preſſure, which always cauſes the wounded bowel and no other to protrude, will make the two wounds, the outward wound and the inward wound of the inteſtine, oppoſe each other point to point; and if all be kept there quiet, though but for one day, ſo lively is the tendency to inflame, that the adheſion will be begun, which is to ſave the patient's life." Diſcourſes on Wounds, p. 361. edit. 3.

When the extravaſation and other ſymptoms, a few days after the accident, evince the nature of the caſe, a ſuture can be of no uſe whatever, as the adheſive inflammation has already fixed the part in its ſituation, and the ſpace, in which the extravaſation lies, is completely ſeparated from the general cavity of the abdomen by the ſurrounding adheſions.

When the bowel is not protruded, and the opening in it is ſituated cloſely behind the wound in the peritoneum, a ſuture is not requiſite; for the contents of the gut, not paſſing onward, will be diſcharged from the outer wound, and not be diffuſed among the viſcera, if care be taken to keep the external wound open. There is no danger of the wounded bowel changing its ſituation, and becoming diſtant from the wound in the peritoneum; for the ſituation which it now occupies is its natural one. Nothing but violent motion, or exertions, could cauſe ſo unfavourable an occurrence, and theſe ſhould always be avoided. The adheſions, which take place in the courſe of a day or two, at length render it impoſſible for the bowel to ſhift its ſituation. See Dict. of Pract. Surgery, edit. 3. art. *Wounds.*

In a penetrating wound of the abdomen, as a late author remarks, whether by gun-ſhot, or a cutting inſtrument, if no protruſion of inteſtine takes place, (and this, it muſt be obſerved, in muſket or piſtol wounds, rarely occurs,) the lancet, with its powerful concomitants, abſtinence and reſt, particularly in the ſupine poſture, are our chief dependence. Great pain and tenſion, which uſually accompany theſe wounds, muſt be relieved by leeches, if they can be procured, by the topical application of fomentations, and the warm bath; and if any internal medicine is given as a purgative, it muſt, for obvious reaſons, be of the mildeſt nature. The removal of the ingeſta, as a ſource of irritation, is beſt effected by frequently repeated oleaginous glyſters; indeed, on the firſt infliction of a wound of the abdomen, the contents of the inteſtinal canal and ſtomach are generally evacuated ſpontaneouſly, the ſtools being ſometimes tinged with blood. Their accumulation muſt be guarded againſt by a rigorous diet; for to the general ſtate of fulneſs of the veſſels induced by food, is added its local and mechanical ſtimulus in the undigeſted form. By this treatment, penetrating wounds, in which ſeveral plicæ of inteſtines have been neceſſarily implicated, have been happily cured. Authors abound with inſtances of this kind, and Mr. Hennen has ſeen ſeveral: among others, he was witneſs to the recovery of a ſoldier, who had been ſhot through the abdomen with a ramrod, at the ſiege of Badajos in 1812, which paſſed in anteriorly, and actually ſtuck in the vertebræ, from which it was not diſengaged without the application of ſome force. Garengeot and Lamotte alſo record cures, after the paſſage of ſwords completely through the body. See Hennen's Obſ. on Military Surgery, p. 436, 437.

In all penetrating wounds of the belly, the dreſſings cannot be too ſimple and light.

In ſome inſtances, the ball, or part of the weapon which has inflicted the wound, remains within the abdominal cavity, and is afterwards evacuated by the natural paſſages.

Balls, ſays Mr. Hennen, frequently paſs clean through the abdomen, evidently wounding the inteſtines, but without occaſioning any protruſion of them at either of the orifices. Theſe caſes, like all others of thoſe parts, are extremely dangerous, but are not neceſſarily mortal. They require the moſt guarded attention, and the utmoſt watchfulneſs of the approach of inflammation, which often comes on moſt inſidiouſly. The mildeſt poſſible application ſhould be employed to the wounds, and no plugging with tents

 or

or introduction of medicated dreffings thought of. (P. 440.) At firft a common linfeed poultice, and afterwards fimple pledgets, are as eligible dreffings as any which can be mentioned.

Extravafation in the Abdomen.—Wounds of the abdomen may be complicated with extravafations of blood, chyle, excrement, bile, or urine. None of thefe complications, however, are half fo frequent as an unreflecting and inexperienced practitioner might apprehend. The employment of the phrafe *cavity of the abdomen* has paved the way to much erroneous fuppofition upon this fubject, and has induced many abfurd notions, which even the fenfible obfervations long ago publifhed by Petit (le fils) have fcarcely yet difpelled.

As a modern writer has obferved, "there is not truly any cavity in the human body, but all the hollow bowels are filled with their contents, all the cavities filled with their hollow bowels, and the whole is equally and fairly preffed. Thus, in the abdomen all the vifcera are moved by the diaphragm and the abdominal mufcles, upwards and downwards, with an equable continual preffure, which has no interval; and one would be apt to add, the inteftines have no repofe, being kept thus in continual motion; but though the action of the diaphragm, and the re-action of the abdominal mufcles, are alternate, the preffure is continual; the motion which it produces (they produce) is like that which the bowels have when we move forwards in walking, having a motion with refpect to fpace, but none with regard to each other, or to the part of the belly which covers them; the whole mafs of the bowels is alternately preffed, to ufe a coarfe illuftration, as if betwixt two broad boards, which keep each turn or inteftine in its right place, while the whole mafs is regularly moved. When the bowels are forced down by the diaphragm, the abdominal mufcles recede: when the bowels are pufhed back again, it is the re-action of the abdominal mufcles that forces them back and follows them; there is never an inftant of interruption of this preffure, never a moment in which the bowels do not prefs againft the peritoneum; nor is there the fmalleft reafon to doubt that the fame points in each are continually oppofed. We fee that the inteftines do not move, or at leaft do not need to move in performing their functions; for in hernia, where large turns of inteftines are cut off by gangrene, the remaining part of the fame inteftines is clofely fixed to the groin, and yet the bowels are eafy, and their functions regular. We find the bowels regular when they lie out of the belly in hernia, as when a certain turn of inteftine lies in the fcrotum, or thigh, or in a hernia of the navel; and where yet they are fo abfolutely fixed, that the piece of inteftine is marked by the ftraightnefs of the rings. We find a perfon, after a wound of the inteftine, having free ftools for many days; and what is it that prevents the feces from efcaping, but merely this regular and univerfal preffure? We find a perfon on the fourth or fifth day with feces coming from the wound! a proof, furely, that the wound of the inteftine is ftill oppofite, or nearly oppofite, to the external wound. We find the fame patient recovering without one bad fign! What better proof than this could we defire, that none of the feces have exuded into the abdomen?

"If in a wound of the ftomach the food could get eafily out by that wound, the ftomach would unload itfelf that way, there would be no vomiting, the patient muft die; but fo regular and continual is this preffure, that the inftant a man is wounded in the ftomach he vomits, he continues vomiting for many days, while not one particle efcapes into the cavity of the abdomen. The outward wound is commonly oppofite to that of the ftomach, and by that paffage fome part of the food comes out; but when any accident removes the inward wound of the ftomach from the outward wound, the abdominal mufcles prefs upon the ftomach, and follow it fo clofely, that if there be not a mere laceration extremely wide, this preffure clofes the hole, keeps the food in, enables the patient to vomit, and not a particle, even of jellies or foups, is ever loft, or goes out into the cavity of the belly.

"How (proceeds Mr. J. Bell), without this univerfal and continual preffure, could the vifcera be fupported? Could its ligaments, as we call them, fupport the weight of the liver? Or, what could fupport the weight of the ftomach when filled? Could the mefentery or omentum fupport the inteftines; or could its own ligaments, as we ftill name them, fupport the womb? How, without this uniform preffure, could thefe vifcera fail to give way and burft? How could the circulation of the abdomen go on? How could the liver and fpleen, fo turgid as they are with blood, fail to burft? Or, what poffibly could fupport the loofe veins and arteries of the abdomen, fince many of them, *e. g.* the fplenic vein, is (are) two feet in length, is (are) of the diameter of the thumb, and has (have) no other than the common pellucid and delicate coats of the veins? How could the vifcera of the abdomen bear fhocks and falls, if not fupported by the univerfal preffure of furrounding parts? In fhort, the accident of hernia being forced out by any blow upon the belly, or by any fudden ftrain, explains to us how perfectly full the abdomen is, and how ill it is able to bear any preffure, even from its own mufcles, without fome point yielding, and fome one of its bowels being thrown out. And the ficknefs and faintnefs, which immediately follow the drawing off of the waters of a dropfy, explain to us what are the confequences of fuch preffure being even for a moment relaxed. But perhaps one of the ftrongeft proofs is this, that the principle muft be acknowledged, in order to explain what happens daily in wounds; for though in theory we fhould be inclined to make this diftinction, that the hernia, or abfcefs of the inteftines, will adhere and be fafe, but that wounded inteftines, not having time to adhere, will become flaccid, as we fee them do in diffections, and fo, falling away from the external wound, will pour out their feces into the abdomen, and prove fatal; though we fhould fettle this as a fair and good diftinction in theory, we find that it will never anfwer in practice. Soldiers recover daily from the moft defperate wounds; and the moft likely reafons that we can affign for it are, the fulnefs of the abdomen, the univerfal, equable, and gentle preffure, and the active difpofition of the peritoneum ready to inflame with the flighteft touch. The wounded inteftine is, by the univerfal preffure, kept clofe to the external wound, and the peritoneum and the inteftine are equally inclined to adhere. In a few hours that adhefion is begun which is to fave the patient's life, and the lips of the wounded inteftine are glued to the lips of the external wound. Thus is the fide of the inteftine united to the inner furface of the abdomen; and though the gut cafts out its feces while the wound is open, though it often cafts them out more freely while the firft inflammation lafts, yet the feces refume their regular courfe whenever the wound is difpofed to clofe." John Bell's Difcourfes on Wounds, p. 323—327, edit. 3.

The foregoing extract, though drawn up in the moft carelefs ftyle, contains fuch obfervations as are well calculated to make the reader underftand that the abdomen is in reality not a cavity, but a compact mafs of containing and contained parts; that the clofe manner in which the various furfaces are conftantly in contact muft powerfully oppofe extravafations; and that in fact it often entirely prevents them.

them. The paſſage cited impreſſes us with the utility of that quick propenſity to the adheſive inflammation which prevails throughout every peritoneal ſurface, and which not only often has the effect of permanently hindering effuſion of the contents of the viſcera, by agglutinating the parts together, but which, even when an extravaſation has happened, beneficially confines the effuſed fluid in one maſs, and ſurrounds it with ſuch adheſions of the parts to each other as are rapid in their formation, and effectual for the purpoſes of limiting the extent of the effuſion, and preventing the irritation of the extravaſated matter from affecting the reſt of the abdomen.

It is to M. Petit that we are indebted for the introduction of more correct modes of thinking upon the foregoing ſubject. See Mém. de l'Acad. de Chirurgie.

But notwithſtanding the influence of the reciprocal preſſure of the containing and contained parts againſt each other, and the uſeful effect of the quickly ariſing adheſive inflammation in all penetrating wounds of the belly, complicated with the injuries of the viſcera, we are not to ſuppoſe that extravaſation never happens, but only that it is much leſs frequent than has been commonly ſuppoſed. Mr. Travers, with much laudable induſtry, has endeavoured to trace more minutely than any preceding writer the particular circumſtances under which effuſions in the abdomen are likely or unlikely to happen. "It being admitted (ſays he) that there are caſes in which effuſion does take place, it is eaſy to conceive circumſtances which muſt conſiderably influence this event. If, for example, the ſtomach and bowels be in a ſtate of emptineſs, the nauſea which follows the injury will maintain that ſtate. If the extent of the wound be conſiderable, the matter will more readily paſs through the wound than along the canal. A wound of the ſame dimenſions in the ſmall and the large inteſtines will more readily evacuate the former than the latter, becauſe it bears a larger proportion to the calibre. Inciſed and punctured wounds admit of the adheſion of the cut edges, or the everſion of the internal coat of the gut, ſo as to be in many inſtances actually obliterated; whereas lacerated or ulcerated openings do not admit of theſe ſalutary proceſſes. Again, in a tranſverſe ſection of the bowel, contraction of the circular fibre cloſes the wound, whereas in a longitudinal ſection, the contraction of this fibre enlarges it. Such (ſays Mr. Travers) are the circumſtances which, combined in a greater or leſs degree, increaſe or diminiſh the tendency to effuſion." On Injuries of Inteſtines, &c. p. 13, 14.

After the details of ſome experiments and caſes, the preceding author makes among other concluſions the following:

1. That effuſion is not an ordinary conſequence of penetrating wounds.

2. That if the gut be full, and the wound extenſive, the ſurrounding preſſure is overcome by the natural action of the bowel tending to the expulſion of its contents.

3. That if food has not recently been taken, and the wound amounts to a diviſion of the gut, or nearly ſo, the everſion and contraction of the orifice of the tube prevent effuſion.

4. That if the canal be empty at the time of the wound, no ſubſequent ſtate of the bowel will cauſe effuſion, becauſe the ſupervening inflammation agglutinates the ſurrounding ſurfaces, and forms a circumſcribed ſac; nor can effuſion take place from a bowel at the moment full, provided it retains a certain portion of its cylinder entire, the wound not amounting nearly to a ſemi-diviſion of the tube, for then the everſion and contraction are too partial to prevent an extravaſation.

5. That when, however, air has eſcaped from the bowel, or blood has been extravaſated in quantity within the abdomen at the time of the injury, the reſiſtance oppoſed to effuſion will be leſs effectual, although the parietal preſſure is the ſame, as ſuch fluids will yield more readily than the ſolids naturally in contact. P. 25, 26. 100.

6. That though extravaſation is not common in penetrating wounds, it follows more generally in caſes where the bowel is ruptured by blows, or falls upon the belly, while the integuments continue unwounded. P. 36.

7. That when the bowels are perforated by ulceration, there is more tendency to effuſion than in caſes of wounds. P. 38, &c.

Mr. Travers explains the reaſon of the greater tendency to effuſion, in caſes of inteſtines burſt by violence, and in thoſe of ulceration, "by the difference in the nature of the injury which the bowel ſuſtains when perforated by a ſword or bullet, as in the one caſe, or burſt or ulcerated in the other. A rupture by concuſſion could only take place under a diſtended ſtate of the bowel, a condition moſt favourable to effuſion, and from the texture of the part, a rupture ſo produced would ſeldom be of limited extent. The proceſs of ulceration, by which an aperture is formed, commences in the *internal* coat of the bowel, which has always incurred a more extenſive leſion than the peritoneal covering. The puncture or cut is merely a ſolution of continuity in a point or line; the ulcerated wound is an actual loſs of ſubſtance. The conſequence of this difference is, that while the former, if ſmall, is glued up by the effuſion from the cut veſſels, or, if large, is nearly obliterated by the full everſion of the villous coat, the latter is a permanent orifice." P. 46.

Blood is more frequently extravaſated in the abdomen than any other fluid. Extravaſations of this kind, however, do not invariably happen, whenever veſſels of not a very conſiderable ſize are wounded. The compact ſtate of the abdominal viſcera, in regard to each other, and their action on each other, oppoſe this effect. The action alluded to, which depends on the abdominal muſcles and diaphragm, is rendered very manifeſt by what happens in conſequence of operations for herniæ attended with alteration of the inteſtines, or omentum. If theſe viſcera ſhould burſt or ſuppurate after being reduced, the matter which eſcapes from them, or the pus which they ſecrete, is not loſt in the abdomen, but is propelled towards the wound of the ſkin, and there makes its exit. The inteſtinal matter effuſed from a mortified bowel has been known to remain lodged the whole interval between one time of dreſſing the wound and another, in conſequence of the ſurgeon ſtopping up the external wound with a large tent. When the above-mentioned action or preſſure of the muſcles is not ſufficient to keep the blood from making its eſcape from the veſſels, ſtill it may hinder it from becoming diffuſed among the convolutions of the viſcera, and thus the extravaſation is confined in one maſs. The blood, effuſed and accumulated in this way, is commonly lodged at the inferior and anterior part of the abdomen, above the lateral part of the pubes, and by the ſide of one of the recti muſcles. The weight of the blood may propel it into this ſituation, or perhaps there may be leſs reſiſtance in this direction than in another. In opening the bodies of perſons who have died with ſuch extravaſations, things may put on a different aſpect, and the blood ſeem to be promiſcuouſly extravaſated over every part of the abdomen. But when ſuch bodies are examined with care, it will be found that the

the blood does not infinuate itfelf among the vifcera till the moment when the abdomen is opened, and the mafs previoufly lies in a kind of pouch. This pouch is frequently circumfcribed, and bounded by thick membranes, efpecially when the extravafation has been of fome ftanding. Sabatier, Médecine Opératoire, tom. i. p. 28—30.

It is of the higheft confequence to a practical furgeon to remember well that all the parts contained in the abdomen are clofely in contact with each other, and with the inner furface of the peritoneum. This is one grand reafon why extravafations are feldom fo extenfively diffufed as one might imagine, but commonly lie in one mafs, as Petit, Sabatier, and all the beft moderns, have noticed. The preffure of the elaftic bowels, of the diaphragm, and abdominal mufcles, not only frequently prefents an obftacle to the diffufion of extravafated matter, but often ferves to propel it towards the mouth of the wound. The records of furgery make mention of numerous inftances in which perfons have been ftabbed through the body without any fatal confequences, and fometimes without the fymptoms being even fevere. In Mr. Travers's publication many cafes exemplifying this obfervation are quoted from a variety of fources. Fab. Hildan. Obf. Chirurg. cent. v. obf. 74. Œuvres de Paré, liv. x. chap. 35. Wifeman's Surgery, p. 371. La Motte's Traité Complet de Chirurgie, &c. &c. In fuch cafes, the bowels have been fuppofed to have eluded the point of the weapon, and this may, perhaps in a few inftances, have been actually the fact; but in almoft all fuch examples there can be no doubt that the bowels have been punctured, and an extravafation of inteftinal matter has been prevented by the oppofite preffure of the adjacent vifcera. Such refiftance and preffure may alfo have occafionally obliged inteftinal matter, or blood actually extravafated, to pafs through the wound of the bowel into its cavity, and thus be fpeedily removed. Certain it is, fuch copious evacuations of blood *per anum* have followed ftabs of the abdomen as could hardly proceed from the arteries of the inteftines. This way of getting rid of an extravafation muft be rare, however, compared with that by abforption.

The pouch or cyft including extravafated blood or matter, as mentioned by Sabatier, is formed by the fame procefs which circumfcribes the matter of abfceffes. (See SUPPURATION.) It is in fhort the adhefive inflammation. All thefe furfaces in contact with each other, and furrounding the extravafation and track of the wound, generally foon become fo intimately connected together by the adhefive inflammation, that the place in which the extravafation is lodged is a cavity entirely deftitute of all communication with the cavity of the peritoneum. The track of the wound leads to the feat of the effufed fluid, but has no diftinct opening into the general cavity of the abdomen. The rapidity with which the above adhefions form is often very great, almoft incredible.

Urine and bile are more frequently difperfed to a great extent among the abdominal vifcera than blood. The latter fluid, indeed, muft often coagulate; a circumftance that muft both tend to ftop further hemorrhage, and confine the extravafation in one mafs.

Symptoms and Treatment of Extravafations in the Abdomen.—1. *Blood.*—Wounds of the fpleen, and of fuch veins and arteries as are above a certain fize, almoft always prove fatal from internal hemorrhage. The blood generally makes its way downwards, and accumulates at the inferior part of the abdomen, unlefs the exiftence of adhefions happen to oppofe the defcent of the fluid to the moft depending fituation. The belly fwells, and the fluctuation of a fluid is perceptible through the anterior part of the abdominal parietes. The patient grows pale, lofes his ftrength, is affected with fyncope, and his pulfe becomes weaker and weaker. In fhort, the fymptoms ufually attendant on hemorrhage are obfervable. The vifcera and veffels in the abdomen being continually compreffed on all fides by the furrounding parts, the blood cannot be effufed without overcoming a certain degree of refiftance; and unlefs a veffel of the firft magnitude, like the aorta, the vena cava, or one of their principal branches, has been wounded, the blood efcapes from the veffel flowly, and feveral days elapfe before any confiderable quantity has accumulated in the leffer cavity of the pelvis.

In thefe cafes of extravafated blood, the fymptoms, which perhaps had difappeared under the employment of bleeding and anodyne medicines, now come on again. A foft fluctuating tumour may be felt at the lower part of the abdomen, fometimes on the right fide, fometimes on the left, occafionally on both fides. The preffure made by the effufed blood on the urinary bladder excites diftreffing inclinations to make water; while the preffure which the figmoid flexure of the colon fuffers is the caufe of obftinate conftipation. In the mean time, the quantity of extravafated blood increafing, irritation and inflammation of the peritoneum are induced. The pulfe grows weaker, debility enfues, the countenance is moiftened with cold perfpirations; and, unlefs inftigated by all the antecedent circumftances, the furgeon practifes an incifion for the difcharge of the fluid, the patient falls a victim to the accident.

In the year 1733, Vacher, principal furgeon of the military hofpital at Befançon, fuccefsfully adopted this mode of treatment. Petit (the fon) afterwards tried the fame plan, though it did not anfwer, (as is alleged,) in confequence of the inflammation having advanced too far before the operation was performed. Long before the time of Vacher and Petit, a fuccefsful inftance of fimilar practice had been recorded by Cabrole.

Indeed, when the fymptoms leave no doubt of there being a large quantity of blood extravafated in the abdomen; when the patient's complaints are of a very ferious nature, and are evidently owing to the irritation and preffure of the blood on the furrounding vifcera; and when a local fwelling denotes the feat of the extravafation, there cannot be two opinions about the propriety of making an incifion for its evacuation.

Surgeons, however, fhould recollect, that a fmall extravafation of blood may exift without producing any confiderable irritation, provided no opening be made into the cyft with which it becomes furrounded. On the contrary, when fuch cyft is opened, the air then having free accefs to the blood contained there, that part of the fluid which cannot be difcharged is apt to putrefy, and become fo irritating, as to excite inflammation of the furrounding parts.—Even though there may be an evident extravafation of blood, the bad fymptoms are alfo fometimes entirely owing to the injury done to the parts within the abdomen, and neither to the preffure nor the irritation of the effufed blood.

But fometimes, as we have already noticed, the accumulated blood at firft neither irritates the adjacent parts by its quantity nor quality. An inflammation, however, of the parts furrounding the extravafation at length takes place. The tenfion, irritation, and pain, which in the firft inftance arofe from the wound itfelf, and fubfided, feem now to be renewed. When the extravafation is at the lower and anterior part of the abdomen, the patient experiences pain about the hypogaftric region. He is alfo conftipated, and as he

fuffers

suffers great irritation of the bladder, he feels frequent propensities to make water, but cannot relieve himself. At last a tumour makes its appearance, attended with a fluctuation more or less distinct.

In this instance, it seems proper to give vent to the accumulated blood. If this fluid should be found coagulated, injections of warm water would facilitate its discharge. Sabatier, Médécine Opératoire, tom. i.

2. *Chyle and Feces.*—These are not so easily extravasated in the abdomen as blood, because they do not require so much resistance on the outside of the stomach and intestines, to make them continue their natural route through the alimentary canal, as blood requires to keep it in the vessels. Extravasations of this kind, however, sometimes happen when the wound is large and the bowel distended at the moment of the injury, or when, as Mr. Travers has likewise explained, air is extravasated, or blood effused in the abdomen; these fluids being incapable of making effectual resistance to the escape of the intestinal matter. (See an Inquiry into the Process of Nature in repairing Injuries of the Intestines, &c. p. 26.) Nothing is a better proof of the difficulty with which chyle and feces are extravasated than the operation of an emetic, when the stomach is wounded and full of aliment. In this instance, if the resistance to the extravasation of the contents of the stomach were not considerable, they would be effused in the abdomen, instead of being vomited up. A peculiarity in wounds of the stomach and intestines is, that the opening which allows their contents to escape may also allow them to return into the wounded viscus.

Extravasation of intestinal matter in the abdomen is attended with a severe train of febrile symptoms; dryness of the mouth, tongue, and fauces; considerable pain and swelling of the belly; convulsive startings; and hiccough and vomiting, with which the patients are generally attacked on the day after that on which the wound was received. Sabatier de la Médécine Opératoire, tom. i. p. 34.

In these cases, general means are the only ones which can be employed; venesection, fomentations, low diet, perfect rest, anodynes, &c. All solid food must be most strictly prohibited. The close state of the viscera may also be increased by applying a bandage round the body.

If the symptoms are not speedily assuaged, the abdominal viscera become affected with general inflammation and gangrene, and the patients die in the course of a few days.

3. *Bile.*—Bile, on account of its great fluidity, is more easily extravasated extensively in the abdomen than either blood or the contents of the stomach and intestines. Besides, the gall-bladder has the power of contracting itself so completely as to expel the whole of its contents. Notwithstanding these circumstances, however, extravasations of this kind are exceedingly uncommon, doubtless on account of the small size of the gall-bladder, and its deep-guarded situation, between the concave surface of the liver and upper part of the transverse arch of the colon.

Sabatier informs us, that he has only been able to find one example on record. This case, after having been communicated to the Royal Society of London by Dr. Steward (N° 414, p. 341. Abridgm. tom. vii. p. 571, 572.), was inserted as an extract in the third volume of the Edinburgh Essays, and also in the third volume of Van Swieten's Commentaries on the Aphorisms of Boerhaave. (Transl. p. 65. edit. 1754.) An officer received a wound, penetrating the cavity of the abdomen, and entering the fundus of the gall-bladder, without doing any material injury to the adjacent parts. The abdomen was immediately distended, as if the patient had been afflicted with an ascites, or tympanitis; nor did the swelling either increase or diminish till the patient's death, which happened a week after the infliction of the wound.

There was no rumbling noise in the abdomen, though it was exceedingly tense. There were no stools, and very little urine was discharged, notwithstanding purgatives and glysters, and a good deal of liquid nourishment, were given. The patient never had one instant of sound sleep, but was always restless, though anodynes were exhibited. There was no appearance of fever, and the pulse was always natural till the last day of the patient's life, when it became intermittent. The intestines were found, after death, very much distended, the gall-bladder quite empty, and a large quantity of bile extravasated in the abdomen.

Sabatier met with an opportunity of observing the symptoms of an extravasation of bile, in consequence of a wound of the gall-bladder. The patient's abdomen swelled very quickly; his respiration became difficult, and he soon afterwards complained of tension, and pain in the right hypochondrium. His pulse was small, frequent, and contracted; his extremities were cold, and his countenance very pale. The bleedings which were practised the first day gave him a little relief; but the tension of the abdomen, and the difficulty of breathing, still continued. A third bleeding threw the patient into the lowest state of weakness, and he vomited up a greenish matter. On the third day, the lower part of the belly was observed to be more prominent, and there was no doubt of an extravasation. M. Sabatier introduced a trocar, and gave vent to a green blackish fluid, which had no smell, and was pure bile, that had escaped from the wound of the gall-bladder. After the operation, the patient grew weaker and weaker, and died in a few hours. On opening the body, a large quantity of yellow bile was found between the peritoneum and intestines; but it had not insinuated itself among the convolutions of the viscera. A thick gluten connected the bowels together, and they were prodigiously distended. The gall-bladder was shrivelled, and almost empty. Towards its fundus, there was a wound about a line and a half long, corresponding to a similar wound in the peritoneum. The wound which had occurred at the middle and lower part of the right hypochondrium, between the third and fourth false ribs, had glided from behind forward, and from above downward, between the cartilages of the ribs, until it reached the fundus of the gall-bladder.

Sabatier takes notice, that the symptoms of the two cases which have just now been related were very similar. Both the patients were affected with an exceedingly tense swelling of the belly, unattended with pain or borborygmus, and they were both obstinately constipated. Their pulse was extremely weak the latter days of their indisposition, and they were afflicted with hiccough, nausea, and vomiting.

M. Sabatier seems to think one thing certain, *viz.* that wounds of the gall-bladder, attended with effusion of bile, are absolutely mortal, and that no operation can be of any avail. Médécine Opératoire, tom. i. p. 34—37.

We are, however, to infer the contrary from the extraordinary case lately published by Mr. Fryer of Stamford. A boy, about thirteen years old, received a violent blow from one of the shafts of a cart, on the region of the liver. The injury was succeeded by pain, frequent vomiting of bilious matter, great sinking, coldness of the extremities, and a weak, small, fluttering pulse. The belly was fomented, and purging clysters thrown up. On the third day, symptoms of inflammation began, attended with considerable pain about the liver, great tension and soreness of the

the abdomen, and frequent vomiting. The pulſe was quick, ſmall, and weak, the ſkin hot and dry, the tongue much furred, the urine high coloured; and there was ſome difficulty of breathing, and great thirſt. Eight ounces of blood were taken away, the fomentations continued, and a few grains of calomel were directed to be given every four hours, until the bowels were properly opened. Afterwards the effervefcing mixture, with ten drops of laudanum, was exhibited every four hours.

On the following day, the patient had had ſome motions, and was much better; but as his ſickneſs continued, he was ordered a grain of opium every four hours. About a week afterwards, he complained of a great increaſe of pain, which was ſomewhat relieved by a bliſter. He was now completely jaundiced, and his ſtools were white, but the tenſion, pain, and ſickneſs, were abated.

Two days afterwards, a fluctuation was perceived in the abdomen, which in another week became conſiderably diſtended with fluid. The patient now did not complain of much pain, but appeared to be ſinking faſt; a puncture was made in the ſwelling, and thirteen pints of what appeared to be pure bile were evacuated. The bowels then ſoon became regular, and the appetite good. In twelve days, the operation was repeated, and fifteen pints of the ſame bilious fluid were drawn off. Nine days afterwards, another puncture was made, and thirteen pints more let out; and ſix were diſcharged in another fortnight. From this period the boy went on well, and perfectly recovered under the uſe of light tonic medicines. See Medico-Chirurgical Tranſactions, vol. iv. p. 330.

A previous accidental adheſion of the gall-bladder to the peritoneum might alſo certainly prevent the extravaſation of bile, and its dangerous effects. Calliſen, Syſt. Chir. Hodiernæ, tom. i. p. 718.

Mr. Hennen has never known a patient recover after a wound of the gall-bladder; and indeed, ſays he, it is difficult to imagine a caſe where the injury could happen without an effuſion of bile into the abdominal cavity, except a previous adheſion had taken place to the parietes. A caſe, however, is mentioned in the "Opuſcules de Chir." of M. Paroiſſe, where a leaden ball had lodged in the gall-bladder two years.

4. *Urine.*—Urine being of a very fluid nature may, like the bile, be eaſily extravaſated in the abdomen, when the bladder is wounded at any part which is connected with the peritoneum. If the urine in this kind of caſe be not drawn off with a catheter, ſo as to prevent it from iſſuing by the wound of the bladder, the patient ſoon periſhes. There are many inſtances recorded of the bladder being injured even by gun-ſhot wounds which were not mortal. (See Larrey's Mém. de Chir. Mil. eſpecially tom. iv.) Such wounds, however, might only have injured the ſides or lower part of the bladder. But in operating for the ſtone above the pubes, the bladder has undoubtedly been occaſionally cut at the part of the fundus which is covered with the peritoneum. However, as the accident was known in the firſt inſtance, the right treatment was adopted, and ſuch patients have recovered. Sabatier, Médécine Opératoire, tom. i. p. 37.

Wounds of the bladder are particularly characterized by a diſcharge of bloody urine and difficulty of making water. They muſt always be regarded as dangerous caſes, both on account of the riſk of the effuſion of ſo irritating a fluid in the abdomen, and of the chance of extravaſation in the cellular membrane. Under proper treatment, however, they often admit of cure. The effuſed fluid ſhould, if poſſible, be diſcharged by a depending poſture, or ſuitable punctures or inciſions, and its recurrence prevented by the introduction of a catheter, which is to be left in the urethra. The patient muſt alſo be allowed little drink. As for the tenſion and pain of the belly, the perpetual attendants of a wounded bladder, they may be greatly relieved by the uſe of the warm bath. (Calliſen, tom. i. p. 719.) Bleeding and other antiphlogiſtic means are not to be omitted. See Dict. of Pract. Surg. art. *Wounds.*

Extraneous bodies, particularly balls, as Mr. Hennen obſerves, are frequently carried into the bladder itſelf, either as it riſes above the pubes or through the openings in the pelvis, or work their way into it, and either come off by the natural paſſage, or are removed by a ſurgical operation reſembling lithotomy. Wounds of the bladder, he remarks, are dangerous in proportion as it is full of urine at the time of their receipt, or as the upper and anterior, or lower and poſterior part of the viſcus may be wounded. If the inteſtines are implicated in the wound, it is highly dangerous. Inflammation from wounds of theſe parts runs rapidly into gangrene, which is chiefly brought on by the effuſion of urine in the cellular membrane. "If there is a free extenſive paſſage, much of this danger will be obviated; and after the firſt effuſion from the bladder has taken place, the judicious uſe of the elaſtic gum catheter affords us an admirable aſſiſtance againſt this accident. "Indeed," ſays Mr. Hennen, "without this uſeful inſtrument, our practice in wounds of this nature, and in thoſe affecting the urethra, would be merely confined to looking on and moderating ſymptoms, inſtead of preventing them." (P. 460.) The reſt of the treatment conſiſts in letting out, without delay, the effuſed urine by proper inciſions, and employing the antiphlogiſtic plan, in the full ſenſe of the expreſſion, together with mild ſuperficial dreſſings or poultices, and the utmoſt attention to cleanlineſs.

A deep wound of the liver, Mr. Hennen conſiders as fatal as one of the heart itſelf. Slighter injuries of this organ, he ſets down as ſometimes recovering. He ſays, that the uſual ſymptoms which characterize wounds of the liver are, yellowneſs of the ſkin and urine, derangement of the ſtomach and of the alimentary canal, and cutaneous affections, particularly great and diſtreſſing itching. The diſcharge from the wound is generally yellow and glutinous; but he has ſeen it of a ſerous nature, and ſometimes very nearly allied to unmixed bile.

Wounds of the liver, ſays another writer, may cauſe a large effuſion of blood from the outer wound, or in the abdomen, a cadaverous yellow countenance, pain in the ſhoulder, ſlow pulſe, dulneſs of the eyes, great anxiety, cold ſweats, and finally death, which happens the more quickly and certainly, the greater the wound is, and the nearer it is ſituated to the place where the large veſſels enter this organ. But ſmall wounds of the liver, particularly of its convex ſurface, when it is adherent to the peritoneum, admit of cure. Calliſen, tom. i. p. 718.

The treatment is to be at firſt conducted entirely on antiphlogiſtic principles, veneſection, and mild aperient medicines in particular being employed. Afterwards ſmall doſes of the pil. hydrarg. and tonic medicines will tend to re-eſtabliſh the health.

A wound of the ſtomach may be known by the diſcharge of aliment from the external opening; by the vomiting of blood; the pain, the anxiety, and other ſymptoms of violent nervous irritation. Large wounds of this organ, eſpecially thoſe about the cardiac orifice, or great curvature, or ſuch as extend through both ſides of the viſcus, are for the moſt part fatal in a few days: but when the wound is differently ſituated, and properly treated, it may often be cured. In certain inſtances, however, a fiſtula remains, through which

a part

a part of the food ſometimes eſcapes. Two caſes of wounds of the ſtomach are recorded by Dr. Thomſon, in his Obſ. on the Military Hoſpitals in Belgium. One was from a muſket-ball; the other from a pike. They were treated on the mild, unirritating plan, adapted for wounds of the inteſtines, and both ended well. "The hiſtories of the Bohemian, Pruſſian, and Engliſh 'cultrivores,' from ſome of whom the knives have been cut out, and from others diſcharged ſpontaneouſly, through the coats of the ſtomach and parietes of the abdomen, as well as many other inſtances on record, are (as Mr. Hennen obſerves) very encouraging in caſes of injuries of this organ." M. Hevin, in the Mém. de l'Acad. de Chir. tom. i. p. 144. has collected a number of intereſting inſtances of recovery, both from inciſed and gun-ſhot wounds. But (ſays Mr. Hennen) the induſtrious Ploucquet, in the articles "Ventriculus" and "Pantophagi," has exceeded all others for the vaſt number of caſes he has amaſſed. In our own Philoſophical Tranſ., Lowthorpe's Abridgment, vol. vi. p. 192. or in the modern one, by Drs. Hutton, Shaw, and Pearſon, vol. iv. p. 66. an inſtance is given, where the ſtomach of a horſe was wounded and ſewed up, and a ſimilar inſtance in the human ſpecies: both recovered. More recently ſutures have been applied to its wounds in Holland and France, as may be ſeen in the "Annales de Litterature," &c. by Kluyſkens, vol. 2. and in the "Traumalogia" of Schlichting, &c. Notwithſtanding theſe narratives, however, we have no doubt of the raſhneſs of ſuch practice, and all that can be ſaid about it is, that the patients had to overcome both the injury and the bad treatment of it. Not unfrequently a wound of the ſtomach has become fiſtulous. Richerand gives a very curious caſe of this kind, where the opening remained for nine years; Etmuller, in the 5th vol. of Haller's "Diſputationes Chirurgicæ," gives an inſtance, where it continued open for ten years; and Wenker, in the ſame volume, relates a caſe where a wound of the ſtomach continued open twenty-ſeven years. (See Hennen on Military Surgery, p. 481, &c.) Copious bleeding, abſtinence, and reſt, are the beſt remedies in the early ſtage of all ſuch caſes.

Wounds of the ſpleen moſtly prove fatal by the profuſe hemorrhage ariſing from them. Mr. Hennen, however, aſſures us, that he has ſeen ſome ſlight wounds of this viſcus terminate favourably. It has ſometimes been cut out of brutes, without any fatal or even any bad conſequences; and there is a recent inſtance recorded, in which it protruded from an inciſed wound, the ſurgeon removed it, and the patient got well. (See Medico-Chirurg. Journal, vol. i. 1816.) It has alſo been tied and cut out in ſome other inſtances with ſucceſs. See caſes in Gooch's Chir. Works, vol. i. p. 97; Leveillé's Doctrine Chir. tom. i. p. 400; alſo ſome references in Thomæ Bartholini Anatome, p. 158. 8vo. Lugd. Bat. 1686, &c.

Wounds of the ſpleen have ſcarcely any ſymptom which is peculiar to them. According to Celſus, however, there is great pain in the ſhoulder, as in wounds of the liver. The looſe ſtructure of the ſpleen, and the magnitude of its veſſels, muſt always render its injuries highly dangerous.

Wounds of the pancreas, according to Calliſen, are not characterized by any peculiar ſymptom, except the effuſion of a fluid analogous to the ſaliva. The pancreas, like the duodenum, can hardly be wounded, without the weapon having at the ſame time injured other viſcera. (Syſt. Chir. Hodiernæ, tom. i. p. 719.) Gooch ſets down wounds of the pancreas as mortal, if its duct or blood-veſſels be injured. Chir. Works, vol. i. p. 99.

Wounds of the kidneys and ureters are always dangerous, on account of the hemorrhage and effuſion of urine. When the latter fluid inſinuates itſelf within the peritoneum, or into the cellular membrane, the patient has but a very diſcouraging chance of preſervation. Small wounds of the kidney, however, may be cured, though a fiſtula will ſometimes remain. The danger of wounds of the kidney is well pointed out in M. Hevin's Eſſay on Nephrotomy, in the Mém. de l'Acad. de Chir., and a great maſs of evidence is produced on the ſubject. The recoveries which Mr. Hennen has ſeen, after wounds of the kidneys, he obſerves, are very few indeed. "If the patient has ſurvived the firſt hemorrhage, the fever and peritoneal inflammation, with inceſſant hiccough and vomiting from ſympathy of the diaphragm and ſtomach, have generally cut him off; and if he has for a time eſcaped, excruciating pains, profuſe ſuppuration from fiſtulous ſores, hectic, and emaciation, have terminated his exiſtence. Where the cure has been effected, there is reaſon to think that the ureter has been but ſlightly bruſhed, and the body of the kidney itſelf left untouched. The remedies conſiſt in veneſection, mild purgatives, as manna, oil, &c. frequent emollient enemas, the warm bath generally, and local fomentations, &c. with a diet of the mildeſt kind, but much reſtricted in fluids, the indulgence in which, even in ſmall quantity, ſhould be avoided." The ſame author properly condemns all ſtimulants, bliſters, and diuretics; and he recommends light dreſſings, ſo as to allow the urine to eſcape freely. The integuments near the wound he alſo adviſes to be greaſed, ſo as to prevent the irritation of the urine from making them inflame and ulcerate. See Obſ. on Military Surgery, p. 454.

The ſubject of wounds is one of infinite length, and this muſt apologize for the extent of the preſent article, in which a great deal is ſtill omitted. Had we introduced a full account of the wounds of every part of the body, our obſervations would have formed a production more than twice as long as that which we have now finiſhed; but we thought that ſo minute and elaborate a paper would hardly be deſirable in a work not expreſsly allotted to the conſideration of ſurgery.

Wounds *in Horſes*. The moſt terrible wounds theſe creatures are ſubject to are thoſe got in the field of battle. The farriers that attend camps have a coarſe way of curing theſe; but it is a very expeditious and effectual one. If the bullet be within reach, they take it out with a pair of forceps; but if it lie too deep to be come at, they leave it behind, and dreſs up the wound in the ſame manner as if it were not there.

They firſt drop in ſome varniſh from the end of a feather, and when the bottom is thus wetted with it, they dip a pledget of tow in the ſame varniſh, which they put into the wound, and then cover the whole with the following charge: Take a quarter of a pound of powder of bole armenic, half a pound of linſeed-oil, and three eggs, ſhells and all; add to theſe four ounces of bean-flour, a quart of vinegar, and five ounces of turpentine; this is all to be mixed over the fire, and the wound covered with it. This application is to be continued four or five days, then the tent put into the wound is to be dipped in a mixture of turpentine and hog's-lard; by this means a laudable matter will be diſcharged, inſtead of the thin ſharp water that was at firſt. Then the cure is to be completed by dreſſing it with an ointment made of turpentine, firſt well waſhed, and then diſſolved in yolks of eggs, and a little ſaffron added to it.

This is the practice in deep wounds that do not go through the part; but in caſes where the bullet has gone quite through, they take a few weavers' linen thrumbs, made very knotty; theſe they make up into a kind of link, and dipping it in varniſh, they draw it through the wound, leaving

leaving the ends hanging out at each fide; by means of thefe they move the link or fkein three or four times a day, always wetting the new part that is to be drawn into the wound with frefh varnifh. They put on a charge of the bole armenic, &c. as before defcribed, on each fide of the wounded part, and continue this as long as the wound difcharges thin watery matter, or the fides continue fwelled. After this they drefs it with the ointment of the turpentine, yolks of eggs, and faffron, till it is perfectly cured.

The other methods are, the dreffing of the wound with an ointment made of wax, turpentine, and lard, and covering it with linen rags wetted with cream; or the dreffing with a mixture of yolks of eggs, honey, and faffron, and covering it up with cream and baum-leaves beaten together.

When the wound is fo dangerous as to require the affiftance of internal medicines, they give the following pills: Take affafœtida, bay-berries, and native cinnabar, of each a pound; beat up the whole into a mafs with brandy, and roll it into pills of fourteen drachms each. Thefe are to be laid in a fhady place to dry, after which they will keep ever fo long without any damage. The horfe is to take two of thefe every other day, or, if neceffary, every day, till he has taken eight or ten of them, and he is to ftand bridled two hours before and after the taking of them.

When the wound feems at a ftand, not appearing foul, and yet not gathering new flefh, there muft be recourfe had to the following powder, whofe effect in bringing new flefh is wonderful: Take dragon's blood, and bole armenic, of each two ounces; maftic olibanum, and farcocolla, of each three drachms; aloes, round birth-wort, and common iris-root, of each one drachm and a half; make the whole into a fine powder. This is fometimes ufed dry, fprinkling it on the wound; but fometimes it is mixed with turpentine, fometimes with juice of wormwood, and fometimes with honey of rofes, and either way does very well.

When the wound grows foul, and requires a detergent to cleanfe it, the common liquor for this purpofe is a phagedenic water, which they make of lime-water, and fublimate in this manner: Take two pounds and a half of newly-made and unflaked lime, put it into a pewter veffel, and pour on it five quarts of boiling water. When the bubbling is over, let it ftand to reft two or three days, ftirring it often with a ftick; then pour it clear off after due time for the lime to fettle, and filtre it through fome whited-brown paper, made for the lining of funnels, on this occafion. To a quart of the clear lime-water, thus prepared, add eight ounces of fpirit of wine, and one ounce of fpirit of vitriol; when thefe are well mixed, by fhaking them together, then add an ounce of corrofive fublimate in fine powder: mix all well together, and keep the whole in a bottle, to be ufed for the cleanfing of thefe foul wounds, and on any other occafions, where a detergent of this powerful kind may be neceffary. It will keep good many years.

If this water will not thoroughly cleanfe the wound, but there ftill will remain a quantity of foul matter in it, and there is danger of a gangrene, they add to it as much arfenic in fine powder as there was of the corrofive fublimate; that is, at the rate of an ounce to a quart and half a pint.

Thefe are all the medicines which the farrier need carry with him on account of wounds; and they are all fuch as may be prepared at home, and will continue good fo long as he has occafion to keep them, or much longer; and what is left of one year will ferve for others.

When the neceffary applications are thus fettled, it may not be improper to add the general rules by which they conduct themfelves in the cure.

1. The wound muft be probed at firft, but very gently, and afterwards as gently and as feldom as may be, for the horfe's flefh is the moft eafy of all others to be contufed in wounded parts, and to fall into a gangrene from the hurt. 2. The wound muft be kept continually as clean as poffible, and free from proud flefh. 3. The neceffary revulfion muft always be made by bleeding, as foon as the wound is dreffed the firft time; this prevents inflammation, and a great many other bad accidents. 4. If the wound be in fuch a place that the horfe can get at it with its tongue to lick it, great care muft be taken to prevent his doing fo, as it will greatly retard the cure. 5. The farrier never is to proceed to fuppuration in any cafe in which the humours can be either diffolved or repelled, and efpecially in parts that are full of finews and ligaments, or that are near the bones. 6. If a wound be accompanied with a great contufion, or if it be of a round or circular figure, incifions are often neceffary about its edges, and fometimes the application of cauftics. 7. The wound muft be always carefully covered, for the accefs of the air retards the cure. 8. The callous lips of a wound muft always be cut to the quick, before they can be united together. Thefe may ferve for general rules, that hold good in all cafes: and to thefe may be added fome that are principally applicable to peculiar circumftances of the wounds.

Wounds of the breaft are to be cured with tents and folds of foft linen laid over them, fteeped in the following mixture: Take verdigrife, vitriol, and alum, of each one ounce; vinegar, eight ounces; honey, a pound; let all thefe be boiled together till they become red.

Wounds in the belly can only be cured by fewing up the peritoneum with ftrong woollen thread, not filk, leaving the extremities without the fkin. The fkin is to be fewed together with ftrong hempen thread waxed, joining the lips of the wound together, by this means, in form of a buckle. This is to be covered with the common ointment for wounds; and if an inflammation comes on, chalk diffolved in vinegar is to be added.

If the wound be fuch that the guts come out at it, the horfe may ftill be recovered, if proper caution be ufed: the guts are to be immediately returned into their place; but they muft not in this be touched with the hand, but with a fponge dipped in warm water. And, in order to the making them more readily get into their places, it is proper to make the creature vomit, by thrufting down his throat a feather dipped in oil. If the wound through which they fell is not big enough to return them eafily by, it muft be enlarged by cutting; but if the guts are found to be bruifed or wounded, it is in vain to attempt any thing, for death muft follow.

There is alfo a certainty of death when, after a wound of any kind in the belly, the horfe voids blood at the fundament.

When a horfe is wounded near the groin, he eafily falls into convulfions; in this cafe, he is to be kept from drinking as much as poffible: he is alfo to be covered well up, and kept quiet, and to have green things given him to eat.

Wounds on the knees are very difficult to cure, becaufe the part is in motion almoft continually, and there is very little flefh to work upon. When the wounds are but flight, and in the mufcular parts of the body, a mixture of honey and tallow, boiled together, will often prove a cure; when the wound is more confiderable, turpentine melted in a little common oil, and applied hot, is the general remedy.

If a wound happens between the fhoe and the hoof, care muft be taken that no foreign matter be left in it, and it muft be dreffed with any of the ointments that have verdigrife in them; and a charge of bruifed elder-leaves is very proper

proper to be applied over all. If the wound be deep and narrow, it muſt be enlarged at the orifice, and turpentine and wax, melted in lard, muſt be poured into it. The ſame rule of opening the orifice holds good in all deep and narrow wounds.

If a nerve happens to be cut, it muſt be cloſed, and a defenſative muſt be applied, to prevent a concourſe of humours to the part; a fomentation made of oil, wine, and honey, mixed together, is alſo very proper, wherever a nerve is hurt, and a poultice may be applied over all, made of marſhmallow-roots boiled ſoft, with bread and milk.

If the horſe happens to be wounded by a piece of wood, bone, or any other hard ſubſtance, part of which remains in the wound, this muſt be carefully taken out, whatever pain it may coſt the creature to do it, and the wound muſt then be dreſſed with the common wound-ointments. In this, or any other caſe of a freſh wound, the waſhing it with oil of turpentine is an excellent method of preventing ill conſequences.

Wounds *in Trees*, ſuch as are cauſed in lopping and pruning their branches, or otherwiſe. Mr. Nichol, in his "Practical Planter," has ſhewn, that lopping of ſtrong branches becomes not neceſſary, and that all wounding in pruning ſhould be performed on or towards the extremities of boughs which have inferior laterals to partake of and divert their luxuriance of growth from injuring the ſtem or leader. It is alſo ſhewn, that from this mode little ill is to be apprehended, and conſequently that the treatment of ſuch wounds is ſimple, and which is ſo much the better for the plant and the intereſt of its owner. Such wounds require no other attention than being lopped clean off with a ſharp knife or bill; and, if the ſaw is uſed, being afterwards ſmoothed with the knife. And it were to be wiſhed, for the ſake of much timber, which otherwiſe might have been rendered more valuable, that wounds of another deſcription had been unneceſſary, or had never been inflicted. The writer here alludes to the neceſſity of lopping by the bole all ſtumps, &c. occaſioned by formerly-injudicious pruning, and the wanton folly of thoſe who lop large branches by or near to the ſtem, when ſimply ſhortening them at a proper diſtance would anſwer a better purpoſe. But ſince it becomes neceſſary to clear formerly-injured trees of ſtumps, &c. in order to prevent farther decay, it alſo becomes a duty to follow the moſt rational and ſimple mode of treatment. With this view, it is briefly obſerved, that whenever it becomes neceſſary to lop a ſtump by the bole, or to ſhorten any branch larger than the wriſt or ankle; in the former caſe, the wound ſhould be to the quick, that is, to the level of the bark, on the ſtem at leaſt; and in the latter, *obliquely* acroſs the branch, ſo as, from its poſition, to prevent moiſture from lodging: being careful to prevent laceration, by notching the bark underneath, before the amputated part falls down, or to one ſide. In both caſes, the face of the wound and edges of the bark are to be made perfectly ſmooth with the knife; and in a few hours after, or ſo ſoon as they are quite dry, let the wound be carefully plaſtered with tar, (ſuch as is uſed for ſheep-ſmearing,) or laid over with white or blue lead, which has been well mixed up with oil, and rendered rather thicker than is commonly uſed for painting. The tar is, however, certainly preferable, being of a more healing nature; and if laid on in a thin ſtate, it is not ſo apt to ſcale off by the action of the weather as the paint. This operation ſhould be performed in the *fall* of the year; at which time, the wound is not ſo apt to crack, and likewiſe dries ſooner than at any other ſeaſon. If, however, in the courſe of the enſuing ſummer, or at any ſubſequent period, the tar or paint is found to rend or ſcale off, care muſt be taken to renew and keep the plaſter ſound and ſmooth, until the bark grow over and cover the wound; and this ſhould be more particularly obſerved in reſpect of wounds on the trunk.

In the caſe of *polling* a tree, lopping an upright branch, or in training for ſhip-timber, ſtopping the leader, &c. when, from the upright poſition of the wounded part in queſtion, plaſtering or painting, as above, might be deemed inſufficient to prevent water from penetrating, and of conſequence injuring the wood at the part affected; yet by this treatment, infection, or the farther decay of the reſt of the tree, will be prevented. But there are ſome who ridicule the idea of uſing plaſter of any kind, urging for argument that the bark grows as faſt together of itſelf without this aid, and why bury in the heart of the tree a load of rubbiſh? But they certainly have not conſidered, that a decayed part of the vegetable being buried in its heart, cannot poſſibly again be renovated, or become ſound timber; but, on the contrary, muſt operate to the corruption of the reſt. And this queſtion, why bury in the tree a load of rubbiſh? leads, it is ſaid, to a deciſion in favour of uſing tar, ſince, beſides that the body incloſed is quite thin, it is of a genial, healing nature, acts as a cement to the fracture, and afterwards becomes equally ſound as the wood.

And this may be demonſtrated by examining fir-trees which have been wantonly hacked *deeply*, had holes bored into them for faſtening gates to, which have afterwards been removed, and above all in the operation of extracting roſin; in all which caſes, the wound is cloſed up by the reſinous juice of the tree, and generally becomes perfectly ſound as the reſt of the wood, although a blemiſh may be the conſequence. Wherefore, with reſpect to reſinous trees, nature prevents the neceſſity of our interference in the cure of wounds, other than the fracture of limbs; which it is certainly our duty to amputate, in order to prevent farther decay and unſightly appearance; but ſhe will haſtily cover the wound with the plaſter ſuperior to any we can prepare.

Wound-*Wort*, in *Botany*, the name given to ſeveral ſpecies belonging to different genera.

Wound-*Wort of Achilles*. See Achillea.

Wound-*Wort*, *Clown's*, a ſpecies of *ſtachys*. See Stachys.

Wound-*Wort*, *Hercules's*, or *All-heal*, the *laſerpitium chironium* of Linnæus. This is a native of the warmer climates, and bears the colds of our own. Both the ſeeds and roots of this ſpecies are conſiderably warmer than thoſe of the *garden* and *wild* parſnep. The roots and ſtalks have a ſtrong ſmell and taſte, reſembling thoſe of opoponax: and Boerhaave relates, that on wounding the plant in ſummer, he obtained a yellow juice, which, being inſpiſſated a little in the ſun, agreed perfectly, in both reſpects, with that exotic gum-reſin. Lewis. See Laserpitium.

Wound-*Wort*, *Saracen's*, *ſolidago*. See Solidago.

Wound-*Wort*, *True Saracen's*, a ſpecies of *ſenecio*. See Senecio.

WOUNICS, in *Geography*, a town of Auſtrian Poland; 32 miles E.S.E. of Cracow.

WOUTERS, Francis, in *Biography*, was born at Liere, in Brabant, in 1614. He was a ſtudent in the ſchool of Rubens, but applied himſelf principally to landſcape, and became one of the moſt eminent of his time. He choſe for his models the ſcenes of his native country, and particularly the foreſt of Soignes, near Bruſſels; embelliſhing the views he choſe with groups of figures repreſenting hiſtorical or allegorical

allegorical ſubjects. Sometimes he attempted hiſtory, but not ſuccefsfully. He was in favour with the emperor Ferdinand II.; but coming to England with his ambaſſador in 1637, he was appointed chief painter to the prince of Wales, afterwards Charles II. On the breaking out of the rebellion he returned to Antwerp, and became director of the academy there, where in 1659 he was killed by the accidental diſcharge of a gun.

WOUVERMANS, Philip, was a remarkable and melancholy inſtance of thoſe mis-ſhapen and unhappy combinations of talent, induſtry, and ill-fortune, which have occaſionally diſgraced the world of connoiſſeurſhip. He was the ſon of an indifferent hiſtorical painter, and was born at Haerlem in 1620. Having obtained poſſeſſion of his father's ſtore of pictorial knowledge, he was placed with John Wynants, the landſcape-painter, under whoſe inſtruction he ſoon acquired a conſiderable degree of power in embodying the creations of his own fancy, and to this acquiſition he added much by an attentive ſtudy of nature.

There is but little known of his private life. Celebrity, which now attends his name, formed no part of his enjoyments; indeed they appear to have been few, and confined to his affection for and attention to his art and his family, which was numerous. His pictures, beautiful as they are, agreeable in their compoſition and colour, and exquiſite in their finiſh, exhauſted his time without raiſing him above indigence and obſcurity. The more free, ſlight, and looſe works of Peter de Laer, called Bamboccio, abſorbed the admiration of the Dutch collectors, while the elegant and delightful productions of Wouvermans remained unnoticed and unknown. Time has adjuſted the balance, and the united voice of the taſteful now ſheds a luſtre over the name of the latter; too late, alas! for his gratification or benefit.

The neglect which he endured, and the ſeverity of labour required to complete ſo many pictures as he has left, in ſo high and perfect a degree of finiſhing, exhauſted his health, and he died at the early age of 48; having burnt a ſhort time before his death all his ſtudies and drawings, to prevent, as he declared, his children from being induced to follow a profeſſion which had been but a ſource of poverty and miſery to himſelf.

The ſubjects of his pictures are drawn from the common ſcenes of nature, but are ſometimes of a more elevated caſt than thoſe choſen by the generality of his compatriots, particularly his hawkings and huntings, where cavaliers and high dames, with appropriate ſcenery, rich trappings to their horſes, and numerous retinues, are introduced with great taſte and propriety. His encampments and battles are compoſed with the ſame ſkill and ſuavity; indeed the latter is a principal characteriſtic of all his works, whatever be their ſubjects, from the humble hay-cart to the richeſt combination of materials which the gay palace, its garden, and ſplendid adornments, afforded him. Farriers' ſhops, fairs of horſes, travellers on their road, or at inn-doors, &c. &c. were equally rendered agreeable by his delightful arrangements of chiaro-oſcuro and of colours, and by the exquiſitely firm full touch with which they are executed. His works are numerous, and when in good preſervation ſell at very conſiderable prices.

Wouvermans, Peter, the younger brother of Philip, was alſo an artiſt of conſiderable talent, though by no means equal to him. He was alſo born at Haerlem, about the year 1625. He was trained under R. Rogman, but principally followed his brother's ſtyle, and adopted his claſs of ſubjects. But though his pictures are frequently ſold for Philip's, yet they are not ſo delicate or ſpirited, and may be eaſily diſtinguiſhed from his by a cultivated eye. There was alſo another brother, a few years younger than Peter, who followed the ſame line of art with rather more talent; ſo that we cannot be ſurpriſed at the number of pictures which bear the name of Wouvermans. John died in 1666, at the age of 38.

WOXEN, in *Geography*, a large and noiſy current of Sweden, formed by the diſcharge of the lake of Saima into the Ladoga, which forms a vaſt cataract about a mile from its mouth.

WOXNA, a town of Sweden, in Helſingland; 40 miles W. of Soderhamn.

WOXTORP, a town of Sweden, in the province of Smaland; 27 miles N.W. of Wexio.

WOYE, a town of Germany, in the principality of Culmbach; 5 miles S.E. of Hof.

WOYTZ, a town of Sileſia, in the principality of Neiſſe; 2 miles E. of Ottmuchau.

WRA, a town of Sweden, in the province of Smaland; 48 miles W.S.W of Wexio.

WRACK. See Wreck.

Wrack, in *Natural Hiſtory*. See Wreck.

Wrack, in *Agriculture*, a name ſometimes given to a marine plant, which is of great utility as a manure. With this plant ſurgeons ſometimes make a cataplaſm, by bruiſing a quantity of it, and applying it in caſes of ſcrofula, or white-ſwelling, but more particularly glandular tumours. Where this cannot be got, ſea-water and oat-meal formed into a poultice have ſupplied its place. There is no reaſon why the tumours and ill-conditioned ſores of brute animals ſhould not be benefited by ſimilar applications. See Wreck.

It is frequently termed *ſea-wrack*, *ſea-tangle*, and *ſea-oak*. See Sea-*Weed*.

WRAGBY, in *Geography*, a ſmall market-town in the wapentake of Wingrove, Lindſey diviſion of the county of Lincoln, England, is ſituated at the junction of the turnpike-roads leading from Lincoln to Louth and Horncaſtle, and is diſtant 11 miles N.E. by E. from Lincoln, and 144 miles N. by W. from London. George Villiers, duke of Buckingham, who poſſeſſed this manor in the reign of Charles II., obtained from that monarch a charter to hold a weekly market on Thurſday and two annual fairs, which are now well frequented. Sir Edmund Turnor, who purchaſed the manor of the duke, erected and endowed an alms-houſe for ſix clergymen's widows, and ſix other deſtitute perſons, for whoſe uſe he built a chapel, with an augmentation to the vicarage of 40*l. per annum* for prayers to be read in it twice every day: this chapel was conſecrated by biſhop Gardiner July 18, 1697. Here is alſo a free-ſchool, founded and endowed in 1633 by William Hanſard, eſq. The population of Wragby is ſtated, in the return of the year 1811, to be 709; the number of houſes 103. The manor is now poſſeſſed by Edmund Turnor, eſq. who has a ſeat in the adjacent pariſh of Panton, called Panton-hall, which was built by Hawkſmoor, a pupil of ſir John Vanbrugh, in the year 1724: conſiderable additions have been made to it from the deſigns of Mr. Carr, architect at York; and the adjoining country has been greatly improved by ornamental plantations. Two miles north of Wragby is Halton Lodge, the ſeat of colonel Caldicot, in whoſe family the manor of Halton has been veſted for ſeveral generations.—Beauties of England and Wales, vol. ix. Lincolnſhire; by J. Britton, F.S.A. 1808.

WRAIN-Bolts, in *Ship-Building*, are iron ring-bolts, uſed when planking ſhips, &c. with two or more fore-lock holes near the end, for taken-in the ſet, as the plank, &c. works nearer the timbers.

Wrain-*Staves*, a ſort of ſtout billets of tough wood, tapered

tapered at the ends fo as to go into the ring of the wrain-bolt, to make the fets neceffary for bringing-to the planks or thick ftuff to the timbers.

WRAM, in *Geography*, a town of Sweden, in the province of Skone; 13 miles W.S.W. of Chriftianftadt.

WRANGLER, SENIOR, a technical term in the univerfity of Cambridge, for the ftudent who paffes the beft examination in the fenate-houfe, and confers lafting reputation. They who follow next in the fame divifion are refpectively termed fecond, third, fourth, &c. wranglers. In a fimilar manner, they who compofe the fecond rank of honours are defignated by the titles of firft, fecond, third, &c. optimi. Thofe of the laft order are diftinguifhed by the denominations of firft, fecond, third, &c. junior optimi.

WRANGON, in *Geography*, a fmall ifland in the gulf of Finland. N. lat. 59° 34′. E. long. 25°.

WRANNY, a town of Bohemia, in the circle of Schlan; 7 miles N.N.W. of Schlan.

WRANOW. See FRAIN.

WRAPPER, in *Botany*. See VOLVA.

WRASSE, in *Ichthyology*, the name of a fifh called by authors *turdus vulgaris*, and by fome *tinca-marina*, the *fea-tench*, and fometimes *old-wife*.

The wraffe, or *labrus tinca* of Linnæus, refembles the carp in figure, and is covered with large fcales. Its ufual fize is about five or fix inches in length, and it grows to the weight of four or five pounds: its colour is very variable; red, yellow, and brownifh, being very frequently mixed in the fcales; and it has five or fix longitudinal lines, alternately of a pale yellow, an olive colour, and a dufky red. Its nofe is long, and bent upwards, and it has thick and flefhy lips extended over the jaws. Its mouth is fmall, and its teeth, which are difpofed in two rows, the firft conic, the fecond very minute, are not very fharp; in the throat, juft before the gullet, are three bones, two above of an oblong form, and one below of a triangular fhape; with the furface of each rifing into roundifh protuberances: thefe are of fingular ufe to the fifh for grinding its fhelly food before it arrives at the ftomach; the dorfal fin confifts of fixteen fharp and fpiny rays, and nine foft ones, longer than the others: the pectoral fins are large and round, and compofed of fifteen rays, the ventral of fix; the firft fharp and ftrong; the anal of three fharp fpines, and nine flexible: its tail is rounded at the end, and is formed of fourteen foft branching rays; the membranes of the fins and tails are variegated with red and blue fpots, and the anterior rays of the back-fin are prickly. It is caught in plenty on the Englifh fhores, and is fold among the poorer fort of people in Wales and Cornwall; but is not efteemed a very delicate fifh. It is found in deep water, adjacent to the rocks; it will take a bait, though its ufual food is fhell-fifh, and fmall cruftacea. Willughby's Hift. Pifc. p. 320. and Pennant. See LABRUS.

WRASSE, *Bimaculated*, *labrus bimaculata* of Linnæus, has a body pretty deep, and of a light colour, marked in the middle on each fide with a round brown fpot, and another on the upper part of the bafe of the tail: the lateral line is incurvated; the branchioftegous rays are fix; the firft fifteen rays of the dorfal fin are fpiny, the other eleven foft, and lengthened by a fkinny appendage; the pectoral fins confift of fifteen rays; the ventral of fix, the firft fpiny, the fecond and third ending in a flender briftle; the anal fin is pointed; the four firft rays being fhort and fpiny, the reft long and foft. This is an inhabitant of the Mediterranean.

Mr. Pennant has defcribed fome other fpecies of wraffe, as the *trimaculated*, *ftriped*, and *gibbous*, taken on the coaft of Anglefea, and another called *ballan*, numbers of which appear during fummer near Scarborough, which is of the form of the common wraffe, except that between the dorfal fin and the tail it has a confiderable finking; above the nofe a deep fulcus; and on the fartheft cover of the gills a depreffion radiated from the centre. Pennant's Brit. Zool. vol. iii. p. 246, &c. See LABRUS.

WRATENI, in *Geography*. See FRATING.

WRATH, CAPE, a cape in the N.W. extremity of Scotland, in the parifh of Durnefs, which affords excellent pafture for fheep. In its vicinity are vaft caverns.

WRBOWALNOI, a town of Bohemia, in the circle of Konigingratz; 16 miles S.W. of Biezow.

WREAK, or WREKE, a river of Leicefterfhire, which paffes by Melton Mowbray, and runs into the Soar, 7 miles N.E. of Leicefter.

WREATH, in *Agriculture*, a fmall roll formed of any kind of light fubftance, fuch as ftraw, hay, &c. and ufed for different purpofes.

WREATH, in *Natural Hiftory*. See TURBO.

WREATH, in *Heraldry*, a roll of fine linen, or filk, (like that of a Turkifh turban,) confifting of the colours borne in the efcutcheon; placed in an achievement, between the helmet and the creft, and immediately fupporting the creft.

WREATH *Stick-Band*, in *Agriculture*, a band formed of any kind of twifted ftick, ufed for tying up fagots, and other fuch purpofes.

WRECK, WRACK, *Sea*-WRECK, or *Sea*-OAK, the *fucus veficulofus* of Linnæus, in *Natural Hiftory*, a foft, very flippery, marine plant, common among rocks that are left dry at the ebb tide, with leaves fomewhat refembling thofe of the oak-tree; the ftalk running along the middle of the leaves, and terminated by watery bladders containing either air or a flippery fluid: the veficles begin in March to fill with a thin juice; and about the end of July they burft, and difcharge a matter as thick as honey.

In fome places it is ufed to manure the ground. In Normandy, and other parts, they burn it; and of the afhes make a kind of foda, or potafh, which they ufe in the making of common green glafs, to promote the fufion or vitrification of the other materials. See SEA-*Weed*.

Dr. Ruffel relates, that he found this plant an ufeful affiftant to fea-water in the cure of diforders of the glands; that he gave it in powder to the quantity of a drachm, and that in large dofes it naufeated the ftomach; that by burning in the open air, it was reduced into the black faline powder; which feemed, as an internal medicine, greatly to excel the officinal burnt fponge; which was beneficially ufed as a dentifrice, for correcting laxities of the gums; and which indicated a remarkable degree of detergent virtue by its effect in cleaning the teeth: that the juice of the veficles, after ftanding to putrefy, yielded, on evaporation, an acrid pungent falt, amounting to above a fcruple from two fpoonfuls; that the putrefied juice, applied to the fkin, finks in immediately, excites a flight fenfe of pungency, and deterges like a folution of foap; that one of the beft applications for difcuffing hardnefs, particularly in the decline of glandular fwellings, is a mixture of two pounds of the juicy veficles, gathered in July, with a quart of fea-water, kept in a glafs veffel for ten or fifteen days, till the liquor comes near to the confiftence of very thin honey: the parts affected are to be rubbed with the ftrained liquor twice or thrice a day, and afterwards wafhed clean with fea-water. Lewis's Mat. Med. See ÆTHIOPS *Vegetabilis*.

WRECK, in *Sea Language*, denotes the ruins of a fhip which had been ftranded or dafhed to pieces on a fhelf, rock, or lee-fhore, by tempeftuous weather.

Wreck, *Wreccum*, called alfo *Ship*-Wreck, or *Ship*-Wrack, in *Law*, &c. is when a fhip perifhes in the fea, and no man efcapes alive out of it.

The civilians term it *naufragium*. The goods in the fhip which are brought to the land by the waves belong to the king, or him to whom he affigns the right thereof. Thus, in the Stat. Prærog. Reg. 17 Edw. II. cap. 11. "Rex habebit *wreckum maris* per totum regnum, balænas et fturgiones captas in mari, vel alibi intra regnum, exceptis quibuflibet privilegiatis locis," &c.

Thus alfo the matter ftood by the ancient common law; but the rigour of the law of wrecks has been gradually foftened in favour of the diftreffed proprietors. Accordingly it was firft ordained by king Henry I. that if any perfon efcaped alive out of the fhip, it fhould be no wreck; and afterwards king Henry II. by his charter, May 26, A.D. 1174, declared, that if on the coafts of England, Poictou, Oleron, or Gafcony, any fhip fhould be diftreffed, and either man or beaft fhould efcape or be found therein alive, the goods fhould remain to the owners, if they claimed them within three months; but otherwife fhould be deemed a wreck, and belong to the king, or other lord of the franchife. This was again confirmed, with improvements, by Richard I., who, in the fecond year of his reign, not only eftablifhed thefe conceffions, by ordaining that the owner, if he was fhipwrecked and efcaped, "omnes res fuas liberas et quietas haberet," but alfo, that if he perifhed, his children, or, in default of them, his brethren and fifters, fhould retain the property; and in default of brother or fifter, then the goods fhould remain to the king. And by the law, as laid down by Bracton in the reign of Henry III., if not only a dog (*e. g.*) efcaped, by which the owner might be difcovered, but if any certain mark were fet on the goods, by which they might be known again, it was held to be no wreck. Afterwards, in the ftatute of Weftm. 1, 3 Edw. I. cap. 4, the time of limitation of claims, given by the charter of Henry II., is extended to a year and a day, according to the ufage of Normandy; and it enacts, that if a man, a dog, or a cat, efcape alive, the veffel fhall not be adjudged a wreck. And it is now held, that not only if any living thing efcape, but if proof can be made of the property of any of the goods or lading which come to fhore, they fhall not be forfeited as wreck. The ftatute farther ordains, that the fheriff of the county fhall be bound to keep the goods a year and a day (as in France for one year, agreeable to the maritime laws of Oleron, and in Holland for a year and a half); that if any man can prove a property in them, either in his own right or by right of reprefentation, they fhall be reftored to him without delay; but if no fuch property be proved within that time, they then fhall be the king's. If the goods are of a perifhable nature, the fheriff may fell them, and the money fhall be liable in their ftead. This revenue of wrecks is frequently granted out to lords of manors, as a royal franchife; and if any one be thus entitled to wrecks, in his own land, and the king's goods are wrecked thereon, the king may claim them at any time, even after the year and the day. In order to conftitute a legal wreck, the goods muft come to land. If they continue at fea, the law diftinguifhes them by the barbarous appellations of *jetfam*, *flotfam*, and *ligan*.

Wrecks, in their legal accrptation, are now not very frequent; the owner being feldom unable to affert his property within the year and day limited by law. And in order to preferve his property entire, our laws have made many humane regulations, very oppofite in their fpirit to thofe which formerly prevailed in all the northern regions of Europe, and a few years ago were ftill faid to fubfift on the coafts of the Baltic fea; permitting the inhabitants to feize on whatever they could get as lawful prize. To what the reader will find under Salvage to this purpofe, we fhall here add, that all perfons who fecrete any goods of a wreck fhall forfeit their treble value; and if they wilfully do any act whereby the fhip is loft or deftroyed, by making holes in her, ftealing her pumps, or otherwife, they are guilty of felony without benefit of clergy. Moreover, by the ftatute 26 Geo. II. cap. 19. the plundering of any veffel either in diftrefs, or wrecked, whether any living creature be on board or not, or the preventing the efcape of any perfon that endeavours to fave his life, or the wounding of him, with intent to deftroy him, or the putting out of falfe lights in order to bring any veffel into danger, are all declared to be capital felonies, in like manner as the deftroying of trees, fteeples, or other ftated fea-marks is punifhed, by 8 Eliz. cap. 13. with a forfeiture of 100*l*. or outlawry. Alfo by the ftatute of Geo. II. the pilfering of any goods caft afhore is declared to be petty larceny; and many other falutary regulations are made for the more effectually preferving fhips of any nation in diftrefs.

By the civil law, to deftroy perfons fhip-wrecked, or prevent their faving of the fhip, is capital; and to fteal even a plank from a veffel in diftrefs, or wrecked, makes the party liable to anfwer for the whole fhip and cargo. The laws alfo of the Vifigoths, and the moft early Neapolitan conftitutions, punifhed with the utmoft feverity all thofe who neglected to affift any fhip in diftrefs, or plundered any goods caft on fhore. Blackft. Com. book i. p. 291, &c.

In divers charters and old writings, it appears that wreck, anciently, not only comprehended goods which came from a perifhing fhip, but whatever elfe the fea caft upon land: whether it were precious ftones, fifh, fea-weed, or the like.

This wreck, in the Grand Cuftomary of Normandy, cap. 17. is called *varech*, and latined *verifcum;* and in fome of our ancient charters, *wreche*, *werec*, *werech*, and *feupwerp*, q. d. *fea-upwerp*, of *fea* and *upwerpen*, *to caft up*.

Shipwreck, in marine infurance, and as it concerns the right of *abandoning*, is generally a total lofs. What may be faved of the fhip or goods is fo uncertain, and depends fo much on accident, that the law cannot diftinguifh this from the abfolute deftruction of the whole. The wreck of the fhip may remain, but the fhip is loft. Thus alfo the goods may remain; but if no fhip can be procured, in a reafonable time, to carry them to their place of deftination, the voyage is loft, and the adventure fruftrated. But the mere *ftranding* of the fhip is not, of itfelf, deemed a total lofs, fo as to intitle the infured immediately to abandon. It is only where the ftranding is followed by fhipwreck, or in any other way renders the fhip incapable of profecuting her voyage, that the infured is intitled to abandon. If the voyage be loft, this is a total lofs, not only of the fhip and freight, but alfo of the cargo, if no other fhip can be procured to carry it to its port of deftination. Moreover, if a cargo be damaged in the courfe of the voyage, fo that what has been faved is lefs in value than the amount of the freight, this is clearly a total lofs. In cafe of fhipwreck the rule in France is, that the infured may abandon, though the goods be recovered and carried to their place of deftination, becaufe goods thus faved are generally in a bad and unmarketable condition. But if the fhip become unnavigable, the infured cannot abandon the goods, if by any other fhip they may be conveyed in time to their place of deftination.

As it is reaſonable and neceſſary that the time of the underwriter's reſponſibility ſhould be limited, this limit is fixed in ſome maritime ſtates on the continent, within which period after the loſs the inſured may abandon. In France, Spain, and Holland, the times are limited by law, according to the diſtance of the place where the loſs happens, within which the abandonment muſt be made. In England there is no time, limited by law, for abandoning: but the courts have adopted a rule better ſuited to the promotion of commerce, and more likely to prevent frauds, which is this: that as ſoon as the inſured receives advice of a total loſs, he muſt make his election whether he will abandon or not; if he determines to abandon, he muſt give the underwriters notice of this "within a reaſonable time" after the intelligence arrives; and any unneceſſary delay in giving this notice will amount to a waver of his right to abandon; for unleſs the waver does ſome act ſignifying his intention to abandon, it will be only a partial loſs, whatever may be the nature of the caſe, or the extent of the damage. If by any interference of the underwriters the inſured be actually prevented from abandoning, the underwriters are liable for all the loſs ſuſtained by the inſured to the extent of the ſum inſured. If the inſured determine to abandon, and demand as for a total loſs, he is not obliged, as in ſome foreign countries, to make a formal proteſt, but merely to give notice of the loſs to the underwriters, and of his determination to abandon. The notice of abandonment may be given, either to the underwriter himſelf, or to the agent who has ſubſcribed for him: and the abandonment ought to be made for the whole of the effects inſured, and not for a particular part. The abandonment muſt be alſo ſimple and unconditional; otherwiſe it will not transfer the entire property to the inſurers, which is of the eſſence of the abandonment. By the abandonment, the inſured yields up to the inſurers all his right, title, and intereſt in the ſhip or goods inſured, or what may be ſaved of them, which, from the notice of abandonment, become the property of the inſurers; but the abandonment of the ſhip does not, as in France, transfer to the inſurer the freight ſhe has earned. The abandonment not only intitles the underwriters to all that can be ſaved of the effects inſured; but if compenſation be made to the inſured for the injury from which the loſs aroſe, this compenſation ſhall go to the underwriters; for when they have paid the loſs, they, and not the inſured, are the real ſufferers. If the ſhip, after abandonment, arrive ſafe, the inſurers ſhall have all the profit of the voyage. Nor ſhall they, on account of the ſafe arrival of the ſhip, refuſe to pay the ſum inſured. So if the ſhip or goods inſured happen to be recovered undamaged, after the inſurer has paid a total loſs, the inſurer cannot compel the inſured to refund the money, and take back the ſhip or goods, but the inſurer ſhall ſtand in his place, and ſhall have the benefit of ſalvage. An abandonment once properly made, on ſufficient ground, and accepted by the inſurers, is abſolute and binding upon both parties, and cannot be revoked unleſs by mutual conſent; but if the ground be inſufficient, it will be void. In caſe of ſhipwreck or other misfortune, the effects that are ſaved continue, till abandonment, the property of the inſured, who is bound in juſtice, honour, and conſcience, to uſe his utmoſt endeavours to make the moſt of what may be reſcued from deſtruction; in order, as much as poſſible, to lighten the burden of the inſurers. To enable him to do this, without prejudice to his right of abandonment, our policies provide, that in caſe of any loſs or misfortune to the inſured, their factors, ſervants, or aſſigns, ſhall be at liberty to ſue, and labour about the defence, ſafeguard, and recovery of the goods and merchandizes, and ſhip, &c. without prejudice to the inſurance; "to the charges whereof, the inſurers agree to contribute, each according to the rate and quantity of his ſubſcription." Marſhall on Inſurance, vol. ii. See *Perils of the* SEA.

WRECK, in *Metallurgy*, a veſſel in which the third waſhing is given to the ores of metals.

In Cornwall, when the tin-ore has been twice waſhed, they take the head tin, or that part of the tin-ore that lies uppermoſt, out of the buddle, and throwing it into this veſſel, they pour water on it, and work it about with wooden rakes, till it is cleared from whatever other extraneous matter there may ſtill have remained mixed with it, and is, after this, fit for the blowing-houſe to be run into metal.

WRECK, in *Agriculture*, a term ſignifying the weeds thrown up by the floods upon the ſea-ſhores; alſo the dead indigeſted roots and ſtems of graſs, and other plants in ploughed lands.

WREKIN, in *Geography*, a mountain of England, in Shropſhire; about 10 miles E. of Shrewſbury.

WREME, a town of the duchy of Bremen; 5 miles N.N.W. of Carlſburg.

WREN, *Sir* CHRISTOPHER, in *Biography*, an eminent architect and mathematician, was born in 1632, at the living of his father, who was rector of Eaſt Knoyle, in Wiltſhire, and finiſhed his education at Wadham college, Oxford, into which he entered in 1646. Before this time, he had given proofs of genius by the invention of aſtronomical and pneumatic inſtruments; the former of which he dedicated to his father, at the age of 13, in a copy of elegant Latin verſes, together with an exerciſe "De Ortu Fluminum." He alſo diſtinguiſhed himſelf by the conſtruction of other philoſophical inſtruments; and in 1647 he wrote a treatiſe on Spherical Trigonometry upon a new plan. In 1650 he graduated B.A., and in 1651 wrote an algebraical tract on the Julian period. In 1653 he was elected fellow of All-Souls' college, and graduated M.A. He was one of the firſt members of the Philoſophical Society at Oxford, from which proceeded the Royal Society, and contributed by his experiments and inventions to the amuſement and inſtruction it afforded; and in 1663 he was elected a fellow of the Royal Society. In 1657 he was choſen aſtronomical profeſſor at Greſham college; but upon being appointed Savilian profeſſor of aſtronomy at Oxford, he reſigned the former office, and in 1661 returned to the univerſity, which created him doctor of laws. Wren next preſents himſelf to our view as a pre-eminent architect; and thus diſtinguiſhed, he received a commiſſion in 1663 to prepare deſigns for the repair of St. Paul's cathedral; and after his return from a tour to France in 1665, with a view to his improvement in architecture, he finiſhed thoſe deſigns; but whilſt they were under conſideration, the edifice was deſtroyed by the fire of London in 1666. This cataſtrophe afforded him an opportunity of deſigning and conſtructing a building altogether new. The contemporary deſtruction of 50 parochial churches and many public buildings furniſhed ample ſcope for the exerciſe of Wren's talents; and he would have had the honour of refounding, as it were, a new city, if the deſign which he laid before the king and parliament could have been accompliſhed without infringing on the rights of private property. On the death of ſir John Denham in 1667, he ſucceeded to the office of ſurveyor of the works; and in order to obtain leiſure for executing the various works in which he was employed, and more particularly the rebuilding of St. Paul's cathedral, he reſigned his Savilian profeſſorſhip in 1673. In 1674 he received the honour of knighthood, and in the following year the foundation of the new cathedral was laid. For a particular account of this magnificent

magnificent edifice, fee the article London. In 1680 fir Chriftopher's fcientific merits caufed him to be elected prefident of the Royal Society. In 1683 he was appointed architect and commiffioner for Chelfea college, and in the following year comptroller of the works in the caftle of Windfor. In 1685 he was introduced into parliament as a reprefentative of Plympton. To his other public trufts were added, in 1698, that of furveyor-general and commiffioner for the repair of Weftminfter abbey; in 1699 that of architect of Greenwich hofpital; and in 1708 that of one of the commiffioners for the 50 new churches propofed to be erected in and near the city of London. Having fulfilled all his duties to the 86th year of his age, the adminiftration of 1718 incurred indelible difgrace, by fuffering political confideration to have fuch influence as to deprive him of his place of furveyor to the royal works. The remaining five years of his life were fpent in honourable retirement, and devoted to fcientific purfuits, and the reading of the Scriptures. It is faid that he indulged a very pardonable vanity by being carried once every year to furvey St. Paul's cathedral. His life was prolonged to his 91ft year, and terminated in confequence of a cold which he caught in coming from Hampton-Court to London, in February 1723. His remains were interred, with fuitable funeral honours, under the choir of St. Paul's, and upon his tomb is a concife but very appropriate and expreffive Latin infcription, ending "Lector, fi monumentum requiris, circumfpice." Sir Chriftopher was twice married, and left one fon, a man of learning and piety, and a good antiquary. The edifices conftructed by Wren were moftly public, including a royal hunting-feat at Winchefter, and the modern part of the palace at Hampton-Court. Some of the moft remarkable, befides St. Paul's, are, the Monument, the theatre at Oxford, the library of Trinity college, Cambridge, the hofpitals of Chelfea and Greenwich, and of Chriftchurch, London, the church of St. Stephen, Walbrook, thofe of St. Mary-le-Bow, St. Michael, Cornhill, and St. Bride, diftinguifhed by their fteeples, and the great campanile of Chriftchurch, Oxford. Of the rank which he occupied as a man of fcience, we may form fome judgment from the fucceeding concife detail of his performances, and more particularly from the teftimony of fir Ifaac Newton, who, in his "Principia," joins the names of Wren, Willis, and Huygens, and characterizes them as "hujus ætatis Geometrarum facilé principes." As to his moral character, it is faid to have been worthy of his intellectual eminence; as with great equanimity, he was pious, temperate, modeft, and communicative of his knowledge; and few men feem to have been more generally efteemed by their contemporaries. With regard to his architectural fkill and attainments, a very competent judge, being himfelf of the profeffion, fays, that he poffeffed an inexhauftible fertility of invention, combined with good natural tafte and profound fcientific knowledge; and that his talent was particularly adapted to ecclefiaftical architecture, which afforded domes and towers to his picturefque fancy; while, in his palaces and private houfes, he has fometimes funk into a heavy monotony, as at Hampton-Court and Winchefter. Among the rich variety of Wren's towers, fteeples, and fpires, many are truly elegant. The church of St. Stephen's, Walbrook, exhibits a deviation from common forms equally ingenious and beautiful. The Monument is grand and fimple. At Greenwich, his additions to the original work of Inigo Jones are fingularly grand and beautiful. Upon the whole, fir C. Wren's architecture is perhaps the perfection of that modern ftyle which, with forms and modes of conftruction effentially Gothic, adopts for the decorative part the orders and ornaments of antiquity. Biog. Brit. Walpole's Anecd. Gen. Biog.

Wren, or *Jenny-Wren*, in *Ornithology*, the *paffer troglodytes* of Gefner, and the *motacilla troglodytes* of Linnæus, has the head and upper part of the body of a deep reddifh-brown; above each eye is a ftroke of white; the back, and coverts of the wings and tail, are marked with flender, tranfverfe, black lines; the quill-feathers with bars of black and red; the throat is of a yellowifh-white; the belly and fides croffed with narrow dufky and pale reddifh-brown lines; and the tail is croffed with dufky bars. Pennant.

This bird, though very fmall, is of a very cheerful difpofition, and has a very agreeable voice, which he throws out with great cheerfulnefs and fprightlinefs, ufually cocking up his tail all the time he is finging, and continues his fong through the winter, except during the frofts. See Song *of Birds*.

The female breeds twice in the year, firft in the latter end of April, and afterwards in the middle of June. The neft is ufually placed among clufters of mofs and ivy, in fuch a manner that it is very hard to difcover it. It is made of dry mofs and leaves put together in a very artificial manner, being clofed all round except for a fmall hole left to go in and out at. They lay a great number of eggs, not lefs than eighteen; and it has been often found that they all hatch except one or two; and thus fixteen young ones have been found together in the neft. Thefe are brought up fo well as to fhift for themfelves by the end of May; and then another brood is provided for by the middle of the month following. The young ones may be eafily raifed. They fhould for this purpofe be taken out of the neft at about fourteen days old, and fed with fheep's, calf's, or ox's heart, cut fmall, with eggs minced among it. When they are able to peck this meat for themfelves, they may be put into cages; but they muft ftill be fed for fome days, left they fhould neglect themfelves, and die of hunger after the greateft part of the trouble is thus over. See Motacilla *Troglodytes*.

When they are grown up, they may be fed with pafte, and will need no more heart. Afterward it will be a great feaft to them to give each a fpider or two at once in two or three days; and after they attain full age, they may either be left to fing their own wild notes, which are very agreeable, or if it be defired that they fhould whiftle tunes, they will eafily be taught it. Ray and Pennant.

Wren, *Crefted*, or *Golden-Crefted* Wren, *regulus criftatus*, or *motacilla regulus* of Linnæus, the name of a very beautiful little bird, the fmalleft of all the Britifh birds. Its whole weight is not more than feventy-fix grains; and the crown of its head is adorned with a very beautiful faffron-coloured or orange-red fpot, which is called its creft, and by fome its crown, and from this golden crown the bird has obtained the name of the *regulus*, *tyrannus*, *bafileus*, and other appellations of royalty. This beautiful fcarlet mark on the head is bounded on each fide by a fine yellow line. The bill is dufky; the feathers of the forehead are green; from the bill to the eyes is a narrow white line; the back and hind part of the neck are of a dull green; the coverts of the wings dufky, edged with green, and tipped with white; the quill-feathers and tail dufky, edged with pale green; the throat and lower part of the body white, tinged with green; the legs are of a dull yellow colour; and the claws are very long.

This bird frequents woods, and is found principally in oak-trees. It is common about the Peak in Derbyfhire, and is feen in autumn as far north as the Shetland ifles, but quits that country before winter. It lays fix or feven eggs, not larger than peas. This bird has been obferved fufpended in the air for a confiderable time over a bufh in flower, whilft it fung very melodioufly. The note does not much differ from that of the common wren, but is very weak. Ray and Pennant. See MOTACILLA *Regulus*.

WREN, *Yellow*. See LUTEOLA, and MOTACILLA *Trochilus*.

WRENCH. See STRAIN.

WRENTHAM, in *Geography*, a town of the ftate of Maffachufetts, in the county of Norfolk, containing 2478 inhabitants; 23 miles S.W. of Bofton.

WRESTBALKING, in *Agriculture*, the operation of turning over upon or covering a balk or rib of whole unmoved ground, by a broad furrow-flice, in the view of rendering the land more mellow and porous. The term is chiefly ufed in the eaftern diftricts of the country.

WRESTLING, a kind of combat or engagement between two perfons unarmed, body to body, to prove their ftrength and dexterity, and try which can throw his opponent to the ground.

Wreftling, *palæftra*, is an exercife of very great antiquity and fame. It was in ufe in the heroic age; witnefs Hercules, who wreftled with Antæus.

It continued a long time in the higheft repute, and had very confiderable rewards and honours affigned it at the Olympic games. It was the cuftom of the athletæ, or wreftlers, to anoint their bodies with oil, to give the lefs hold to their antagonift. See PALÆSTRA.

Ablancourt obferves, that Lycurgus ordained the Spartan maids to wreftle in public, quite naked, to break them of their too much delicacy and nicenefs; to make them appear more robuft, and familiarize the people, &c. to fuch nudities.

A wreftling match, or *neobering*, is a very common diverfion in the Mandingo countries of Africa. It is exhibited at the "Bentang," which is a large ftage found in each town, that anfwers the purpofe of a public hall or townhoufe: it is compofed of interwoven canes, and is generally fheltered from the fun by being erected in the fhade of fome large tree. It ferves alfo for a kind of lounging place, where the indolent and unemployed affemble to fmoke their pipes, and talk over the news of the day.

At the wreftling match, the fpectators arrange themfelves in a circle, leaving the intermediate fpace for the wreftlers, who are ftrong, active, young men, trained up from infancy to this fort of exertion. Being ftripped of their clothing, except a fhort pair of drawers, and having their fkin anointed with oil, or *fhea* butter, they approach each other on all fours, parrying with and occafionally extending a hand for fome time, till at length one of them fprings forward and catches his rival by the knee. Great dexterity and judgment are now difplayed; and the conteft is at length decided by fuperior ftrength. The combatants are animated by the mufic of a drum, which ferves alfo in fome meafure to regulate their motions. The wreftling is fucceeded by a dance, in which many performers affift, all being provided with little bells faftened to their legs and arms; their motions being regulated by the drum, beaten by a crooked ftick, which the drummer holds in his right-hand, occafionally ufing his left to deaden the found, and thus vary the mufic. The drum is alfo ufed to keep order among the fpectators; and when the wreftling match is about to begin, the drummer ftrikes what is underftood to fignify "ali bæ fee," fit all down; upon which the fpectators immediately feat themfelves; and when the combatants begin, he ftrikes "amuta, amuta," *i. e.* take hold, take hold.

WRETESTA, in *Geography*, a town of Sweden, in Sudermannland; 36 miles N.W. of Nykioping.

WRETSTORP, a town of Sweden, in the province of Nericia; 16 miles S.W. of Orebro.

WRETWEED, in *Agriculture*, a name fometimes given to wart-weed or fun-fpurge, a troublefome weed in fields. See WEED.

WREXHAM, in *Geography*, a market-town in the hundred of Bromefield, towards the eaft corner of the county of Denbigh, North Wales, is fituated 25 miles E.S.E. from Denbigh, $11\frac{3}{4}$ S.S.W. from Chefter, and by the road through Whitechurch 176 N.W. from London. The parifh of Wrexham is extenfive and populous, and comprifes 14 townfhips. By the returns of 1811, the population of the whole amounted to 19,495, and the houfes to 4142.

Wrexham is a place of confiderable antiquity, for it is mentioned in the Saxon Chronicle by the name of Wrightelefham. Although belonging to Cambria, yet being feparated by the ancient trench called Offa's Dyke, it came to be ranked as appertaining to the great internal diftrict of England, Mercia. In the reign of Edward I., the town and the lordfhip were granted to earl Warren; and as early as the reign of Henry VIII., the town was known for its trade, particularly for its buckle-makers. Wrexham is noted for its fairs, one of which continues for nine days, for the fale of Welfh flannels, cattle, Irifh linens, Englifh woollens, ironmongery, &c. The weekly markets are kept on Monday and Thurfday. The church of Wrexham is the moft remarkable and moft ornamented building of its kind in North Wales. It was erected in 1472, but the tower was not finifhed till 1506. It confifts of a nave, with fide aifles, and a chancel; the whole length being 178 feet, and the breadth 72: the tower rifes to the height of 135 feet; the aifles are feparated from the nave by clustered columns fupporting pointed arches; the ceiling is compofed of oak, in imitation of groined ftone. In the town is a free-fchool for educating twelve boys. Two miles weft from Wrexham is Borfham, which is noted for the great iron-furnaces of Meffrs. Wilkinfon. Notwithftanding the difficulties in the beginning, the works are now among the greateft in the kingdom. The machinery employed is very ingenious; and every article of caft-iron, from cannon down to kitchen utenfils, is fabricated in great numbers. Iron-ftone and coal are plentiful in the neighbourhood; and at a fhort diftance is a productive lead-mine. The Ellefmere canal between Shrewfbury and Chefter paffes half a mile to the weft of Wrexham. Two miles more to the weftward is the celebrated intrenchment called Offa's Dyke, which extended from the river Wye in Monmouthfhire on the fouth into Flintfhire on the north; and is fuppofed to have been formed by that Saxon chief of Mercia, to defend his country from the native Britons, who had retired among the mountains of Wales. On the eaft fide of Wrexham is Wat's Dyke, another intrenchment of the fame kind, probably intended for a fimilar purpofe, but unconnected with the work of Offa.

About feven miles S.S.W from Wrexham is Ruabon, a village with a refpectable church, containing the monuments of the ancient families of Williams and Wynn; one in particular for the firft fir Watkin, who died in 1749, is a diftinguifhed production of Ryfbrack. The learned Dr. David Powell, the tranflator and editor of fundry hiftorical works relative to Wales, was a native and vicar of Ruabon, where he died in 1590. On the eaft fide of the village is the gate leading to the park and manfion of Wynnftay, the feat of

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of ſir Watkin Williams Wynn, bart. The road runs through an avenue of trees of uncommon growth, in a ſtraight line for a mile, to a ſpacious lawn, on which ſtands the houſe. Erected at different periods, and in different ſtyles of architecture, Wynnſtay-hall is more diſtinguiſhed for ſize and irregularity than for beauty of architecture. The new parts erected by the firſt baronet, although only a portion of the deſign, form a plain, ſubſtantial, comfortable place of reſidence; the older parts are chiefly appropriated to menial purpoſes. The interior comprehends ſome ſpacious apartments, in which are a few valuable portraits, particularly one by Vandyke of ſir Richard Wynn, who attended Charles I. on his romantic matrimonial adventure to Spain. Adjoining to the houſe is a ſmall building, formerly uſed as a theatre. The park, from the ancient intrenchment Wat's Dyke which traverſes it, was formerly called Wat-ſtay; but when the heireſs married ſir John Wynn, who incloſed the grounds in 1678 with a ſtone-wall, the name was changed to its preſent appellation. The grounds are not greatly diverſified, but they are well wooded, and favourably ſituated for proſpects. On an eminence ſtands a fluted ſtone column, 100 feet high, on a plinth 16 feet ſquare, acceſſible to the ſummit by an internal ſtair-caſe. It was erected in memory of the late baronet by his mother, with this ſimple but eloquent inſcription: "Filio optimo mater eheu! ſuperſtes." Near the park the river Dee winds through Nant-y-Bele, or the dingle of the Marten, a place of great natural romantic beauty. Caer-ddin in this pariſh, commonly called Garthen, is a ſtrong Britiſh poſt on a lofty hill, at no great diſtance from Offa's Dyke. It is formed by a rampart and ditch, in ſome parts double, and the inner conſiſting of a thick wall. The area, containing about four acres, exhibits veſtiges of ancient buildings.—Beauties of England and Wales, Denbighſhire, by the Rev. J. Evans, 8vo. London, 1812.

WRIETZEN. See BRIETZEN.

WRIGHT, EDWARD, in *Biography*, an Engliſh mathematician, flouriſhed in the latter part of the 16th and beginning of the 17th century. Of his private hiſtory little is known, except ſome few particulars that may be collected from the Latin memoirs of his life, preſerved among the annals of Gonvile and Caius college in Cambridge. This year (1615) died, it is ſaid, at London, Edward Wright, of Garveſton in Norfolk, formerly a fellow of this college, much reſpected for the integrity and ſimplicity of his manners, and alſo famous for his ſkill in the mathematical ſciences. He was the firſt undertaker of the difficult but uſeful work, by which a little river is brought from the town of Ware, in a new canal, to ſupply the city of London with water; but by the tricks of others he was prevented from completing it. Nor was he inferior to the moſt ingenious mechanic in the conſtruction of inſtruments, either of braſs or of any other matter. He, it is ſaid, taught Iodocus Hondius the method of conſtructing his geographical charts, though Hondius concealed his name, that he might arrogate to himſelf the honour of the invention. Of this act of injuſtice, Wright complained in the Preface to his "Treatiſe of the Correction of Errors in the Art of Navigation," a work compoſed with excellent judgment, and after long experience, to the great advancement of naval affairs. For his improvement of this art he was appointed mathematical lecturer to the Eaſt India Company; and he read lectures, for which he was allowed a yearly ſalary of 50*l.* This office he diſcharged with great reputation, and much to the ſatisfaction of his hearers. He publiſhed, in Engliſh, a book on the doctrine of the ſphere, and another concerning the conſtruction of ſun-dials. He alſo prefixed an ingenious preface to the learned Gilbert's book on the load-ſtone. By theſe and other writings he tranſmitted his fame to the lateſt poſterity. It is added, whilſt he was a fellow of this college, he was called forth to the public buſineſs of the nation by the queen, about the year 1593, or, according to other accounts, 1589. He was ordered to attend the earl of Cumberland in ſome maritime expeditions; of one of which he gave a faithful account, under the form of a journal or ephemeris, prefixing to it an elegant hydrographical chart of his own invention. His poſthumous work, which was an Engliſh tranſlation of the book of logarithms, then lately diſcovered by lord Napier, a friend of Mr. Wright, was publiſhed ſoon after his death by his ſon Samuel Wright, a ſcholar of the above-named college. Death prevented the execution of ſeveral other deſigns which he had formed. Of him it may be truly ſaid, that he ſtudied more to ſerve the public than himſelf; and though he was rich in fame and in the promiſes of the great, he died poor, to the ſcandal of an ungrateful age. To the preceding extracts from the memoirs above cited, we may add, that Mr. Wright firſt diſcovered the true method of dividing the meridian line, according to which Mercator's charts are conſtructed (ſee CHART), and upon which his failing is founded. An account of it was ſent from Cambridge to Mr. Blondeville, who publiſhed it among his exerciſes in 1594; and in 1597 a demonſtration of it was given by the Rev. Mr. William Barlowe, in his "Navigator's Supply." In 1599 Mr. Wright publiſhed "The Correction of certain Errors in Navigation," written many years before, and ſhewing the reaſon of his diviſion of the meridian, the manner of conſtructing his table, and its uſes in navigation, &c. &c. In 1610 he dedicated a ſecond edition to his royal pupil, prince Henry, with farther improvements, and an excellent method for determining the magnitude of the earth. To his other works, comprehending an account of his various diſcoveries, tables, and improved inſtruments for obſervation, we ſhall add his tract on navigation, entitled "The Haven-finding Art." It is ſaid that he conſtructed, for the uſe of prince Henry, a large ſphere with curious movements, ſerving by ſpring-work to exhibit the motions of the whole celeſtial ſphere, the particular ſyſtems of the ſun and moon, their circular motions, places, and poſſibilities of eclipſing each other. (See ORRERY.) This ſphere was overlooked in the time of the civil wars, and found among duſt and rubbiſh in 1646 by ſir Jonas Moore, who was at the expence of reſtoring it to its original ſtate, and depoſited it at his own houſe in the Tower, among other mathematical inſtruments. Preface to Robertſon's Navigation. Hutton's Math. Dict.

WRIGHT, RICHARD, was a native of Liverpool, and born about the year 1735. He was bred to the humble occupation of a houſe and ſhip painter, but exerted his talents in painting ſea views, and obtained for his encouragement the premium offered in 1764 by the ſociety for the encouragement of arts, &c.; and in 1766 he gained another premium of fifty guineas, for a picture which had the greater credit of being moſt beautifully engraved by Woollett, and is known under the name of the "Fiſhery." He died about 1775.

WRIGHT, JOSEPH, one of our earlieſt painters of celebrity in this age of reſtoration of the art. He was born at Derby in 1734, and thence obtained the name of Wright of Derby, to diſtinguiſh him from R. Wright mentioned above. He came to London to ſtudy with Hudſon, but afterwards eſtabliſhed himſelf at his native place, and had very con-

ſiderable

fiderable encouragement as a portrait-painter, though his ftyle was dry and too minute. He gained much more reputation by painting fcenes of fire and candle-light, and indeed ftood unrivalled in that way till Loutherbourg fubfequently appeared. His pictures of a forge and of a blackfmith's fhop, exhibited with the fociety of artifts about the year 1765, eftablifhed his reputation. In 1773 he vifited Rome, and Italy generally, and was abfent two years. In 1782 he was elected an affociate of the Royal Academy, but refigned his diploma foon after, on Mr. Garvey's being preferred to him in an election for an academician; though he continued occafionally to exhibit with the academy. He had great induftry and profeffional fkill, living very much apart from the world. This enabled him to produce many pictures, and in 1785 he made an exhibition of twenty-four pictures of his own painting at the great room under the Piazza Covent-garden, one of which was a large work reprefenting the deftruction of the floating batteries before Gibraltar. His ftyle in all his works was peculiar to himfelf, fomewhat dry, yet not void of richnefs, and his drawing coldly correct. One peculiarity marks his pictures, and renders them eafily diftinguifhable, efpecially thofe in which the illumination proceeds from the moon or fire. He prepared his cloths or grounds with rough furfaces, caufed by fand fifted or ftrewed upon them; and then when he had painted his fcene, he dragged his pallet-knife, covered with the colour of the light, acrofs the picture, when the colour adhering to the projections on the furface, gave the glitter which characterizes that kind of illumination, and he toned the parts to due relief by glazings. No one ever gave the exact tone of moon-light fo completely as Wright of Derby. He died in 1797, aged 63.

Wright, *Mifs*, a vocal apprentice to Michael Arne, the natural fon of Dr. Arne. She had a fweet, fpirited, and active voice, but was fo young in mufic, that fhe learned the parts which fhe had to perform on the ftage, after fhe was too haftily engaged at Drury-lane, by her ear. The firft part affigned to her in that theatre was Leonora, in Bickerftaff's Padlock, in which the airs, as fet by Dibden, were fo pleafing, and fo much on the Italian model, that they eftablifhed her in the favour of the town. But the air "Say little foolifh fluttering thing" was never fung in fuch a brilliant and captivating manner by any other finger.

In 1766 fhe appeared in the Cunning Man, Rouffeau's Devin de Village, tranflated *totidem fyllabis*, and adapted to his original mufic by the author of this article, in which fhe pleafed extremely.

Soon after this, the apprentice was exalted into the wife of her mafter, the *ferva padrona*, and fung with great applaufe in Cymon, and feveral of his and other compofers' compofitions that were performed at Drury-lane; and, if we remember right, in the fummer fhe fung in Mary-le-bone gardens. But the town was fo fond of hearing her, and the produce of her talents fo alluring to her hufband, that fhe may truly be faid to have fung herfelf to death; or, like the fwans of old in the Po, to have died finging. The truth is, that her ignorance of mufic made it neceffary for her to fing at home, in rendering herfelf perfect in her parts, ten times more than fhe did in public, which brought on a pulmonary complaint, and prematurely put an end to her exiftence in 1770, at the age of 22, to the grief of her friends, and great regret of the public.

Wright, in *Geography*, a town of Virginia; 44 miles W. of Richmond.

Wright's *Town*, a townfhip of Pennfylvania, in the county of Bucks, with 562 inhabitants; 24 miles N. of Eafton.

WRIGHTIA, in *Botany*, is dedicated by Mr. Brown to his much-refpected friend William Wright, M.D. fellow of the royal focieties of London and Edinburgh, and affociate of the Linnæan fociety, "whofe ardour in the purfuit of botanical knowledge," fays Mr. Brown, "even while engaged in extenfive medical practice in the ifland of Jamaica, has long entitled him to this mark of diftinction." We heartily concur in this fentiment, and cannot but regret that Dr. Swartz did not retain for this purpofe what he has called Meriana. (See that article.)—Brown in Tr. of the Wernerian Soc. v. 1. 73. Prodr. Nov. Holl. v. 1. 467. Ait. Hort. Kew. v. 2. 68. (Nerium; Gærtn. t. 117.)—Clafs and order, *Pentandria Monogynia*. Nat. Ord. *Contortæ*, Linn. *Apocineæ*, Juff. Brown.

Gen. Ch. *Cal.* Perianth inferior, of one leaf, in five fmall, rounded, bluntifh fegments, with five or ten internal fcales at the outfide of the bafe of the corolla, permanent. *Cor.* of one petal, falver-fhaped: tube cylindrical, various in length: limb in five oblong, fpreading, oblique fegments, as long as the tube, or longer: mouth crowned with ten divided fcales, fhorter than the limb. *Stam.* Filaments five, thread-fhaped, fhort, inferted into the throat of the corolla; anthers arrow-fhaped, pointed, prominent, cohering by their middle part to the ftigma. *Pift.* Germens two, fuperior, roundifh, cohering; ftyle one, thread-fhaped, the length of the tube, dilated at the apex; ftigma contracted. *Peric.* Follicles two, almoft cylindrical, either diftinct or cohering, pointed, erect. *Seeds* numerous, inferted into the margins of each follicle, oblong, imbricated downwards, crowned at the lower extremity with filky hairs, directed towards the bafe of the feed-veffel.

Eff. Ch. Corolla oblique, falver-fhaped; mouth crowned with ten divided fcales. Stamens prominent. Follicles two, erect. Seeds imbricated downward, hairy at the lower extremity.

A genus of upright fhrubs, or fmall trees, natives of the Eaft Indies, Ceylon, the Malay archipelago, or the tropical part of New Holland. Their *leaves* are oppofite. *Flowers* white, corymbofe, nearly terminal. *Albumen* none. *Embryo* white, turning rofe-coloured by immerfion in warm water; *cotyledons* involute longitudinally. *Brown.*

1. W. *antidyfenterica.* Oval-leaved Wrightia. Br. n. 1. Ait. n. 1. (Nerium antidyfentericum; Linn. Sp. Pl. 306, excluding Rheede's fynonym. Willd. Sp. Pl. v. 1. 1236. N. n. 107; Linn. Zeyl. 45. N. indicum, filiquis anguftis, erectis, longis, geminis; Burm. Zeyl. 167. t. 77.)—Leaves obovate-oblong, fhort-pointed, fmooth. Corymbs moftly terminal. Tube of the corolla fix times as long as the calyx. Follicles diftinct.—Native of Ceylon. A handfome erect fhrub, with numerous branches. *Leaves* on fhort ftalks, fpreading, two inches, or two and a half, long. *Tube* as well as *limb* of the *flowers* each an inch in length. *Follicles* thrice as long, a little fwelling upwards; their points converging. *Brown. Burmann.*

2. W. *zeylanica.* Lanceolate-leaved Wrightia. Br. n. 2. (Nerium zeylanicum; Linn. Sp. Pl. 306. Am. Acad. v. 4. 309. Willd. Sp. Pl. v. 1. 1236. Apocynum arborefcens, nerii flore minus; Burm. Zeyl. 23. t. 12. f. 2.)—Leaves oblong-lanceolate, blunt-pointed, fmooth. Corymbs terminal. Tube of the corolla four or five times as long as the calyx. Follicles diftinct.—Native of Ceylon. Our fpecimen was given to Linnæus by Burmann. The *branches* are long and ftraight, round, purplifh. *Leaves* fmaller than the laft, about an inch and a half long, with more or lefs of a linear blunt point. *Flowers* like the preceding, but, according to Mr. Brown, the *tube* is fhorter in proportion.

3. W. *tinctoria.* Dyer's Wrightia. Br. n. 3.—"Leaves

elliptic-

elliptic-lanceolate, or ovate, pointed, ſmooth. Branches and corymbs divaricated. Tube of the corolla twice the length of the calyx. Follicles diſtinct."—Found by Koenig and Roxburgh in the Eaſt Indies. We received from Dr. Roxburgh in 1789, by the name of *Nerium antidyſentericum*, ſpecimens which anſwer to the above characters, except that the *tube* is not at all longer than the *calyx*; the *limb* moreover appears purpliſh, and is clothed on both ſides with fine pubeſcence. This plant muſt be known to Mr. Brown, and perhaps is one of the undeſcribed ſpecies of which he makes mention.

4. W. *pubeſcens*. Downy Wrightia. Br. n. 4. Prodr. n. 1.—" Leaves elliptic-oblong, pointed, downy as well as the calyx. Corymbs erect. Tube of the corolla ſcarcely longer than the calyx. Follicles combined."—Gathered by Mr. Brown in the tropical part of New Holland, and in the iſle of Timor, near Coepang.

This author ſpeaks of ſome other ſpecies, of which he has not yet publiſhed either characters or names, and which are not known to us. *Nelem-Pala*, Rheede Hort. Mal. v. 9. 5. t. 3 and 4, is preſumed to belong to the preſent genus.

WRIGHTSBOROUGH, in *Geography*, a ſettlement in the ſtate of Georgia, on a branch of the Savannah; 30 miles W. of Auguſta.

WRING-HOUSE, in *Rural Economy*, a name ſometimes applied to the place for making cyder in, in the ſouthern diſtricts.

WRINGLE-TAIL, a name given by the people of ſeveral parts of England to the *curvicauda*, a ſpecies of bee-fly, very much reſembling the bee in ſhape, but having only two wings and no ſting. It is very troubleſome to horſes, but does not ſuck their blood, but only lays its eggs in their ſkins: it is called in other countries the *whame* and the *barrel-fly*.

WRINGTON, in *Geography*, a market-town in the hundred of Brent-with-Wrington, in the county of Somerſet, England, is ſituated to the S.W. of the Mendip hills, at the diſtance of 6 miles N.N.E. from Axbridge, and 129 miles W. from London. The ſtreets are irregularly built, and moſt of the houſes are thatched. A weekly market, by a very ancient grant, is held on Tueſday; and here is an annual fair. In the market-place are the ruins of a croſs. The church, a ſpacious edifice, 120 feet in length and 52 in width, conſiſts of a nave, chancel, ſide aiſles, and a porch. The tower, at the weſt end, is 140 feet high to the top of the battlements, which are adorned with four turrets, one at each corner, and ſixteen elegant pinnacles fifteen feet in height. The church contains ſeveral ancient and modern monuments. One is of peculiar beauty: it is built of white and Sienna marble, and was erected in memory of Dr. Henry Waterland, prebendary of Briſtol, and above fifty years miniſter of this pariſh, where he conſtantly reſided: he died March 27, 1779. In the town is a free-ſchool for ſix boys and as many girls. In the return of the year 1811, the population of the pariſh is enumerated as 1109, the number of houſes as 183. Wrington is diſtinguiſhed by being the birth-place of the celebrated philoſopher, John Locke: he was born 1632, in an old thatched houſe, ſtill ſtanding on the north ſide of the church-yard: he died October 28, 1704. See LOCKE, JOHN.—Collinſon's Hiſtory of Somerſetſhire, vol. i. 1791.

WRIST, CARPUS, in *Anatomy*. See EXTREMITIES.

WRIST, *Fracture*, *Ligaments*, and *Luxation of*. See the reſpective articles.

WRIST, in the *Manege*. The bridle wriſt is that of the cavalier's left-hand. A horſeman's wriſt and his elbow ſhould be equally raiſed, and the wriſt ſhould be two or three fingers above the pummel of the ſaddle. To ride a horſe from hand to hand, *i. e.* to change hands upon one tread, you need only to turn your wriſt to that ſide you would have the horſe to turn to, without advancing your hand. But if your horſe ſtops, you muſt make uſe of both your legs. See HAND and LEGS.

WRIT, formed from the Saxon *writan*, to write, *Breve*, in *Law*, a precept of the king in writing, under ſeal, iſſuing out of ſome court to the ſheriff or other perſon, whereby any thing is commanded to be done, touching a ſuit or action, or giving commiſſion to have it done: as, the ſummoning of a defendant, taking a diſtreſs, redreſſing a diſſeiſin, or the like. Or, according to Fitzherbert, a writ is a formal letter of the king in parchment, ſealed with a ſeal, and directed to ſome judge, officer, or miniſter, &c. at the ſuit or plaint of a ſubject, requiring to have a thing done, for the cauſe briefly expreſſed, which is to be diſcuſſed in the proper court according to law. See BREVE, BRIEF, and PRECIPE.

Writs are variouſly divided, and in various reſpects. Some, with regard to their order, or manner of granting, are termed *original*, and others *judicial*.

WRITS, *Original*, are thoſe ſent out of the high court of chancery, to ſummon the defendant in a perſonal or tenant in a real action; either before the ſuit begins, or to begin the ſuit by it. See ORIGINAL.

Royal writs are held to be demandable of common right, on paying the uſual fees; for any delay in the granting of them, or ſetting an unuſual or exorbitant price upon them, would be a breach of Magna Charta, cap. 29. "Nulli vendemus, nulli negabimus, aut differemus juſtitiam vel rectum."

Original writs are either optional or peremptory, or, in the language of our law, they are either a *præcipe*, or a *ſi te fecerit ſecurum*.

WRITS, *Judicial*, are thoſe ſent by order of the court where the cauſe depends, upon emergent occaſions, after the ſuit begins.

Judicial writs are diſtinguiſhed from original, in that their teſte bears the name of the chief-juſtice of that court whence they come; whereas the original ſay, *teſte meipſo*, in the name or relating to the king.

The *original* writ is always made returnable at the diſtance of at leaſt fifteen days from the date or *teſte*, and upon ſome day in one of the four terms: and all *judicial* writs, being grounded on the ſheriff's return, muſt reſpectively bear date the ſame day on which the writ immediately preceding was returnable. See PROCESS.

Judicial writs, if erroneous, may be amended: whereas *original* writs are not amendable, if the error be by default of the party who gave inſtruction; yet a new original may be taken out, where it is not amendable.

Writs are alſo diſtinguiſhed, according to the nature of the action, into *real* and *perſonal*.

Real, are either touching the poſſeſſion, called *writs of entry*; or the property, called *writs of right*. See RECTO.

Perſonal writs, are thoſe relating to goods, chattels, or perſonal injuries.

To which may be added *mixt* writs, for the recovery both of the thing and damages.

Some writs, again, are at the ſuit of the party; ſome, of office; ſome, ordinary; ſome, of privilege. A writ of privilege is that which a privileged perſon brings to the court for his exemption, by reaſon of ſome privilege which he enjoys.

But the moſt common writs in daily uſe are, in debt, detinue,

tinue, trefpafs, action upon the cafe, account, and covenant, &c. which, as well as others, muft be rightly directed, or they will be naught.

Writs may be renewed every term, until a defendant is arrefted; but in the court of king's bench, if the *latitat* be not renewed in five terms, a new writ is to be taken out, and the plaintiff is not allowed to renew the old one.

The fheriff's bailiffs cannot execute a writ directed to the fheriff, without his warrant; and if feveral perfons are included in a writ (for four defendants may be in one writ), there muft be feveral warrants from the fheriff to execute the fame. All writs are to be returned and filed in due time, to avoid *poft-terminums.*

Attachment lies againft fheriffs, &c. for not executing a writ, or for doing it oppreffively by force, extorting money on it, or not doing it effectually, by reafon of any corrupt practice.

Writ *of Appraifement*, a writ iffued out of court for the valuation of goods feized as forfeited to the crown; or goods taken as prize of war, or found wrecked, flotfam or jetfam.

Several feizures by feveral perfons not amounting to 100*l.* may be included in one writ. (Bunbury, p. 63.) And a new writ was ordered where the firft appraifement was too high. (Ibid. 49. 185.) They are alfo required to fpecify the goods particularly, p. 89.

Writ *of Affife*. See Assise.

Writs *of Affiftance*, are writs iffued out of the exchequer, to enable officers to enter fhips, houfes, warehoufes, and other places, to fearch for fmuggled or prohibited goods. They are directed to be granted by 13 & 14 Car. II. c. 11. and are iffued on oath, that there is ftrong prefumption to believe goods of thofe kinds are harboured; but if they are executed in the night, the officers muft be accompanied by a peace-officer.

Writ *of Capias*. See Capias.

Writ *of Delivery*, a writ directing the delivery of goods out of the king's poffeffions, either by verdict or by confent. They cannot be iffued till the information is in court (Bunbury, p. 27.); and they are difcretionary in the court. (Ibid. p. 196.) A writ was granted out of the exchequer for watches, becaufe the fprings and fteel-work were liable to ruft (p. 74.); but it was refufed for tobacco-ftalks, becaufe they were directed to be burnt. (P. 196.) A writ was alfo refufed in Ladd's and in Thomfett's cafe, in the fame court, for coins; the former reported, the latter not reported.

Writ *of Diftringas*. See Distringas.

Writ *of Election to Parliament*. See Parliament.

Writ *of Entry*. See Entry.

Writ *of Inquiry of Damages*, a judicial writ that iffues out to the fheriff upon a judgment by default, in an action of the cafe, covenant, trefpafs, trover, &c. commanding him to fummon a jury to enquire what damages the plaintiff hath fuftained, *occafione præmifforum;* and when this is returned with the inquifition, the rule for judgment is given upon it; and if nothing be faid to the contrary, judgment is thereupon entered. 2 Lill. Abr. 721.

Writ *of Mainprife*. See Mainprise.

Writ *of Neifty*. See Neifty.

Writ *of Rebellion*. See Commission *of Rebellion*.

Writ *of Right*. See Recto.

Writs *Vicountiel*. See Vicountiel.

Writ, *Action of a*. See Action.

Writ, *Appeal by*. See Appeal.

Writ, *Attachment by*. See Attachment.

Writ, *Continuance of a*. See Continuance.

WRITER *of the Tallies*, an officer of the exchequer, being clerk to the auditor of the receipt, who writes upon the tallies the whole letters of the tellers' bills. See Tally and Exchequer.

WRITING, Scriptura, the art or act of fignifying and conveying our ideas to others, by letters or characters vifible to the eye.

Or, writing may be defined to be the art of exhibiting to the fight the conceptions of the mind, by means of marks or characters fignificant of the founds of language, which enable us to transfer ideas from the eye to the ear, and *vice verfâ.*

Written characters are of two forts: they are either figns for things, or figns for words. Of the former fort, are the pictures, hieroglyphics, and fymbols, employed by the ancient nations; of the latter fort, are the alphabetical characters now employed by all Europeans. Pictures were, undoubtedly, the firft effay towards writing; accordingly, we find in fact, that this was the only fort of writing known in the kingdom of Mexico, when America was firft difcovered. By hiftorical pictures, the Mexicans are faid to have tranfmitted the memory of the moft important tranfactions of their empire. (See Warburton's Divine Legat. of Mofes, vol. ii. part i. p. 67, &c. vol. iii. p. 73. Robertfon's Hift. Am. vol. iii. p. 203, &c. and Appendix, note 26. p. 440. edit. 8vo.) But as pictures could do no more than delineate external events, without exhibiting their connections, defcribing fuch qualities as were not vifible to the eye, or conveying any idea of the difpofitions or words of men, there arofe in procefs of time, for fupplying this defect, the invention of hieroglyphical characters; which may be confidered as the fecond ftage of the art of writing.

Hieroglyphics (which fee) confift in certain fymbols, which are made to ftand for invifible objects, on account of an analogy or refemblance which fuch fymbols were fuppofed to bear to the objects. Among the Mexicans were found fome traces of hieroglyphical characters, intermixed with their hiftorical pictures. But Egypt was the country where this fort of writing was moft ftudied, and brought into a regular art. However, this fort of writing could be no other than enigmatical and confufed, in the higheft degree; and muft have been a very imperfect vehicle of knowledge of any kind.

As writing advanced from pictures of vifible objects to hieroglyphics, or fymbols of things invifible; from thefe latter it advanced, among fome nations, to fimple arbitrary marks which ftood for objects, though without any refemblance or analogy to the objects fignified. Of this nature was the method of writing practifed among the Peruvians; who made ufe of fmall cords, of different colours, and by knots upon thefe, of various fizes, and differently arranged, contrived figns for giving information, and communicating their thoughts to one another. Of this nature, alfo, are the written characters which are ufed to this day in China. The Chinefe have no alphabet of letters, or fimple founds, which compofe their words; but every fingle character which they ufe in writing is fignificant of an idea: it is a mark which ftands for fome one thing or object, and confequently the number of thefe characters muft be immenfe. This Chinese *writing*, (which fee,) probably began, like the Egyptian, with pictures and hieroglyphical figures; which figures being, in their progrefs, abbreviated in form, for the fake of more eafily writing them, and greatly enlarged in number, paffed at length into thofe marks or characters which they now ufe, and which have fpread themfelves through feveral nations of the Eaft. For it is faid, that the Japanefe, the Tonquinefe, and the Coroeans, who ſpeak different languages from one another, and from the inhabitants of China, uſe the ſame written characters with them, and thus intelligibly correſpond with each other in writing, though ignorant of the language ſpoken in their ſeveral countries. Our European arithmetical figures are ſignificant marks, preciſely of the ſame nature with the Chineſe characters. Thus far nothing has appeared which reſembles our letters, or which can be called writing, in the ſenſe now given to that term. What we have hitherto ſeen were all direct ſigns for things, and made no uſe of the medium of ſound or words; either ſigns by repreſentation, as the Mexican pictures; or ſigns by analogy, as the Egyptian hieroglyphics; or ſigns by inſtitution, as the Peruvian knots, the Chineſe characters, and the Arabian cyphers. At length, in different nations, men became ſenſible of the imperfection, the ambiguity, and the tedioufneſs of each of theſe methods of communication with one another, and began to conſider the advantage reſulting from employing ſigns, which ſhould ſtand not directly for things, but for the words which they uſed in ſpeech for naming theſe things; and they alſo conſidered, that though the number of words in every language be very great, yet the number of articulate ſounds, uſed in compoſing theſe words, is comparatively ſmall. Hence they were led to invent ſigns, not for each word by itſelf, but for each of thoſe ſimple ſounds that are employed in forming words; and they obſerved, that by joining together a few of thoſe ſigns, it would be practicable to expreſs, in writing, the whole combination of ſounds which our words require.

The firſt ſtep in this new progreſs was the invention of an alphabet of ſyllables, which probably preceded the invention of an alphabet of letters, among ſome of the ancient nations; and which is ſaid to be retained, to this day, in Ethiopia, and ſome countries of India. By fixing upon a particular mark or character for every ſyllable in the language, the number of characters, neceſſary to be uſed in writing, was reduced within a much ſmaller compaſs than the number of words in the language. Still, however, the number of characters was great; and muſt have continued to render both reading and writing very laborious arts. At laſt ſome happy genius aroſe; and tracing the ſounds made by the human voice to their moſt ſimple elements, reduced them to a very few vowels and conſonants; and, by affixing to each of theſe the ſigns which we now call letters, taught men how, by their combinations, to put into writing all the different words, or combinations of ſound, which they employed in ſpeech. By being reduced to this ſimplicity, the art of writing was brought to its higheſt ſtate of perfection, and in this ſtate, we now enjoy it in all the countries of Europe.

To whom we are indebted for this admirable and uſeful diſcovery does not appear. There ſeems reaſon to conclude, from the books which Moſes has written, that, among the Jews, and probably among the Egyptians, letters had been invented prior to his age. The univerſal tradition among the ancients is, that they were firſt imported into Greece by Cadmus the Phœnician, who, according to the common ſyſtem of chronology, was contemporary with Joſhua; but according to ſir Iſaac Newton's ſyſtem, contemporary with king David. As the Phœnicians are not known to have been the inventors of any art or ſcience, though, by means of their extenſive commerce, they propagated the diſcoveries made by other nations, the moſt probable and natural account of the origin of alphabetical characters is, that they took riſe in Egypt, the firſt civilized kingdom of which we have any authentic accounts, and the great ſource of art and polity among the ancients. In that country, the favourite ſtudy of hieroglyphical characters had directed much attention to the art of writing. Their hieroglyphics are known to have been intermixed with abbreviated ſymbols, and arbitrary marks; whence, at laſt, they caught the idea of contriving marks, not for things merely, but for ſounds. Accordingly, Plato (in Phædro) expreſsly attributes the invention of letters to Theuth or Thoth, the Egyptian, who is ſuppoſed to have been the Hermes, or Mercury, of the Greeks. Cadmus himſelf, though he paſſed from Phœnicia to Greece, as ſeveral of the ancients have affirmed, was originally of Thebes in Egypt. Moſt probably Moſes carried with him the Egyptian letters into the land of Canaan; and there, being adopted by the Phœnicians who inhabited that part of the country, they were tranſmitted into Greece.

It is curious to obſerve, that the letters which we uſe at this day, can be traced back to the alphabet of Cadmus. The Roman alphabet, which obtains with us and moſt of the European nations, is plainly formed on the Greek, with a few variations. And all learned men obſerve, that the Greek characters, eſpecially according to the manner in which they are formed in the oldeſt inſcriptions, have a remarkable conformity with the Hebrew or Samaritan characters, which, it is agreed, are the ſame with the Phœnician, or the alphabet of Cadmus. If the Greek characters are inverted from left to right, according to the Phœnician and Hebrew manner of writing, they will appear to be nearly the ſame. Beſide the conformity of figure, the names or denominations of the letters, alpha, beta, gamma, &c. and the order in which they are arranged, in all the ſeveral alphabets, Phœnician, Hebrew, Greek, and Roman, agree ſo much, as to amount to a demonſtration that they were all originally derived from the ſame ſource. The letters were, at firſt, written from the right-hand to the left; and this manner of writing obtained among the Aſſyrians, Phœnicians, Arabians, and Hebrews: and from ſome very old inſcriptions, it appears to have obtained alſo among the Greeks. Afterwards the Greeks adopted the method of writing their lines alternately from the right to the left, and from the left to the right, called *bouſtrophedon*. At length, however, the motion from the left-hand to the right being found more natural and commodious, the practice of writing, in this direction, prevailed throughout all the countries of Europe. See more on this ſubject under ALPHABET, CHARACTERS, and LETTERS.

Writing was long a kind of engraving. Pillars, and tables of ſtone, were firſt employed, and afterwards, plates of the ſofter metals, ſuch as lead: but as writing became more common, lighter and more portable ſubſtances were employed. The leaves, and the bark of certain trees, were uſed in ſome countries; and in others, tablets of wood, covered with a thin coat of ſoft wax, on which the impreſſion was made with a ſtylus of iron. See BOOK, BARK, and STYLE.

In later times, the hides of animals, properly prepared and poliſhed into parchment, were the moſt common materials: our preſent method of writing on paper is an invention of no greater antiquity than the fourteenth century.

The advantages of writing above SPEECH (which ſee) are, that writing is both a more extenſive and a more permanent method of communication: nevertheleſs, ſpoken language has a great ſuperiority over written language, in point of energy or force. See Warburton, *ubi ſupra*. Blair's Lectures on Rhetoric, &c. vol. i. lect. 7.

An

An ingenious and learned writer has lately difcuffed the fubject of this article in a very elaborate manner. He obferves, that there is a difference, deferving particular attention in the inquiry, concerning the origin and progrefs of writing, between the imitative characters and fymbolic or arbitrary marks. The former derive their origin from that imitative faculty, which is fo confpicuous in the human fpecies; the latter are founded in neceffity or convenience, and become fignificant by compact: the one comprehends fymbols and marks for founds, fignificant of ideas; and the other have an immediate reference to fenfible objects which prefent themfelves to fight, and are applicable to hieroglyphical reprefentations. Accordingly all reprefentations, marks, or characters, which were ever ufed by any nation or people, muft have been either imitative or fymbolic.

This writer controverts the opinion of M. Fourmont, bifhop Warburton, and M. Gebelin, who have endeavoured to fhew, that alphabets were originally formed of hieroglyphical characters; alleging that the letters of an alphabet were effentially different from the characteriftic marks deduced from hieroglyphics, which are marks for things and ideas, like the ancient and modern characters of the Chinefe; whereas the former are only marks for founds; and that, though there be a fufficient refemblance between the Mexican picture-writing, the Egyptian hieroglyphics, and the Chinefe characters, yet thefe are foreign to alphabetic letters, and, in reality, do not bear the leaft relation to them. The hieroglyphic characters of the Chinefe are, it is faid, in their nature imitative, and do not combine into words, like arbitrary marks for founds or letters, which are very few, and of a fymbolic nature.

Letters, it is maintained, do not derive their powers from their forms, but originally their forms entirely depended on the fancy or will of thofe who made them.

Many learned men have fuppofed, that the alphabet was of divine origin; and feveral writers have afferted, that letters were firft communicated to Mofes by God himfelf; whilft others have contended, that the Decalogue was the firft alphabetic writing. But if this art had been a new difcovery in the time of Mofes, he would probably have commemorated it; nor is there any reafon to fuppofe, that God was the immediate revealer of the art, for Mofes could never have omitted to have recorded the hiftory of fo important a circumftance, as the memory of it would have been one of the ftrongeft barriers againft idolatry.

It appears, however, that the art of writing is of great antiquity, and that the ancients, who afcribed the invention of it to the gods, had very imperfect ideas of its true origin. When it is confidered that letters muft have been the produce of a certain degree of civilization among mankind, the inquirers into their original have been naturally led to feek it in the hiftory of thofe nations that appear to have been firft civilized. Accordingly, many authors have decided in favour of the Egyptians. See Letters.

Others have vindicated the claim of the Phœnicians to the invention of letters; urging the teftimony of Sanconiatho, the moft ancient and alfo the moft celebrated Phœnician hiftorian, corroborated by Pliny, Curtius, Lucan, Eufebius, &c. as well as their very early and high degree of civilization. The Chaldæans have alfo had feveral learned advocates, who have attributed the invention of letters to the patriarch Abraham: and fir Ifaac Newton, in particular, admits, that letters were known in the Abrahamic line for fome centuries before Mofes.

It is needlefs to mention the claims of the Tufcans, Indians, and Arabians. Mr. Aftle, *ubi infra*, declares in favour of the Phœnicians; and obferves, that as the Chaldæans, Syrians, Phœnicians, and Egyptians, all bordered upon each other, and as the Phœnicians were the greateft as well as the moft ancient commercial nation, it is very probable that they communicated letters to the Egyptians; the ports of Tyre and Sidon, and thofe of the Egyptians, being not far diftant from each other. This author adds, that before the time when Mizraim went into Egypt, in the year before Chrift 2188, and 160 years after the flood, Taaut, his fon, had invented letters in Phœnicia; and if this invention took place ten years before the migration of his father into Egypt, as Mr. Jackfon fuppofes, we can trace letters as far back as the year 2178 before Chrift, and 150 after the deluge recorded by Mofes: and beyond this period, the written annals of mankind, which have been hitherto tranfmitted to us, will not enable us to trace the knowledge of them, though this want of materials is no proof that letters were not known until a century and a half after the Deluge.

An opinion feems to be gaining credit among the learned, that arts and letters took their rife in the northern parts of Afia, and that they were cultivated in thofe parts, long before they were practifed in Phœnicia or Egypt. Some travelled fouthwards, others ftaid behind; and thofe who afterwards emigrated from the Eaft were generally called Scythians, and fometimes Huns, who overfpread the northern parts of Europe. Many fettlements were made in Germany long before the Chriftian era.

It has been afferted by many writers, that all alphabets are derived from one; but Mr. Aftle maintains, that there are various alphabets ufed in different parts of Afia, which differ from the Phœnician, ancient Hebrew, or Samaritan, in name, number, figure, order, and power. In feveral of thefe alphabets, there are marks for founds peculiar to the language of the Eaft, which are not neceffary to be employed in the notation of the languages of Europe.

The following alphabets, fays this learned writer, feem to be immediately derived from the Phœnician; *viz.* the ancient Hebrew, or Samaritan; the Chaldaic; the Baftulan, or that of the colony of Phœnicians or Canaanites, who are faid to have fled from Jofhua, and to have fettled themfelves, in the moft early ages, in that part of Spain now called Andalufia and Grenada; the Punic, Carthaginian, or Sicilian; the Pelafgian Greek, and its derivatives, which are written in the Eaftern manner, from right to left; and the Ionic Greek, written from left to right. This laft-mentioned branch from the Pelafgic ftock is the fource from whence not only moft of the alphabets of Europe are derived, but alfo of many others which have been adopted in different parts of Afia and Africa. From the Ionic Greek are derived the Arcadian, the Latin or Roman, the ancient Gaulifh, the ancient Spanifh, the ancient Gothic, the Coptic, the Ruffian, the Illyrian or Sclavonian, the Bulgarian, and the Armenian: the Runic is immediately derived from the Gothic.

The alphabets derived from the Roman are, the Lombardic, the Vifigothic, the Saxon, the Gallican, the Franco-Gallic or Merovingian, the German, the Caroline, the Capetian, and the Modern Gothic. The firft relates to the MSS. of Italy; the fecond, to thofe of Spain; the third, to the MSS. of Great Britain; the fourth and fifth, to thofe of France; the fixth, to Germany; the feventh, eighth, and ninth, to all the countries of Europe where Latin is read. The fix former alphabets are before the age of Charlemagne; the three latter follow it. The characters of thefe are more diftinguifhed by their names than by their forms, which indicate that they are all of Roman extraction. The Lombardic, introduced into Italy by the Lombards in 569, was ufed by the popes in their bulls, and fometimes called Roman in the eleventh century: it ceafed in the thirteenth century. The Vifigothic, or Spanifh Gothic, was introduced into Spain by the Goths or Vifigoths; it was abolifhed in a provincial fynod, held at Leon in 1091, when the Latin letters were eftablifhed for all public inftruments; though thefe characters were occafionally ufed in private tranfactions for upwards of three centuries afterwards. Saxon writing admits of various diftinctions, *viz.* the Anglo-Saxon, Britanno-Saxon, and Dano-Saxon. The Gauls, on being fubdued by the Romans, adopted their mode of writing; and by additions of their own, gave rife to the Gallican or Roman Gallic. The Franks, a people of Germany, having conquered part of Gaul, introduced their characters called Franco-Gallic, or Merovingian, becaufe this kind of writing was practifed under the kings of the Merovingian race. It took place about the clofe of the fixth century, and prevailed till the beginning of the ninth. The Caroline was derived from the improvement of Charlemagne; this declined in the twelfth century, and totally difappeared in the thirteenth, when it was fucceeded in Germany by the Modern Gothic. The Caroline writing was reftored by Hugh Capet about the year 987, and called Capetian: it was much practifed till about the middle of the twelfth century; but in the thirteenth it degenerated into the Modern Gothic. The Capetian writing was ufed in England and in Germany, as well as France, during the above-mentioned period. The Modern Gothic, which fpread itfelf over Europe in the twelfth and thirteenth centuries, is improperly fo called; becaufe it does not derive its origin from the writing anciently ufed by the Goths and Vifigoths in Italy and Spain, but it is the moft barbarous kind of writing: it took its rife in the decline of the arts among the lazy fchoolmen, who had the worft tafte; it is nothing more than the Latin writing degenerated. It began in the twelfth century, and was generally ufed (efpecially by monks and fchoolmen) in all parts of Europe, till the reftoration of the arts in the fifteenth century, and longer in Germany and the northern nations. Our ftatute-books are ftill printed in Gothic letters.

The learned are not agreed with refpect to the origin of what is called *national* writing. Some will have it, that the Roman manner prevailed throughout the Weft, until the irruption of the barbarous nations of the North, in the fifth and fixth centuries: the Goths, they fay, firft introduced their mode of writing into Italy, inftead of the Roman manner; the Vifigoths did the like in Spain; the Franks in Gaul; the Saxons in England; and the Lombards in Italy.

According to others, the Romans were in poffeffion of various forms of writing; but it is fuppofed, that the barbarous nations introduced fome of their own letters in the writings compofed of capitals and fmall letters; that the running-hand, peculiar to each nation, was ufed in grants and contracts, and found admittance likewife in manufcripts after the middle of the feventh century.

Mr. Aftle, however, is of opinion, that the different modes of writing in Italy, Spain, France, England, and Germany, were derived from the Roman alone.

While Rome continued the centre of all the provinces of the empire, her manner of writing generally prevailed in each; but the empire being difmembered, and all the weftern provinces difunited, a change was produced; the conquerors disfigured the Roman writing, and by their falfe tafte and ignorance, diftinguifhed their writing from that of their neighbours: the genius and difpofition of the different people having no fmall fhare in producing this diverfity.

This notion greatly affifts in difcovering the age of manufcripts; for if a writing is Merovingian, it cannot be fubfequent to the ninth, nor prior to the fifth century; if another is Lombardic, it muft be pofterior to the middle of the fixth, and anterior to the thirteenth; if Saxon, it cannot be earlier than the feventh, nor later than about the middle of the twelfth.

With regard to the forms of letters, many authors are of opinion that they are derived from the pofitions of the organs of fpeech in their pronunciation. Accordingly, M. Van Helmont hath taken great pains to prove, that the Chaldaic characters are the genuine alphabet of nature, becaufe, he fays, no letter can be rightly founded, without difpofing the organs of fpeech into an uniform pofition with the figure of each letter.

Mr. Nelme publifhed a work, in which he endeavours to fhew that all elementary characters or letters derive their form from the line and the circle. Mr. Gebelin deduces them from hieroglyphic reprefentations, and he hath given feveral delineations of human figures, trees, &c. in confirmation of his hypothefis. Mr. Aftle obferves, that as letters are only marks for founds, their forms entirely depended upon the tafte, fancy, will, or caprice, of thofe who firft formed them. In this point of view, they may be confidered as arbitrary marks, or fecret cyphers, which, by being made known and adopted, would become of general ufe, wherever they were received by agreement. For the number and forms of the letters of various alphabets, illuftrated by figures, we muft refer to Mr. Aftle's account, *ubi infra.*

After the moft diligent inquiry, it doth not appear, fays Mr. Aftle, that the Britons had the ufe of letters before their intercourfe with the Romans: and though, from the coming of Julius Cæfar till the time when the Romans left the ifland in the year 427, the Roman letters were familiar to the eyes of the inhabitants, he is of opinion, that writing was very little practifed by the Britons till after the coming of St. Auguftine, about the year 596.

The writing which prevailed in England from this time to the middle of the eleventh century, is generally termed Saxon, and may be divided into five kinds; *viz.* the Roman Saxon, which is very fimilar to the Roman, and prevailed in England from the coming of St. Auguftine till the eighth century; the fet Saxon, which took place toward the middle of the eighth century, continued till about the middle of the ninth, and was not entirely difufed till the beginning of the tenth century; the running-hand Saxon, which came into ufe towards the latter end of the ninth century, when learning was diffufed in England under the aufpices of king Alfred, in whofe reign many books were written in this ifland, in a more expeditious manner than formerly; the mixed Saxon, occurring in the ninth, tenth, and in the beginning of the eleventh centuries, in many MSS., which were written in England in characters partly Roman, partly Lombardic, and partly Saxon; and the elegant

elegant Saxon, which took place in England early in the tenth century, lafted till the Norman Conqueft, but was not entirely difufed till the middle of the twelfth, and is more beautiful than the writing in France, Italy, and Germany, during the fame period.

The writing introduced into England by William I. is ufually called Norman, and is compofed of letters nearly Lombardic, which were generally ufed in grants, charters, public inftruments, and law proceedings, with very little variation, from the Norman Conqueft till the reign of king Edward III.

About the reign of king Richard II. variations took place in writing records and law proceedings; the charters from the reign of king Richard II. to that of king Henry VIII. were compofed partly of characters called fet chancery and common chancery, and fome of the letters called court-hand; which three different fpecies of writing are derived partly from the Norman and partly from the modern Gothic. The modern Gothic began to take place in England in the twelfth century; the old Englifh about the middle of the fourteenth century; and fet chancery and common chancery in the decline of the fame century, and are ftill ufed in the enrolments of letters patent, charters, &c. and in exemplifications of recoveries: the court-hand was contrived by the Englifh lawyers, and took its rife about the middle of the fixteenth century, and continued till the beginning of the late reign, when it was abolifhed by law. The court-hand characters were nothing more than the Norman characters very much corrupted and deformed.

In the fixteenth century, the Englifh lawyers engroffed their conveyances and legal inftruments in characters called fecretary, which are ftill in ufe.

The French call their writing by the names of the different races of their kings, in whofe time they were written: thefe were, the Merovingian, the Carlovingian, the Capetian, the Valefian, and the Bourbonian.

The writing called Merovingian began in France foon after the time of Merovæus, fon of Pharamond; who was made king A.D. 460: this race ends with Childeric, who died in 752. The Caroline race properly began with Pepin, who was made king of France upon the death of Childeric. This prince was fucceeded by Charlemagne, A.D. 814, whofe line in France ended with Lewis V. A.D. 987. The Capetian race began with Hugh Capet, who fucceeded Lewis V., and ended with Charles IV. A.D. 1327. The Valefian race began with Philip IV. the fucceffor of Charles IV., and ended with Henry III. the laft of this line, who was flain in 1589. The Bourbonian line began with Henry IV. A.D. 1589, whofe defcendants now fill the throne of France.

The MSS. written in the northern parts of Scotland and in Ireland are in characters fimilar to the Saxon. The learned and ingenious colonel Vallancey thinks, indeed, that the Iberians, who migrated from the borders of the Euxine and Cafpian feas, and fettled in Spain, learned letters and arts from the Phœnicians: that a colony of the ancient Spaniards, by the name of Scots or Scythians, fettled in Ireland about a thoufand, or perhaps fix hundred years before Chrift, and that they brought elementary characters with them into Ireland. He obferves, that the Irifh alphabet differs from that of all other nations, in name, order, number, and power, and fuppofes, that they might have received their alphabet from the Carthaginians, who alfo fettled a colony in Ireland about fix hundred years before Chrift; and adds, that this opinion is the more to be credited, as the Irifh language appears to have a radical identity with the Punic.

In order to difcover what real pretenfions the Irifh have to the early ufe of letters, for which they eagerly contend, Mr. Aftle has examined their ftone monuments, their coins, and their MSS., and appealed to the hiftorians of that country. The letters upon the moft ancient of their monuments are apparently of Roman and Roman-Britifh original; and none of thefe infcribed monuments are fo ancient as to prove that the Irifh were poffeffed of letters before the Romans had intercourfe with the Britons; though they prove that they had letters before the arrival of St. Patrick in that kingdom, which, Mr. Whitaker, with great probability of truth, fays, were wafted over from the Caledonians, who ufed the Roman letters. Sir James Ware fays, that the Irifh alphabet was borrowed from the Britifh, and that the Saxon characters were nearly the fame as the Irifh; and adds, that Mr. Camden inclined to this opinion.

Moreover, there are no Irifh coins, infcribed with letters, till long after the twelfth century: except coins ftruck by fome of our Saxon kings, who made incurfions into that country, and ftruck money there in the Saxon manner.

The oldeft Irifh MS. which has been difcovered is the Pfalter of Cafhel, written in the latter end of the tenth century.

The teftimony of approved hiftorians is likewife unfavourable to the ancient literature of Ireland. Mr. Innes, in his Effay on the Antiquities of Scotland and Ireland, and Mr. James Macpherfon, in the third edition of his Introduction to the Hiftory of Great Britain and Ireland, maintain, that Ireland was firft peopled from Britain; and that the manners of the old Irifh were inconfiftent with the knowledge of letters.

It feems probable, that the interior parts of Europe were immediately peopled from the northern parts of Afia, and the maritime parts from Phœnicia, and the fouthern and weftern parts of that quarter of the globe. If this be the cafe, it is not furprifing that fome Eaftern cuftoms prevailed in Great Britain and Ireland, and that many Celtic words are ftill preferved both in the Irifh and in the Welfh languages.

The Norman characters, it is obferved, were generally ufed in England from the coming of William I., and the Saxon characters were entirely difufed in the very beginning of the twelfth century; but the Irifh and Scots preferved the ancient forms of their characters till the end of the fixteenth century.

The Gaëlic or Erfe language, ufed in the Highlands of Scotland, and the Iberno-Gaëlic, are nearly the fame, and their letters are fimilar to each other, as Mr. Aftle has fhewn by various fpecimens. The curious will find much information on the fubject of this article in Aftle's Origin and Progrefs of Writing, 4to. 1784.

J. Ravenau has a treatife, intitled "Des Infcriptions en Faux," in which he fhews how to revive and reftore old writings almoft effaced, by means of galls ground in white wine and diftilled, and thus rubbed over the writings.

To write without blacking the fingers: prepare the paper with a fine powder, made of three parts of calcined copperas, two of galls, and one of gum arabic; thofe being frefh mixed, rub them with a hare's foot into the pores of the paper, and then write with fair water, and the black letters will immediately appear.

To make new writing appear old, moiften it with oil of tartar *per deliquium*, more or lefs diluted with water, as you defire the ink to appear more or lefs decayed.

We may write without ink or its materials; for this purpofe, take a fine powder of calcined hartfhorn, of clean tobacco-pipes, or rather of mutton-bones burnt to a perfect white-

whitenefs, and rub it upon the paper, and then write with a filver bodkin, or the like. Boyle's Works abr. vol. i. p. 114, 115. See INK.

The difcharging of ink out of parchment, paper, &c. is commonly done by aqua fortis diluted fufficiently with water, that it may not deftroy the paper. The like may be done with oil, or fpirit of vitriol diluted. The juice of lemons, or ftrong vinegar, will take ink out of linen more fafely, as the mineral acids are apt to deftroy the linen, unlefs great care be ufed in diluting them.

We may write on iron with corrofive fublimate wetted with common water: for this purpofe, the parts of metal we would preferve untouched fhould be covered with wax, and that taken off in the proper places to make way for the corroding fubftance. Boyle, ib. p. 528.

The like may be practifed by means of aqua fortis.

Mr. Boyle mentions a method he had of copying a whole page of writing at once. But we do not find his defcription of it any where. Ib. p. 136.

A machine has been lately invented and conftructed by Meffrs. Watt and Co. of Birmingham; by means of which letters and other writings may be copied. For an account of the ftructure and ufe of this machine, we muft refer to the directions for copying with it, furnifhed by the inventors; obferving, however, that the date, at which a writing will yield a copy, is extremely uncertain, from the weather, as it is more or lefs drying, and from the ftate of the ink. In general the purpofe will be anfwered to the end of twenty-four hours, and fometimes of three or four days; but it is moft advifeable to copy letters as foon after they are written as may prove convenient. See COPYING.

Mr. Boyle informs us of a method of imitating writing on copper-plates. The copy to be engraved is to be wrote with a peculiar kind of ink, and the copper-plate being moderately warmed is rubbed over with a white varnifh, and fuffered to cool; then the paper being gently moiftened, that it may readily communicate its ink, the writing is applied to the prepared furface of the plate, and paffed through a rolling-prefs; by which means, the ink adhering to the varnifh leaves the letters very confpicuous. And hence it is eafy with a needle to trace the ftrokes through the varnifh upon the plate, which being afterwards cleaned, the letters are finifhed with the graver, and the work printed off in a rolling-prefs, as common cuts.

Mr. Boyle does not mention what the varnifh or ink, ufed by the artificer from whom he received this method, was; but he tells us, that he himfelf ufed the purer fort of virgin wax for a varnifh; and for his ink he took fine Frankfort black, carefully ground with water, till it obtained the confiftence of common ink; but no gum was added, left it fhould hinder the ink from coming off. He alfo obferves, that written characters may be taken off without the help of a prefs, by laying the moiftened paper fmooth upon the varnifhed copper, and rubbing it on hard with a convex piece of glafs. See *Sympathetic* INK.

In law, we fay, deeds, conveyances, &c. are to be in writing. A will may either be in writing, or by word of mouth.

We alfo fay, *written law*, *lex fcripta*, in oppofition to common law, which is called *lex non fcripta*. We have alfo *written* and *unwritten traditions*, &c.

Authentic writings of any contract, fealed and delivered, make the evidences thereof.

La Vayer has a curious differtation on the proof of facts by comparifon of hand-writings, in which he endeavours to fhew this method of proof to be very fufpicious and fallacious.

WRITING, *Gothic*. See GOTHIC.

WRITING, *Secret*. See CRYPTOGRAPHY, STEGANOGRAPHY, SCYTALA, CIPHER, DECIPHERING, &c.

WRITING, *Short*. See BRACHYGRAPHY, STENOGRAPHY, and TACHYGRAPHY.

WRITINGS, *Stealing of*. See LARCENY.

WRITTEN EVIDENCE. See EVIDENCE.

WRITTEN *Tradition*. See TRADITION.

WRITZEN, in *Geography*, a town of the Middle Mark of Brandenburg, on a branch of the Oder; 18 miles N.W. of Cuftrin.

WRONG, in a *Logical Senfe*. See ERROR, FALSEHOOD, and TRUTH.

WRONG, in a *Legal Senfe*, *injury*, *tort*. See INJURY, and TORT.

Wrongs are divifible into two forts, *viz*. *private* and *public*. The former are an infringement or privation of the private or civil rights belonging to individuals, confidered as fuch; and are frequently termed *civil injuries*. The latter are a breach and violation of public rights and duties, which affect the whole community, confidered as fuch; and are diftinguifhed by the harfher appellation of *crimes* and *mifdemeanours*.

WRONG, *Executor of his own*. See EXECUTOR *de fon Tort*.

WRONG-*Lands*, in our *Old Writers*, feem to denote trees that will never prove timber; fuch as wrong the ground they grow in.

WRONGS, in *Agriculture*, a term applied to the crooked arms or large boughs of trees, when the fagot-wood is cut off from them.

WROTHAM, in *Geography*, a market-town in the upper half hundred of the fame name, in the lathe of Aylesford, and county of Kent, England, is fituated near the bafe of fome chalk-hills, at the diftance of 10 miles W.N.W. from Maidftone, and 24 miles S.E. by E. from London. The manor was granted by king Ethelftan, in the year 964, to the priory of Chrift-church, Canterbury. On the divifion of the poffeffions of the monks by Lanfranc, it was allotted to the archbifhops of Canterbury, who had a palace and frequently refided here, till the time of archbifhop Iflip, who pulled down the buildings for the fake of the materials, which he applied to the completion of the palace at Maidftone, which his predeceffor, John Ufford, had begun. Archbifhop Cranmer refigned the manor to Henry VIII., and it was granted by Edward VI. to fir John Mafon, who difpofed of it to the Byngs, anceftors of the lords Torrington, of whom it was purchafed by William James, efq. of Ightham, whofe defcendants ftill poffefs it. Wrotham church, the only public edifice in the town, is a fpacious well-built ftructure, and confifts of a nave, aifles, chancel, and tranfept, with an embattled tower at the weft end; the chancel is light and elegant. The fepulchral memorials are numerous; among which are feveral curious braffes, recording the family of Peckham, who were refident in this parifh during feveral centuries. The Rayner family, who refided at Wrotham-Place the whole of the 17th century, have alfo monuments here. The rectory is efteemed one of the beft livings in Kent. Of the ancient archiepifcopal palace little now remains but a gateway, and a fubftantial ftone building which formed part of the offices. The population return of the year 1811 ftates the town to contain 107 houfes, and 613 inhabitants. Here is an annual fair, and a weekly market on Tuefday. The parifh is very extenfive, comprehending the villages of Hale, Nepicar, Plaxted, Winfield, and Roughway. In a park within the limits of the parifh is a capital manfion, once the feat of fir Harry

Harry Vane, who on the reftoration of Charles II. fuffered death for the part he took againft Charles I. This eftate, on the death of lord vifcount Vane in 1789, became the property of David Papillion, efq.: it is now occupied by the earl of Delawar.—Beauties of England and Wales, vol. viii. Kent, by E. W. Brayley, 1807.

WROTZKO, a town of Pruffia, in the palatinate of Culm; 12 miles S.W. of Strafburg.

WROUGHT, in *Ship-Building*, a term applied to any piece of timber, &c. when it is trimmed and fitted for its fituation.

WROXETER, in *Geography*, a village of England, in the county of Salop, at the union of the Torn and the Severn, by Antoninus called "Uriconium," by Ptolemy "Viriconium," by the Welfh and Britons "Caer Vruach," and by the Saxons "Wrekenceafter." It was the chief city of the Cornavii, and founded by the Romans, when they fortified the bank of the Severn where fordable. It was encompaffed by a rampart and ditch; the walls were three yards thick, and were three miles in circumference. After fuffering much in the Saxon wars, it was quite ruined by the Danifh, and is now but a fmall place. Many Roman coins and other antiquities have been found here; 5 miles S.E. of Shrewfbury, and 155 N.W. of London.

WRUNG-HEADS, a former name given to the bilge of a fhip, &c. or that part near the floor-heads, which, when a fhip lies aground, bears the greateft ftrain.

WRY-NECK, (*Caput obftipum, cervix obftipa, torticollis,*) denotes that deformity of the human body, in which the neck is bent laterally, generally inclining at the fame time fomewhat forwards, fo that the head is alfo drawn to one fide and forwards, being indeed frequently quite approximated to the fhoulder. For the moft part, the neck is in this cafe altogether irregularly formed: on the fide towards which the head inclines, it feems exceedingly plump, the ftrong fhortened mufcles being bulky, and affected with confiderable fpafm; while, on the other hand, the oppofite fide, where the neck is convex, exhibits no fuch ftrong rigid mufcles, or at all events fo little of this appearance, that, notwithftanding its convex form, it feems obvioufly lefs flefhy. When the difeafe has continued a long while, and attained a ferious degree, its effects extend alfo to the head itfelf. On that fide where the irregular action of the mufcles is ftrongeft, and where confequently the head is moft drawn downwards, the half of the face is ufually more or lefs contracted, and weaker than the oppofite half, the zygomaticus major, the buccinator, the maffeter, and other mufcles, being confiderably lefs prominent. This disfigurement of the countenance has a very unpleafant appearance, and plainly indicates the diftorted pofition into which the head is drawn. The patients are alfo incapable of turning their heads properly, or of directing their faces upwards; and if thefe functions can be executed in a very imperfect way, it is not without a good deal of effort, which in general the patients prefer avoiding. Hence they moftly choofe to remain in their diftorted pofture, and inftead of trying to turn their heads with the mufcles of the neck alone, they prefer accomplifhing this object rather by turning the whole body. Hence an opportunity is given for the evil to increafe in a very rapid and afflicting degree. According to the obfervations of Richter and Bernftein, the face is commonly turned towards the oppofite fide, and only now and then towards that to which the head inclines. (Anfangfgr. der Wundarzneykunft 4ter. Band, 2te. Auflage, f. 256. Practifchen Handbuche für Wundärzte, &c. Neue Auflage, 3ter. Theil, f. 215.) Profeffor Jörg of Leipfic does not exactly coincide with thefe furgeons on this particular point; but we think that the difference is merely in terms, and not in the thing itfelf, Richter meaning that the face is *turned* towards the found fide, not that it is *drawn away*, and *made more diftant* from the fhoulder to which the whole neck and head incline. Profeffor Jörg takes a review of the action and infertions of the fterno-cleido-maftoideus mufcle, which proceeds down the neck from the maftoid procefs, and fplits into two portions; one of which is inferted into the external and anterior part of the clavicle, the other into the upper and outer furface of the fternum. The clavicular portion of this mufcle muft neceffarily tend to draw the head towards the clavicle, which is the fixed point, while the fternal portion will pull it towards the breaft; but both acting together, will draw it in a diagonal line. At the fame time that they have the effect of inclining the head forwards and to one fide, they impart to the neck the fame direction, and even flightly turn it, fo that the nofe is no longer fituated in a ftraight line directly over the fternum, but is placed to one fide of fuch a line. When, for example, fays profeffor Jörg, the right fterno-cleido-maftoideus is too fhort, and is therefore the caufe of the wry-neck, it will pull the head towards the right fide, and alfo forwards, in fuch a manner that the nofe is moved to the left of a line drawn upwards from the fternum, and the neck itfelf is at the fame time flightly turned. But when this is the cafe, the whole face muft obvioufly be fomewhat turned towards the left fide, and drawn a little way downwards and forwards. When, however, the whole head is drawn forwards, laterally, (in this cafe to the right,) and at the fame time downwards, confequently the face forwards, laterally, (in this cafe to the left,) and downwards, it cannot be faid that the face is moved in a different direction from that of the reft of the head. Although the face is turned in a different direction, ftill it is not inclined towards the oppofite fide; for, fays profeffor Jörg, if this were fo, the neck muft be much more turned than actually happens. Hence, he thinks, that a cafe has really never exifted, where the face and head have been inclined in different directions.

With refpect to the caufes of this infirmity, they are, according to feveral writers, very numerous, and it is not to be denied that they may be of different kinds. Yet, fays Jörg, "I have never feen the complaint originate in the bones: the mufcles were always the parts firft concerned. According to my obfervations, the fterno-cleido-maftoideus muft be looked upon as being the chief original caufe of this deformity, which I have never feen unattended with the particular and manifeft influence of that mufcle. When alfo feveral other mufcles gradually participate in the diforder, the fterno-cleido-maftoideus is ufually the firft affected. While it is more difpofed to an irregular action than any other mufcle of the neck, its greater ftrength makes it in fome meafure govern the reft." As children, both in the erect and horizontal poftures, frequently keep their necks unevenly, and more to one fide than the other, profeffor Jörg conceives that this will account for one fterno-cleido-maftoideus readily becoming fhorter than its fellow; the equilibrium ceafes, and a wry-neck is immediately produced. Young children often contract a habit of lying in bed conftantly upon the fame fide, whereby the mufcles of the neck become gradually habituated to an irregular kind of tenfion, which by degrees breaks the antagonizing power between the oppofite fets of mufcles. The fame thing happens, when children are conftantly carried with their head upon one and the fame fide of their nurfe. But this irregularity in the mufcles in queftion is alfo fre-

 quently

quently congenital, and then we need not ſpecify any occaſional cauſes. The evil, though it exiſts at the time of birth only in a trivial degree, afterwards quickly increaſes, and ſoon becomes ſerious. The regular equilibrium between the ſterno-cleido-maſtoidei may likewiſe be deſtroyed, when one of them is wounded, or completely cut through; when it remains preternaturally weak, in conſequence of having been the ſeat of abſceſſes, and previous ulceration; or when, from any cauſe whatſoever, its action is rendered either too feeble or too powerful.

In one patient cured by profeſſor Jörg, it is alleged that the inner portion of the left ſterno-cleido-maſtoideus was inſerted into the middle and right ſide of the ſternum, in the ſame place as the inner portion of the muſcle of this name on the right; and the above author conceived, that this preternatural attachment was probably the cauſe of the inclination of the head to the right ſide.

Profeſſor Jörg does not give much credit to the opinion, that the wry-neck is frequently brought on by a contraction of the ſkin of the neck and of the platyſma myoides; the firſt of theſe parts being very yielding, and the ſecond very thin and elaſtic. But, he thinks, that when theſe parts, or any other muſcles of the neck, are ſhortened and ſpaſmodically contracted, it is generally as a conſequence of the affection of the ſterno-cleido-maſtoideus, which is the part originally diſordered.

The ſame writer will not deny alſo, that the malformation of the bones may be the firſt cauſe of this infirmity. If, ſays he, the dorſal and lumbar vertebræ are liable to curvature, why ſhould the cervical ones not be ſo, and thereby deſtroy the equilibrium between the muſcles of the neck? Yet, he thinks, the cauſe of the diſorder muſt lie much more rarely in the bones than the muſcles, ſince he has never ſeen one inſtance of it. He admits alſo, that there can be no doubt that the bones ſooner or later ſhare in the effects of the diſeaſe; that they become bent to one ſide, and even cemented together by anchyloſis.

As in every other diſorder, the practitioner muſt endeavour to find out the original cauſe of the complaint; and, therefore, the queſtion ariſes, how can it be known whether the muſcles and the integuments, or the bones, are the firſt cauſe of the deformity? The cauſe may be aſcribed to the muſcles, when there is obviouſly ſomething wrong about them; when they are hard and contracted on one ſide, and ſoft and little prominent on the other; and when thoſe which are ſhrunk and ſhortened become ſtill harder and more painful, on putting the head in a ſtraight poſition, to the doing of which they alſo make more or leſs reſiſtance. We may be more certain of the thing, when no diſeaſe of the bones in any part of the body, and no cauſes of ſuch complaint, can be detected; for when the bones are about to ſoften, or are already ſoftened, the latter affection muſt be preceded by certain occaſional cauſes, and accompanied with the uſual ſymptoms. The diſcovery of theſe, according to profeſſor Jörg, is not difficult to the practitioner, at leaſt not impoſſible. The diſorder, on the other hand, may be referred to the bones, when no particular defect about the muſcles is apparent, when they are no where remarkably hard and contracted, and when the caſe is attended with ſymptoms and veſtiges of a partial or general ſoftening of the bones. When this is the caſe, the muſcles are uſually much leſs altered than when they conſtitute the original cauſe of the deformity; and the head can be more eaſily raiſed, turned, and moved about.

Another queſtion is, what degree has the diſorder already attained, and have the bones materially participated in the affection or not? Perhaps the cervical vertebræ are anchyloſed? Although it may at firſt ſeem eaſy to anſwer theſe queſtions, yet it is not always ſo eaſy. The prognoſis and treatment, however, are to be regulated by the deciſion; and we can never ſpeak ſatisfactorily of the caſe, unleſs we have inquired into the whole of its progreſs.

When the bones are affected, that is to ſay, when in conſequence of the wrong poſture of the neck a change has taken place in their form; when they, as is moſt uſual, on the ſide towards which the head is inclined, are lower than on the other; or when their proceſſes are diminiſhed or abſorbed; the practitioner can frequently feel and ſee that the defect lies in the texture of the bones. The depreſſions thus produced may ſometimes be plainly ſeen, or, at all events, can be felt with the finger. When the head and neck are put into the right poſition, theſe depreſſions become ſtill more obvious, as well as the alteration of the ſpinous proceſſes. In order to derive from ſuch examination any preciſe knowledge, we muſt indeed be well acquainted with the anatomy of the neck. Profeſſor Jörg then gives us ſome directions how to move the head and neck, and how to place our fingers in trying to aſcertain whether the cervical vertebræ are anchyloſed. We paſs theſe over, becauſe we place very little confidence in their accuracy or utility.

The profeſſor next notices the influence which the deformity has over the whole organization of the body. An imperfection in the formation of the head is the firſt and principal effect derived from the infirmity. In caſes of wry-neck, he has never ſeen the face and head altogether well conſtructed. The half of the face which was neareſt to the contracted ſterno-cleido-maſtoideus was always ſmaller, and leſs prominent, than the other. Frequently the lower jaw, the zygoma, and the eye, were more ſunk on this ſide than the other, and hence the countenance preſented a very diſtorted emaciated appearance. The foregoing author has alſo conſtantly found the raiſing of the head, and other motions of this part, materially prevented. The patients always ſtoop to one ſide in a moſt awkward kind of poſture. None of them can turn their heads well. Whenever they want to look laterally, they are obliged to turn their whole bodies. Hence many of them become diſqualified for certain occupations, and even if they are capable of work, they labour with more difficulty than other perſons. The preternatural dragging downward of the head, and the curvature of the cervical vertebræ, one would think (ſays profeſſor Jörg) would have a bad effect on the functions of the brain and ſpinal marrow. He has, however, never ſeen this happen; but on the contrary, in the worſt forms of the complaint, he has not found the brain at all affected. Still he does not venture to conclude that things are always ſo. Our limits oblige us to paſs over ſome other remarks on the preceding topic, in order to begin the conſideration of the method of treatment.

We find then that the wry-neck moſtly ariſes from an affection of the muſcles, and eſpecially from irregular action in the ſterno-cleido-maſtoidei, the equilibrium between which is deſtroyed: hence the treatment is generally directed againſt the muſcles, particularly thoſe above-mentioned. It is ſeldom that it is neceſſary to do any thing for the bones. For this reaſon, the prognoſis is generally favourable, and this the more ſo the younger the patient is, and the more yielding the contracted ſterno-cleido-maſtoideus happens to be found. Indeed, when the patient is farther advanced in life, and not more than twenty-five or thirty years of age, we ſhould not totally deſpair of being able to render aſſiſtance, if no anchyloſis exiſt, and not too much deformity of the cervical vertebræ. What kind of a prognoſis nofis can be made, when the bones are originally concerned in the production of a wry-neck, muft depend upon the nature and degree of the morbid affection of thofe parts.

In the treatment of a wry-neck, we muft endeavour to foften and relax the contracted mufcles, and ftrengthen thofe which are ftretched and tenfe. The firft indication, Jörg thinks, may be fulfilled by the ufe of oily emollient liniments two or three times a day; the fecond by the employment of fpirituous ftimulating embrocations. When common applications of the laft kind are unavailing, we are advifed to ufe fpirit of ammonia, tincture of cantharides, &c. It is alfo neceffary to perfevere for a long time in thefe remedies, even though the fkin may become red and tender. Jörg is an advocate likewife for applying compreffes to the parts dipped in fuch ftimulating fluids, and kept conftantly wet with them. Thus he calculates on maintaining the effects of their operation without interruption.

If the complaint be confiderable in degree, and the head and neck much diftorted, we are advifed to combine with the foregoing means what are termed *manipulations*, which confift in manual endeavours to obtain an elongation of the contracted mufcles, efpecially the fterno-cleido-maftoideus. In thefe manœuvres, we are directed to rub with one hand the mufcle upwards, and at the fame time to try to move the head in the fame direction. With the other hand we are to bring the head into its natural pofition, and keep it there, fo that the contracted mufcles may be extended as much as poffible. The greater their fpafmodic contraction is, the more muft we rub them in the direction above fpecified, even as long as a quarter or half an hour at a time; and the plan muft be repeated once, twice, or thrice a day, until the head will remain quite ftraight, or until that fide of the neck, which was previoufly convex, has become concave, and *vice verfâ*. Befides thefe *manipulations*, the head and face fhould be moved together into a perfectly upright pofture, laterally, and efpecially towards the fide to which they could not be turned, owing to the contracted ftate of the mufcles. By thefe means, the patient will foon acquire the faculty of moving the neck to one fide, which muft always be a defideratum in the treatment.

Profeffor Jörg fays, he has not deemed it neceffary to mention electricity and galvanifm as remedies, which may be joined with thofe above recommended. Whoever likes to try them, however, fhould only apply them to thofe mufcles which are in a ftate of tenfion; for every ftimulus muft be improper for fuch as are contracted.

This author does not fay much in favour of the warm bath as a remedy for wry-necks, in which cafes he owns he has never made trial of it. All his patients have been children from one to nine years of age; and he thinks it would have been difficult, and even dangerous in fome circumftances, to have immerfed them fufficiently in the warm water to cover their necks. Thefe are the only reafons which he gives for not having tried fo important a remedy for the wry-neck as the warm bath.

One of the principal means for the cure of a wry-neck confifts in a mechanical apparatus, by which the head is brought into a ftraight pofition, the contracted mufcles are elongated, and others, which are on the ftretch, kept in a ftate of reft and relaxation. It may be faid, indeed, that the patient fhould be able to put his head and neck in this pofture himfelf, and that no mechanical apparatus is requifite. But fuch pofture can only be adopted by making a great effort, and even then imperfectly. Hence the beft inclined patients foon give up the attempt, and the head becomes depreffed again. For children who cannot be perfuaded to obferve regularly the defirable pofition, the apparatus is more effential than for many adults. Several other writers had entertained this opinion previoufly to profeffor Jörg. Köhlers, Bernftein, and other authors, recommend a variety of mechanical contrivances for the cure of the wry-neck. None of thefe, however, have anfwered the expectations of profeffor Jörg, who has felt himfelf called upon to make an invention of his own. In the conftruction of his machine, he went upon the following principles: 1. That its operation fhould be effected by means of a fpring. 2. That the action of the ftretched enfeebled fterno-cleido-maftoideus fhould be ftrengthened, and the equilibrium between it and its fellow thereby re-eftablifhed.

The apparatus confifts of a leather pair of ftays, and of a band or fillet which goes round the head. On the centre of the fore-part of the ftays is a kind of pulley, or wheel, which admits of being turned to the right or left, and then becomes fixed by means of a fpring. From this apparatus a band proceeds up the patient's neck to the fillet, placed round the head, and to which it is faftened directly behind the ear, clofe to the maftoid procefs. This band lies in the fame direction as the lengthened fterno-cleido-maftoideus mufcle, and when drawn towards the breaft by the wheel, it produces the fame effect as would arife from an increafe of ftrength in the action of that mufcle. In fhort, it pulls the maftoid procefs downwards and forwards towards the fternum, counteracts the influence of the oppofite mufcle of the fame name, and thus rectifies the pofition of the head.

But this band, fays profeffor Jörg, does not merely draw down the fide of the head which is too elevated, it alfo tends to put the neck in a ftraight pofition. It was above explained, that a wry-neck is always more or lefs twifted, in confequence of the contraction of one of the fterno-cleido-maftoidei, and thus the mouth does not lie in a direct line perpendicularly above the centre of the fternum, but to one fide of this point. The action of the preceding band, by drawing forwards as well as downwards towards the middle of the breaft, the maftoid procefs evidently tends to counteract the effect produced by the wrong action of the faulty mufcle of the oppofite fide.

Profeffor Jörg makes his patients wear the apparatus day and night, and he does not even take it off when the frictions are made. The band is to be tightened and regulated according to the effects produced. Particular care, however, muft be taken not to make it too tight at firft.

When by perfeverance in the ufe of this apparatus, and the other means above recommended, the neck has been put into a proper pofition again, it ufually happens that the head itfelf continues inclined too much forward; an effect which the contracted fterno-cleido-maftoideus, and its antagonift the band, both tend to promote. Something, therefore, muft be done for the alleviation of this deformity. With this view, Jörg removes the above band from the breaft, carries it under the arm, and through a ring at the fide of the leather ftays or corfets, and thence to the fillet round the head, where it is faftened in the fame place as before. In this manner, the head will be confiderably elevated, while ftill the object of counteracting the fhortened fterno-cleido-maftoideus of the oppofite fide is not neglected. The ring hinders the band from hurting the axilla, and keeps it from following the motions of the fhoulder. The preceding author lets his patients, towards the latter part of the treatment, wear the apparatus in this way a long while; yet fometimes he applies it in both modes alternately, with

a defign

a defign of habituating the mufcles of the head and neck to different poftures.

Together with this treatment, profeffor Jörg enjoins attention to every thing which tends to improve the health, efpecially a proper nourifhing diet, pure air, &c. One thing he infifts upon as effential, *viz.* that during work or repofe, fleeping or awake, the patient conftantly keep the head and neck in the right pofition. Hence children muft be moft vigilantly obferved, as they foon forget what is told them; and the pofture in which they lie when afleep muft be attended to, as it is frequently a bad one. Jörg recommends laying their heads on firm round bolfters filled with horfe-hair, and placeing them on the fide on which the mufcles are contracted. The bed fhould be flat, and not fink, in order that the fhoulder may not be depreffed. In this pofition, the head will be preffed and inclined towards the oppofite fide. The patients muft alfo be forbidden to do any kind of labour which will oblige them to hold their heads in a hurtful pofition; but Jörg rather commends dancing and the military exercife, as accuftoming the patient to hold his head as he ought to do.

When the bones are concerned, the above apparatus and treatment will not be effectual; and particular machinery adapted to the cafe muft be employed.

Frequently the curative means are prematurely difcontinued, and the diforder recurs. It is commonly imagined, that when the head and neck can be brought ftraight, every thing is accomplifhed. But, as Jörg remarks, it is wrong to confider this period the completion of the cure; for, when the head and neck can be kept every day feveral hours in a right pofture, without any machinery, the convalefcents foon become fatigued, as it cannot be at firft done without exertion. It is only when both fterno-cleido-maftoidei feem to be formed alike; when one is not tenfer than the other; and when, confequently, the equilibrium betwixt them is re-eftablifhed; when alfo one fide of the neck is as prominent and well-formed as the other; and when the head can be brought into the right pofition naturally, and without any effort; that the cure ought to be regarded as accomplifhed. The machinery may now be gradually relinquifhed with fafety. At firft it is to be taken off for an hour at a time every day, and the period of its difcontinuance is to be lengthened by degrees, until at length it is entirely laid afide. For the foregoing excellent obfervations we are indebted to profeffor Jörg of Leipfic, whofe publication on the deformities of the human body is entitled in German "Ueber die Verkrümmungen des Menfchlichen Körpers und eine rationelle und fichere Heilart derfelben." Leipfic, 1816, 4to.

This author has not mentioned or given any opinion refpecting the plan which was propofed by Mr. Sharp, of dividing and even cutting out a portion of the fterno-cleido-maftoideus mufcle, which appears to act with too much power.

Mr. Gooch cured a patient by merely dividing the fkin and platyfma myoides mufcle; a kind of cafe which Jörg thinks unfrequent. Mr. Gooch alfo fometimes employed machinery with fuccefs.

Wry-neck, a difeafe of the fpafmodic kind in fheep, in which the head is drawn forcibly to one fide, and the animal difabled from walking. The cure is to be effected by the ufe of calomel with opium in pretty full dofes; putting the animal into a dry well-graffed pafture during the time, and avoiding cold and moifture.

Wry-neck, *Jynx*, in *Ornithology*, a bird called alfo the *torquilla*, which Linnæus has made a diftinct genus of the *picæ*, under the denomination of *yunx:* the characters of which are, that the bill is flender, round, and pointed; the noftrils are concave and naked; the tongue is very long, very flender, cylindric, and terminated by a hard point; and the feet are formed for climbing.

There is only one fpecies, *viz.* the *jynx torquilla*. The colours of this bird are elegantly pencilled, though its plumage is marked with the plaineft kinds: a lift of black and ferruginous ftrokes divides the top of the head and back; the fides of the head and neck are afh-coloured, beautifully traverfed with fine lines of black and reddifh-brown; the quill-feathers are dufky, but each web is marked with ruft-coloured fpots; the chin and breaft are of a light yellowifh-brown, adorned with fharp-pointed bars of black; the tail confifts of ten feathers, broad at their ends and weak, of a pale afh-colour, powdered with black and red, and marked with four equidiftant bars of black: the irides are of a yellowifh colour.

The wry-neck, Mr. Pennant apprehends, is a bird of paffage, appearing with us in the fpring before the cuckow. Its note is like that of the keftril, a quick-repeated fqueak: its eggs are white, with a very thin fhell; this bird builds in the hollows of trees, making its neft of dry grafs. It has a very whimfical way of turning and twifting its neck about, and bringing its head over its fhoulders, whence it had its name *torquilla*, and its Englifh one of wry-neck: it has alfo the faculty of erecting the feathers of the head like thofe of the jay. It feeds on ants, which it very dexteroufly transfixes with the bony and fharp end of its tongue, and then draws them into its mouth. Ray and Pennant.

WRYNOSE, in *Geography*, a mountain of England, on which are three ftones, marking the boundaries of the three counties of Lancafter, Cumberland, and Weftmoreland; 12 miles S. of Ravenglafs.

WSCHESTAD, a town of Bohemia, in the circle of Kaurzim; 10 miles N.W. of Kofteletz.

WSETIN, a town of Moravia, in the circle of Hradifch; 23 miles N.E. of Hradifch.

WUIPENS. See Wippingen.

WULDA, a town of Bohemia, in the circle of Bechin; 12 miles S.W. of Crumau.

WULFEN, a town of Weftphalia, in the bifhopric of Ofnabruck; 8 miles E.N.E. of Ofnabruck.

WULFENIA, in *Botany*, was fo named by profeffor Jacquin, in honour of his highly deferving friend, and conftant botanical correfpondent, the Rev. Francis Xavier von Wulfen, profeffor of natural philofophy and mathematics at Klagenfurt, in Carniola, to which charge he was appointed in 1762, and where he died March 17, 1806, aged feventy-eight. Amid the duties of his profefforfhip, and the more ferious calls of his ecclefiaftical ftation, which he fulfilled by the moft exemplary and active benevolence and charity to all within his reach, his favourite purfuit was the ftudy of the botany and mineralogy of the furrounding country. His numerous contributions to the publications of Jacquin, on the rare plants of Carniola and Carinthia, conftitute a treafure of the moft valuable and original information. He writes with the ardour of a real lover of nature, and we have nothing to difapprove, except fomewhat of the diffufe, and what Linnæus terms "oratorical," ftyle, in the defcriptive parts of his writings, where terfenefs and precifion are moft defirable, however agreeable the graces of oratory, and the expreffion of tafte and feeling, may be in any accompanying remarks. The *Flora Lapponica* of Linnæus is our ftandard of perfection in this refpect. Wulfen was an accomplifhed fcholar, a man of the moft amiable and elevated character, who adorns every thing that he touches, and who lived and died beloved and revered by men of all ranks, and of every perfuafion. As he lived remote from the fcientific circles of Europe, it is no wonder if, in the abftrufe ftudy of cryptogamic botany, he fell into fome errors, efpecially relative to the *Lichen* tribe, a part of which the writer of this article prefumed to correct, in a paper printed in the Tranfactions of the Linn. Soc. v. 2. p. 10, certainly without intending any difrefpect for the excellent author, though a German writer of a more vulgar ftamp, by mif-tranflation and mifreprefentation, tried to excite them to enmity, but in vain. He may be pardoned for the fake of the great man whom he, though unfkilfully, meant to defend, and for his own fervices to fcience, though of inferior pretenfions. Wulfen is reported to have left behind him in MS. a complete *Flora Norica*, defcriptive of the vegetable productions of a particular part of Carniola, an *Agroftographia*, and feveral other works, rich in practical and fcientific obfervations. Of thefe, it is to be hoped the learned world will not be deprived.—Jacq. Mifc. Auftr. v. 2. 62. t. 8. f. 1. Schreb. Gen. 16. Willd. Sp. Pl. v. 1. 78. Vahl Enum. v. 1. 86. Mart. Mill. Dict. v. 4. Sm. Tranf. of Linn. Soc. v. 6. 96. (Bonarota; Mich. Gen. 9. t. 15. Pæderota; Juff. 120. Lamarck Dict. v. 4. 692. Illuftr. t. 13, but not the original *Pæderota* of Linnæus. See Tr. of Linn. Soc. as above.)—Clafs and order, *Diandria Monogynia*. Nat. Ord. *Perfonatæ*, Linn. *Scrophulariæ*, Juff.

Gen. Ch. *Cal.* Perianth inferior, of one leaf, in five deep, linear-awlfhaped, equal, erect, permanent fegments. *Cor.* of one petal, ringent: tube gibbous, and nearly globofe at the bafe: limb two-lipped; upper lip fhorteft, undivided, or flightly notched, vaulted, acute; lower longeft, deflexed, three-lobed. *Stam.* Filaments two, thread-fhaped, afcending, fhorter than the upper lip; anthers roundifh. *Pift.* Germen fuperior, ovate-oblong, compreffed; ftyle thread-fhaped, twice as long as the calyx; ftigma capitate. *Peric.* Capfule ovate, compreffed, furrowed at each fide, of two cells and two divided valves, burfting at the fummit. *Seeds* numerous, roundifh.

Eff. Ch. Corolla tubular, ringent; upper lip vaulted; lower three-cleft. Calyx in five deep fegments. Capfule of two cells, and two cloven valves.

Obf. This genus is certainly next akin to VERONICA, under which article we have recorded a remark to that effect made by Mr. Brown. The effential difference, however, between thefe two genera refides in the limb of the *corolla*, which in *Veronica* is wheel-fhaped, its lower fegment narroweft; a character of more importance than the proportion of the tube, that part being, in a few fpecies, nearly as much elongated as in the prefent genus. If any of thofe fpecies fhould prove to have a ringent *corolla*, whofe upper lip is vaulted, and the lower three-lobed, they muft be removed to *Wulfenia;* but we difcover nothing of this in *V. fibirica* or *virginica*, whofe limb is truly that of a *Veronica*. Whether the throat be bearded in every fpecies of *Wulfenia*, we are not certain; nor is that circumftance material, any more than the valves of the *capfule* being cloven or not, the fame difference exifting between different fpecies of *Veronica*, as has already been mentioned in its proper place. The five-cleft *calyx*, indicated by Linnæus as the mark of *Pæderota*, is found in the two *Veronicæ* juft named, as well as in fome lefs ambiguous fpecies, as *V. auftriaca*, *multifida*, *Teucrium*, and *latifolia*, though in thefe laft the fifth fegment varies in fize, is occafionally abfent, and is always unequal to the others.

1. W. *Bonarota*. Blue Leafy Wulfenia. Sm. n. 1. Vahl n. 1. (Pæderota Bonarota; Linn. Sp. Pl. 20. Willd. Sp. Pl. v. 1. 77. Jacq. Auftr. append. t. 39. P. cærulea; Linn. Suppl. 84. Lamarck Illuftr. v. 1. 48. t. 13. f. 1. Bonarota montana italica, chamædryos folio, flore cæruleo; Mich. Gen. 19. t. 15. f. 1; alfo f. 2, with rounder leaves, and a more denfe fpike. Chamædrys montis Sumani; Bauh. Hift. v. 3. 289.)—Stem leafy. Upper lip of the corolla entire. Leaves roundifh-ovate.—Native of the mountains of Italy and Carniola; perennial: a ftranger in our gardens, as well as the two following. The *root* is fomewhat creeping. *Stems* fimple, erect, five or fix inches high, downy like the reft of the herbage, each bearing four or five pair of roundifh-ovate *leaves*, about an inch long, with broad, rather fhallow ferratures. *Clufter* terminal, folitary, ovate-oblong, of feveral pretty blue *flowers*, accompanied by lanceolate *bracteas*. *Calyx* hairy. The *corolla* is decidedly ringent, with a concave upper lip, and the valves of the *capfule* fplit at the fummit, each into two fharp points.

2. W. *Ageria*. Yellow Leafy Wulfenia. Sm. n. 2. Vahl n. 2. (Pæderota Ageria; Linn. Mant. 171, excluding Bauhin's fynonym. Willd. Sp. Pl. v. 1. 77. P. lutea; Scop. Ann. 2. 41. Lamarck n. 3. excluding the reference to Bauhin. Linn. Suppl. 84. P. Bonarota; Jacq. Hort. Vind. v. 2. 55. t. 121. Bonarota montana italica, chamædryos folio minùs crenato, fpicâ luteâ; Mich. Gen. 19.)—Stem leafy. Upper lip of the corolla cloven. Leaves ovato-lanceolate, elongated at the point.—Native of Carniola and Italy, in places where, according to Scopoli, the former is not found. Great confufion refpecting thefe two plants has long exifted. Linnæus and Scopoli fometimes confidered them as varieties of each other, and when they made them diftinct, they mifapplied their fynonyms. The prefent is faid to be diftinguifhed by the emarginate, or cloven, upper lip of the *corolla*, which, neverthelefs, Jacquin's figure does not exprefs, and which is but flightly perceptible in our dried fpecimens. The *leaves* differ materially in their more elongated form, and narrower, more copious, ferratures; the lower ones being alternate, as noticed by Scopoli, is but a cafual occurrence. The *corolla* is of a pale fulphur-colour, not blue. *Calyx* fmooth. The *ftyle* in both thefe fpecies is full as long in proportion to the *calyx* and *corolla* as in the following, though defcribed, in the generic character of *Pæderota* by Linnæus, as only the length of the *ftamens*.

The fpecific name of *Ageria*, given by Linnæus to what had much better have been called *lutea*, is intended to commemorate Nicholas Agerius, a friend of John and Cafpar Bauhin, who fent our *W. Bonarota* to the former, and is mentioned by him in feveral places. His name occurs in Linn. Sp. Pl. 1670, as the original difcoverer of *Verbafcum Thapfi*. Haller fpeaks of him as having publifhed, at Strafburg, in 1625, a quarto differtation *de Zoophytis;* and another in 1629, *de Animâ vegetativâ;* works not mentioned in fir Jofeph Banks's rich catalogue, and therefore, doubtlefs, very rare.

3. W. *carinthiaca*. Carinthian Wulfenia. Sm. n. 3. Willd. n. 1. Vahl n. 3. Jacq. Mifc. Auftr. v. 2. 60. Ic. Rar. t. 2. (Pæderota nudicaulis; Lamarck Dict. v. 4. 692. Illuftr. v. 1. 48. t. 13. f. 2.)—Stem naked. Leaves crenate.—Found by Wulfen, in a rich foil, among limeftone rocks, on the loftieft and moft craggy mountains of Carinthia, flowering in the middle of July. The *root* is creeping, perennial, half as thick as the middle finger. *Leaves* feveral together in a tuft, all radical, obovate, obtufe, four or five inches long, doubly or unequally crenate, fmooth and fhining, except the ftrong mid-rib, which is hairy, at the back; their bafe tapering into a winged *footftalk*.

Flowers large and handsome, of a fine blue, crowded numerously into a dense cluster, supported by an upright, round, firm, unbranched, leafless, though somewhat scaly and slightly hairy, solitary, radical *stalk*, twice or thrice the height of the leaves. After flowering, the *cluster* becomes three or four inches long, and the permanent *calyces* turn reddish. The *capsules* are each one-third of an inch in length, brown, abrupt, scarcely exceeding the calyx, soon splitting into four parts at the top. The error of the specific name in Lamarck's synonym, *P. Wulfenia*, for *P. nudicaulis*, in Vahl and Willdenow, is copied by the former from the latter.

WULFRADT, in *Geography*, a town of the duchy of Berg; 3 miles N.E. of Medman.

WULFSDORP, a town of the duchy of Holstein; 11 miles N.N.W. of Lubeck.

WULFSFELDE, a town of the duchy of Holstein; 12 miles N.W. of Lubeck.

WULFTEN, a town of Westphalia, in the bishopric of Osnabruck; 2 miles S.W. of Osnabruck.

WULLED, a town of Arabia, in the province of Yemen; 46 miles S.E. of Loheia.

WULLERSDORFF, a town of Austria; 2 miles S.E. of Gunderstorff.

WULLI, *Mountains of*, mountains of Persia, which extend from the vicinity of Shatzan, across to the lake of Vaikind, and form one range with that on the N. of Mekran, called Gehelabad by La Rochette.

WULPERODE, a town of Westphalia, in the principality of Halberstadt; 4 miles W. of Osterwick.

WULTZESHOFEN, a town of Austria; 1 mile S.W. of Laab.

WULVESHEVED, or WULVESHEAD. See WOLFESHEAD.

WUMBLE, in *Rural Economy*, the provincial name of an auger. It is sometimes written wummle and wimble.

WUMME, in *Geography*, a river of the duchy of Bremen, which runs into the Weser, about 6 miles N.W. of Bremen.

WUNALACHTIKOS, a tribe of Delaware Indians.

WUNNENBERG, a town of Westphalia, in the bishopric of Paderborn, which received its name from a victory which Charlemagne gained in the year 974 over the Saxons; 14 miles S. of Paderborn. N. lat. 51° 29'. E. long. 8° 7'.

WUNSCHELBERG, or HRADECK, a town of Silesia, in the county of Glatz. Here are manufactures of thread, cloth, and variety of stuffs; 10 miles N.W. of Glatz. N. lat. 50° 19'. E. long. 16° 15'.

WUNSCHUECH, a town of Stiria; 8 miles S. of Gratz.

WUNSEES, a town of Germany, in the principality of Bayreuth; 13 miles W. of Bayreuth.

WUNSIEDEL, a town of Germany, in the principality of Bayreuth, on the Fichtelberg; near it are mines of copper and iron, and quarries of marble; 34 miles E. of Bayreuth. N. lat. 50° 3'. E. long. 12° 3'.

WUNSTORF, a town of Westphalia, in the principality of Calenberg, the chief place of a county, which became extinct in the year 1533; 10 miles W.N.W. of Hanover. N. lat. 52° 27'. E. long. 9° 32'.

WUNT, in *Agriculture*, a term provincially applied to the mole.

WUNT-*Hillock*, a word signifying a mole-hill. See MOLE and MOLE-*Hill*.

WUNTZ, in *Geography*, a town of the county of Henneberg; 6 miles N.W. of Meinungen.

WURBEN, a town of Silesia, in the principality of Schweidnitz; 4 miles N. of Schweidnitz.

WURBENTHAL, a town of Silesia, in the principality of Troppau; 13 miles W. of Jajerndorf. N. lat. 49° 57'. E. long. 17° 15'.

WURFE, in *Commerce*, a denomination distinguishing a certain quantity of inferior silver coins in Germany; thus, a wurfe denotes 5 pieces of 17 or of 7 creutzers; and 12 wurfe of 17 creutzer pieces make 17 florins, and 12 wurfe of 7 creutzer pieces make 7 florins.

WURGLAU, or GUERGALA, in *Geography*. See WERGELA.

WURL, a river of Westphalia, which runs into the Ems, near Rietberg.

WURLITZHAIDT, a town of Germany, in the principality of Culmbach; 7 miles S.E. of Hof.

WURMBEA, in *Botany*, is dedicated by Thunberg to the honour of baron Frederick van Wurmbs, secretary to the Academy of Sciences at Batavia, whom he celebrates for great skill in Natural History, and other scientific pursuits, and who rendered him important services in his expedition to Japan.—Thunb. Nov. Gen. 18. t. 1. Schreb. Gen. 239. Willd. Sp. Pl. v. 2. 265. Mart. Mill. Dict. v. 4. Ait. Hort. Kew. v. 2. 325. Poiret in Lamarck Dict. v. 8. 802. Lamarck Illustr. t. 270. (Melanthii species; Juss. 47. Thunb. Prodr. 67.)—Class and order, *Hexandria Trigynia*. Nat. Ord. *Coronariæ*, Linn. *Junci*, Juss.

Gen. Ch. *Cal.* none; unless, like Thunberg, we take the corolla for such. *Cor.* of one petal, tubular, permanent: tube with six angles, abrupt at the base: limb in six deep, lanceolate, acute, equal, erect, or spreading segments, usually about the length of the tube. *Stam.* Filaments six, thread-shaped, erect, inserted into the mouth of the tube, and shorter than the limb; anthers roundish, of two lobes. *Pist.* Germen superior, triangular, furrowed, smooth; styles three, awl-shaped, triangular, the length of the stamens; stigmas obtuse. *Peric.* Capsule invested with the withered corolla, oblong, with three angles and three furrows, consisting of three cells, separating from the top half way down. *Seeds* numerous, round.

Eff. Ch. Calyx none. Corolla in six deep equal segments, with an hexagonal tube. Stamens inserted into the mouth of the tube. Capsule superior.

Obs. Under the genus MELANTHIUM, (see that article,) we have expressed a determination of reducing the present genus to that. By a casual oversight, however, the species which compose *Wurmbea* were there omitted. Having examined them with more attention, and particularly with respect to ORNITHOGLOSSUM, which the reader will find in its proper place, our opinion has changed. The latter genus, to which *Melanthium indicum* perhaps really belongs, has most resemblance to *Wurmbea* in habit, and in the general aspect of the *flowers*; though most widely estranged therefrom in its generic character, founded on the insertion of the *stamens*. If *Ornithoglossum* be retained, *Wurmbea* must. No difficulty attends its essential character, which is obvious enough, in the pale sexangular tube, abrupt or gibbous at the base, as if furnished with six small spurs. The Linnæan herbarium shews, that Linnæus himself had established the present genus, and dedicated it to his friend Sparrmann, by whom his specimens were brought to Europe. There is a singular remark in Thunberg, of *Wurmbea* having, " without all doubt," been produced from *Melanthium ciliatum*!

1. W. *pumila*. Dwarf Wurmbea. Willd. n. 1. (W. capensis α; Thunb. Nov. Gen. 19. t. 1. f. 7.)—Cluster of three

three or four flowers. Tube the length of the limb.—Native of the Cape of Good Hope, in fandy ground, at the foot of fmall hills, flowering in Auguft or September. The *root* is a fmall globular bulb, as in all the reft, funk deep into the earth. Whole *herb* but an inch high, with two or three fhort, fheathing, lanceolate *leaves*. *Clufter* hardly rifing above the foliage, of three or four, rarely more, erect white *flowers*, on longifh partial ftalks, not feffile, or fpiked, if Thunberg's figure be correct, like the other fpecies. The margins of the fegments of the *flower* are purple, and there are fpots of the fame colour juft above the mouth of its tube. The *ftamens* are white. *Thunberg*.

2. W. *campanulata*. Bell-flowered Wurmbea. Willd. n. 2. Ait. n. 2. (W. capenfis γ; Thunb. Nov. Gen. 19. t. 1. f. β. Lamarck f. 1. Melanthium monopetalum; Linn. Suppl. 213. Ker in Curt. Mag. t. 1291.)—Tube of the corolla bell-fhaped, the length of the limb, which is twice as long as the ftamens. Spike denfe, cylindrical.—Native of the fame country. Sent to Kew garden, by Mr. Maffon, in 1788. It flowers in the green-houfe in May and June. The *bulb* is ovate. *Stem* folitary, fimple, leafy, from three to five inches high; zigzag, tapering, and pale, in the part which is below the furface of the ground. *Leaves* three or four, alternate, widely fpreading, or recurved, much longer than the ftem, but not elevated above it, tapering, channelled, rather glaucous, fmooth; their bafe dilated and fheathing. *Spike* terminal, erect, two or three inches long, of numerous, feffile, white *flowers*, whofe limb is rather concave, its edges brown in our fpecimens, anfwering to Thunberg's defcription, though that circumftance is not expreffed in the Botanical Magazine. *Stamens* white, fpreading, not half the length of the limb, with yellow *anthers*.

3. W. *purpurea*. Purple Wurmbea. Banks MSS. Ait. n. 2. (W. capenfis β; Thunb. Nov. Gen. 19. Andr. Repof. t. 221. W. campanulata β; Willd. n. 2. Melanthium fpicatum; Curt. Mag. t. 694.)—Tube of the corolla much fhorter than the widely fpreading limb.—Native of the Cape. Sent to Kew in 1788, by Mr. Maffon. This has the herbage of the laft, but the *fpike* is rather more lax, and the *flowers* all over of a dark violet purple, except the yellow *anthers*, have a much fhorter *tube*, and longer *limb*.

4. W. *longiflora*. Long-flowered Wurmbea. Willd. n. 3. (W. capenfis δ; Thunb. Nov. Gen. 19. t. 1. f. α. Lamarck f. 2.)—Spike taller than the leaves. Tube of the corolla twice the length of the limb.—Found at the Cape of Good Hope, on fandy hills in various places. A taller larger plant than any of the preceding; its *leaves* much broader at the bafe. *Spike* three or four inches long, rather lax, many-flowered, with a zigzag angular *ftalk*. *Flowers* entirely white; their *tube* near an inch long; *limb* about half that length, widely fpreading. *Stamens* full half the length of the limb. That all thefe fpecies fhould have been confidered as varieties only, appears as ftrange as any other particular in the hiftory of the prefent genus. The Linnæan herbarium proves the *Melanthium monopetalum* of the *Supplementum* to be not this, but the *W. campanulata*.

WURMBERG, in *Geography*, a town of the duchy of Stiria; 6 miles N.W. of Pettau.

WURMSEE, a lake of Bavaria; 13 miles S.W. of Munich.

WURST, a Ruffian meafure. See WERST.

WURSUREE, in *Geography*, a town of Hindooftan, in Guzerat; 32 miles N.E. of Chitpour.

WURTEMBERG, late a duchy and now a kingdom of Germany, bounded on the north by the bifhopric of Spire, the palatinate of the Rhine, the county of Hohenlohe, and territories of the city of Hall in Swabia; on the eaft by the county of Limburg, the territories of the imperial towns Gemund and Ulm, and county of Oettingen; on the fouth by Auftrian Swabia, the territories of Furftenberg, Zwifalten, Rothweil, and the Brifgau; and on the weft by the marquifates of Baden Baden, and Baden Durlach: about 64 miles from north to fouth, and about as much from eaft to weft, comprehending about 3200 fquare miles. This kingdom confifts of a great number of counties and lordfhips, fome of which were purchafed, fome devolved to it by marriage, and others were acquired by conqueft. It is beyond difpute the moft confiderable and fertile part of the circle of Swabia, and may indeed be faid to be, after Saxony, one of the beft countries in all Germany. From its natural difpofition, the country confifts of three tracts, which are all remarkably different. Of thefe, the loweft and warmeft is the north, called Unterland, reaching from Heilbronn to Stuttgard. This duchy abounds fo in grain, that it exports confiderable quantities; but this grain is chiefly fpelt, rye and wheat being much lefs cultivated here. Of all the other forts of grain, however, here is alfo a fufficiency, even for export. Flax and hemp are alfo cultivated, and the former of thefe thrives beft in the cold parts. The valleys, fome of which are feven or eight miles in length, are covered as it were with forefts of fruit-trees, of which there is no fcarcity in the other parts of this country, cyder and perry being the liquors drank in common by the country people, when wine happens to be dear. This duchy abounds likewife in very rich, palatable, and wholefome wines, called by the general name of Neckar wines, though each has a particular title of its own, which it receives from the parts where it grows. The grapes alfo, which yield the beft wines, bear the appellation of the countries whence the fets were firft brought, as the Chiavenna, Valteline, Tyrolefe, and Hungarian. The vineyards of the duchy of Wurtemberg have been greatly improved by fhoots from France, Italy, Greece, Hungary, Cyprus, and even Schiras in Perfia. The cultivation of filk was revived under duke Charles. The forefts of this country are confiderably leffened. The confumption of oak, in particular, has been very large. The mountains of the Black foreft on the W. and thofe of the Alt on the S. and E., not only diverfify the face of the country, but fupply timber, food, and wines. Moft parts of the country abound in game; near Frudenftadt, and near Konigfwart, are mines of filver and copper; of filver at Konigftein, and of copper at Guttach: near Hornberg iron is alfo found. Of minerals, *terra figillata*, which is reckoned preferable to that of Malta, and a fine clay for earthenware, as alfo porcelain, which is worked at Calw; fine variegated marbles, fome of which are equal to thofe of Italy; and remarkably tranfparent alabafter, agate, cryftalline pebbles, black amber, or rather obfidian, fine mill-ftones, &c.: and at Sulz there are faltworks. Among the baths in Wurtemberg, the moft celebrated is that of the Wildbad. The principal rivers are, the Neckar, the Enz, and the Nagold. The number of inhabitants in this ftate is known to precifion, an exact inquiry being made every year by the general fuperintendants, and reported to the annual fynod; they are now about 600,000. The ftate contains 68 cities and towns, with about 1200 boroughs, market-towns, villages, and hamlets. The revenue is computed at 245,000*l.*, and the military force at 6000. The eftablifhed religion of this country is Lutheranifm, and though duke Charles Alexander embraced the Roman, yet in the years 1729, 1732, and 1733, he gave affurances to the ftates, in formal inftruments,

ments, that no change or innovation ſhould be made in the Lutheran religion in any part of the whole duchy, and that in all the churches and ſchools throughout the duchy, and the countries thereto belonging, no other religion than that of Lutheraniſm ſhould be taught: that no Catholic churches, chapels, altars, or images, ſhould be erected or ſet up, nor any ſuch as were decayed or forſaken again uſed. The Calviniſts only are tolerated here, and their place of worſhip at Stuttgard is a private houſe. In this duchy are alſo ſome Waldenſes, who are either huſbandmen or farmers, and live in the Italian villages, as they are called, ſome few towns alone excepted; where they have eſtabliſhed manufactures of hats and ſtockings, and are allowed the public exerciſe of their religion. The toleration of the Jews here was aboliſhed by an edict of duke Chriſtopher, that of two or three families at Stuttgard excepted, under the particular protection of the court. The church is governed by four ſuperintendants, ſtyled abbots, and 38 rural deans; a ſynod is annually held in the autumn. Education, and particularly that of eccleſiaſtics, is favoured by laudable inſtitutions; the ſeminary of Tubingen uſed to accommodate about 300 ſtudents; and at Stuttgard there is a public academy. Here are manufactures of pottery, glaſs, woollen, linen, and ſilk, which, with the natural products of the country, ſupply a conſiderable export. The imports are by Frankfort on the Maine. The chief city is Stuttgard, and the ſecond town is Tubingen. The other towns are numerous, but ſmall; and the villages are thickly placed in a populous and flouriſhing country. The origin of the princely houſe is ſomewhat obſcure and uncertain. It is certain, however, that there were counts of Wurtemberg at the beginning of the twelfth century. In 1802 Wurtemberg was created an electorate of the empire; and in 1806 was erected into a kingdom. The caſtle of Wurtemberg, which gave name to the duchy, is ſituated 4 miles E. from Stuttgard. By the treaty of Preſburg in 1805, the king of Wurtemberg acquired ſeveral important reſerves.

WURTZBURG, a town of Germany, in the county of Erbach; 3 miles E. of Erbach.

WURTZEN, a mountain of Carinthia; 8 miles S. of Villach.

WURWAMA, a town of Hindooſtan, in Guzerat, on the ſouth ſide of the gulf of Cutch; 40 miles N.E. of Noanagur.

WURWAY, a river of North Wales, which runs into the Vurney, 3 miles S. of Llanvilling, in the county of Montgomery.

WURZACH, a town of Germany, in the county of Waldburg, on the Aitrach; 26 miles N.W. of Kempten. N. lat. 48° 0′. E. long. 9° 52′.

WURZBACH, a river of Germany, which runs into the Klein Enz, 2 miles E. of Wildbad.

WURZBURG, a duchy, late a biſhopric, bounded on the north by the county of Henneberg and principality of Coburg; on the eaſt by the biſhopric of Bamberg, the margravate of Anſpach, and the county of Caſtel; on the ſouth by the county of Hohenlohe; and on the weſt by Mergentheim, county of Wertheim, electorate of Mentz, and the biſhopric of Fulda; about 80 miles in length, and 64 in breadth. The territory of Wurzburg is fertile in corn, paſtures, and divers ſorts of fruits and plants, as alſo in wine, the very beſt Franconian vines growing in it. The prevailing religion is the Roman Catholic; but there are alſo Lutheran and Calviniſt churches within the eccleſiaſtical juriſdiction and territory of Wurzburg, which from time to time preferred to the diets of the empire grievous complaints of oppreſſion and injuſtice. In the ſixteenth century, this biſhopric abounded with Proteſtant inhabitants. The biſhopric was not founded here till 741. In the year 1752, pope Benedict XIV. granted them the privileges of bearing the archiepiſcopal pall and croſs; but in other reſpects they were ſuffragans to the archbiſhops of Mentz. This prince and biſhop maintained five regiments of foot and horſe, military affairs being ſubject to the aulic council of war. In 1806 Wurzburg was ſecularized, ſoon after erected into a duchy, and given to the archduke Ferdinand. The number of inhabitants is computed at 200,000. By the treaty of Preſburg in 1805, the new kingdom of Bavaria, to which Wurzburg had been before aſſigned, acquired ſeveral important additions.

WURZBURG, a city of Germany, and capital of a duchy, late reſidence of the biſhop. It is ſituated on the Maine, well fortified, and defended by a fortreſs, ſituated on a rock without the town; in which fortreſs is an epiſcopal palace, and a church, ſuppoſed to be the oldeſt in Franconia. The town is divided into four quarters and four ſuburbs, in which are, a new palace, built in the beginning of the eighteenth century, a cathedral, ſeveral collegiate and pariſh churches, colleges, abbeys, and convents. The univerſity was founded in the year 1403; and, after falling to decay, reſtored again in 1582. In Auguſt 1796, Wurzburg was taken by the French, but given up to the Auſtrians the month following; 50 miles E.S.E. of Frankfort on the Maine. N. lat. 49° 50′. E. long. 9° 59′.

WURZELBAU, or WURTZELBAU, JOHN PHILIP, in *Biography*, a German aſtronomer, was born at Nuremberg in 1651, and being diverted from his ſtudies by a change of circumſtances, devoted himſelf to mercantile purſuits. But in the midſt of theſe occupations, he reſerved his ſpare hours for reading, and acquainting himſelf with the French, Italian, and Spaniſh languages. His chief attention was directed to mathematics and aſtronomy. In 1684 and 1685 he made obſervations on an eclipſe of the moon, which were printed; and in 1689 tranſmitted to the Royal Society communications pertaining to aſtronomy. In 1691 devoting himſelf more ſeduloully to the ſtudy of geometry and aſtronomy, the emperor Leopold, apprized of his merits, raiſed him and his heirs to the rank of nobility in 1692. In 1699 he was choſen one of the foreign aſſociates of the Academy of Sciences at Paris, and in 1706 he became a member of the Academy of Berlin. Declining a removal to Dreſden, with the offer of an annual ſalary of 1000 dollars and free lodging, he occupied himſelf in aſtronomical obſervations with inſtruments of his own invention and conſtruction; and he built, at his reſidence in Nuremberg, an obſervatory conſiſting of an octagon turret, covered with copper, and reſting on iron bars, which was placed on the top of the houſe, and which was moveable to every part of the heavens: it was furniſhed with an azimuth quadrant of five feet radius, a ſextant of ſix feet, and other inſtruments; of which obſervatory he publiſhed an account at Nuremberg, 1697, fol. He publiſhed alſo other works, ibid. 1713, fol. and ibid. 1719, fol. Having publiſhed ſolar tables, &c. he died at Nuremberg in 1725. He publiſhed alſo various obſervations in the Phil. Tranſ. vol. xv. xvi. xvii. and vol. xxx.; and alſo at Nuremberg. Montucla. Weidler. Gen. Biog.

WURZEN, or WURTZEN, in *Geography*, a town of Saxony, in the territory of Leipſic; the bailiwick of which extends over ſeventy-ſix villages, and twenty-two noble eſtates; anciently the ſee of a biſhop, but in 1661, the eſtates of the foundation were annexed to the Leipſic circle. The town is ſituated on the Mulda; though not large in itſelf, it is much increaſed by its fauxbourgs, which contain the

the citadel and cathedral. The beer brewed here is the chief article of trade, and is exported in great quantities; 14 miles E. of Leipfic. N. lat. 51° 19′. E. long. 12° 42′.

WUSEN, a town of Pruffia, in the province of Ermeland, on the Paffarg; 25 miles W. of Heilfberg.

WUSHUTEE, or MEECH, a general term applied to all that country of the province of Mekran in Perfia, lying to the weftward, and on the parallel of Punjgoor or Panger, and forming the northern boundary of the Sandy Defert. It is reprefented to be a mountainous diftrict, producing in fome of its villages grain, fufficient for the confumption of the few wandering fhepherds who inhabit them. Water is plentiful, except in April, May, and June; dates are alfo produced, and camels, fheep, and goats, are procurable, but not in great number. The people are rather a fmall delicate race: their arms are, a match-lock, fword, and fhield; and each village has its own chief, who fettles difputes that arife among the inhabitants.

WUSLACH, a town of Pruffia, in the province of Ermeland; 10 miles E. of Heilfberg.

WUSTENSAXEN, a town of Germany, in the principality of Wurzburg; 5 miles N. of Bifchofsheim.

WUSTERHAUSEN, a town of the Middle Mark of Brandenburg; 11 miles S.S.E. of Berlin.—Alfo, a town of the Middle Mark of Brandenburg, on the Doffe; 36 miles N.W. of Berlin. N. lat. 52° 53′. E. long. 12° 31′.

WUSTERSDORF, a town of Auftria; 9 miles S.W. of Laab.

WUSTHAL, a town of Germany, in the circle of the Lower Rhine; 4 miles N. of Rothenbach.

WUSTRO, a town of Weftphalia, in the principality of Luneburg Zelle, on the Jetze and the Dumme; 40 miles S.E. of Luneburg.

WUTACH, a river of Germany, which croffes the county of Stuhlingen, and runs into the Rhine, 10 miles below Lauffenburg.

WUTTOOR, a town of Hindooftan, in Dowlatabad; 6 miles E. of Junere.

WUTZKOW, a town of Hinder Pomerania: it is the laft poft ftage bordering on Poland; 30 miles E. of Stolpe.

WYACONDA, a river of Louifiana, which runs into the Miffiffippi, N. lat. 39° 46′. W. long. 91° 48′.

WYALUSING, a townfhip of Pennfylvania, in the county of Luzerne, with 576 inhabitants; 320 miles N. of Wafhington.

WYALUSING *Creek*, a river of Pennfylvania, which runs into the E. branch of the Sufquehanna, N. lat. 41° 40′. W. long. 76° 20′.

WYANDOT, a town of North America, belonging to the United States: a tribe of Indians called Wyandots inhabit the neighbourhood; 6 miles S. of Sandufky.

WYASTON, a village in the hundred of Appletree, Derbyfhire, England, fituated 3 miles from Afhborne, and 137 from London. In the year 1811 it contained 16 houfes, and 69 inhabitants.

WYAT, *Sir* THOMAS, in *Biography*, an Englifh poet, was the fon of Henry Wyat, efq. of Allington-caftle in Kent, and born in 1503. Having finifhed his education at Cambridge and Oxford, he travelled, as an envoy, into various parts of Europe, and acquired the favour of Henry VIII. whofe good will was of very fhort duration; for either from a fufpicion of his connection with Ann Boleyn, or the ill offices of Bonner, he was for fome time imprifoned. After his liberation he retired to his caftle of Allington, and being employed to conduct the ambaffador of Charles V. from Falmouth to London he was feized with a fever, of which he died at Sherburn in 1541. In an elegy on his death, his character was highly drawn in an encomium by the earl of Surrey, with whom he was intimate, as his fellow-labourer in polifhing Englifh poetry; though his ftrains are faid to have been inferior to thofe of the earl of Surrey. Mr. Warton diftinguifhes him by the appellation of the firft polifhed Englifh fatirift. His reputation was high, and Leland publifhed a book of Latin verfes on his death. His poems were printed with the editions of thofe of Surrey in 1559 and 1565, and fince by Dr. Sewel, in 1717. His verfion of David's Pfalms is much commended by Surrey and Leland; but it is not extant. Warton's Hift. of Eng. Poetry. Gen Biog.

WYBERTON, in *Geography*, a village and parifh in the wapentake of Kirton, Holland divifion of the county of Lincoln; 2 miles from Bofton, and 115 from London. It was returned in the year 1811 as containing 74 houfes, occupied by 353 perfons.

WYBOLDSTON, a village in the hundred of Barford, Bedfordfhire, England, fituated 8 miles from Biggleswade, and 2 miles from St. Neot's. The population is not feparately returned, being included in the parifh of Eaton-Socon.

WYBORG. See VIBORG.

WYBUNBURY, or WIBBUNBURY, a village in the hundred of Namptwich, county palatine of Chefter, is fituated on the borders of Staffordfhire, about 3 miles E. from Namptwich. The church is a handfome ftructure, and contains a great variety of monuments and other fepulchral memorials. A fchool was built here nearly two centuries ago by fubfcription; the endowments are but fmall, though increafed by occafional donations: the fchool is for boys, fome of whom are taught reading only, others reading, writing, and arithmetic. The population return of the year 1811 ftates this village to contain 76 houfes, and 353 inhabitants. The parifh of Wybunbury is very extenfive, and comprehends eighteen townfhips.—Lyfons's Magna Britannia, vol. ii. Chefhire, 1810.

WYCH-HOUSE, a houfe in which falt is boiled. (See SALT.) In the places where there are falt-fprings, and falt-works are carried on at them, the work-houfe where the falt is made is always called the wych-houfe; and hence we may naturally conclude that *wych* was an old Britifh word for falt, which is the more probable, as all the towns in which falt is made end in *wych*; as *Namptwych*, *Droitwych*, *Middlewych*, &c.

WYCHERLEY, WILLIAM, in *Biography*, was born at Cleve, in Shropfhire, about the year 1640; and in France, whither he went for his education, he conformed to the Roman Catholic religion. Upon his return to England a little while before the Reftoration, he entered, without matriculation, as a gentleman-commoner at Queen's college, Oxford, and leaving it without a degree, took chambers in the Middle Temple. However, he abandoned the law, and addicted himfelf to the compofition of comedies, the firft of which was entitled "Love in a Wood, or St. James's Park," which brought him into notice in 1672; fo that he became a favourite of the duchefs of Cleveland, and of Villiers, the duke of Buckingham. He was alfo honoured by the attention of the king, and by promifes of future promotion. His majefty, however, was difpleafed by his marriage with the countefs of Drogheda, and the connection was unhappy. On occafion of her death, however, fhe fettled her whole eftate upon him, and his title being difputed, he was involved in law expences and other incumbrances, which occafioned his being committed to prifon. Having remained in prifon for feven years, he was liberated by king James II., who, delighted by feeing his comedy of the

the "Plain Dealer," gave orders for the payment of his debts, and fettled upon him a penfion of 200*l.* a year.

His circumftances were ftill embarraffed, and though by his father's death he became a tenant of the eftate to which he fucceeded, he was not emancipated from his difficulties. Some time after he married a young woman, on whom he fettled a jointure of 1500*l.*, humouroufly ftipulating with her that fhe fhould not take an old man for her fecond hufband, which condition, it is faid, fhe promifed faithfully to obferve. He died in 1715, at the age of 75.

Befides the two comedies already mentioned, he compofed "The Gentleman Dancing-Mafter," and "The Country-Wife." The laft and the Plain Dealer are faid to be the moft noted. His plays, though commended by lord Rochefter, are ftrongly marked with his own character,—"fome wit and ftrength of delineation, with much coarfenefs and licentioufnefs." He attacks vice, it is faid, with the feverity of a cynic, and the language of a libertine. A volume of poems publifhed in 1704 was fo unfuccefsful, that he applied to Pope, who was a mere youth, to correct the verfification. Dr. Johnfon remarks, that "when Pope was fufficiently bold in his criticifms, and liberal in his alterations, the old fcribbler was angry to fee his pages defaced, and felt more pain from the detection than content from the amendment of his faults." The pofthumous works of Wycherley, in profe and verfe, were publifhed by Theobald in 1728, 8vo., but they are utterly forgotten. Biog. Brit. Johnfon's Life of Pope. Gen. Biog.

WYCK, John, was the fon of Thomas Wyck, a painter of fhipping and views of towns, of no very great celebrity, who was in England in the time of Charles II. John was born at Haerlem about the year 1640, and diftinguifhed himfelf as a painter of battles and fieges, and fometimes of huntings and proceffions. He imitated the ftyle of Wouvermans and Vander Meulen, but never obtained their neatnefs or finifh, though his colour is oftentimes very agreeable. His execution is better upon a fmall than a larger fcale. He died at Mortlake in 1702.

Wyck, in *Geography*, a part of the city of Maeftricht, on the E. fide of the Meufe, ftrongly fortified. See Maestricht.—Alfo, a fmall fea-port of Ruffia, on the W. coaft of the ifland of Efel.

Wyck *op Zee*, a town of Holland, near the fea; 3 miles W. of Beverwick.

Wyck *te Duerftede*, a town of Holland, in the department of Utrecht, fuppofed to be mentioned by Tacitus, by the name of "Batavodurum," and faid to have been built by Battus, prince of the Catti. It was granted, with its territory, to Rixfride, the feventh bifhop of Utrecht, and his fucceffors, for the zeal he had fhewn in converting the infidels. Trithemius relates, that it was anciently three leagues in circumference, and had 55 parifh-churches, and that it had been deftroyed by the Normans and Danes three feveral times; 13 miles S.E. of Utrecht.

WYCLIFFE, a fmall village and parifh in the wapentake of Weft Culling, North Riding of Yorkfhire, England, is fituated two miles N.E. from Greta-bridge; and in the year 1811 was returned as containing 26 houfes, and 140 inhabitants.

WYCOMBE, High, or *Chipping-Wycombe*, a large market and borough town in the hundred of Defborough, Buckinghamfhire, England, is fituated 34 miles S.S.E. from the county town, and 29 miles W. by N. from London, on the banks of a fmall river, which rifes at Weft Wycombe, and, in its courfe through this parifh, turns feveral corn and paper mills. A weekly market on Fridays has been held from time immemorial, and is a great mart for corn and other articles: here is alfo an annual fair. This borough has fent members to parliament from the 28th year of Edward I.: the right of election is vefted in the mayor, aldermen, bailiffs, and burgeffes; and the number of voters is about 180. Edmund Waller, the poet, was one of the reprefentatives in 1625; fir Edmund Verney, king Charles's ftandard-bearer, who fell at the battle of Edgehill, was elected to the parliaments of 1639 and 1640; and Thomas Scott, the regicide, was a member during the protectorate of Cromwell. The firft incorporation of the town appears to have been in 1461; but the mayor and aldermen are mentioned in a record of the reign of Edward III.: the earlieft charter now extant bears date 1586. The corporation confifts of a mayor, twelve aldermen, a recorder, and other officers; formerly here was a high fteward, but the office was annulled by a charter of Charles II.; yet fince that time it has been held (by virtue of former charters) by the earl of Bridgewater, lord-chancellor Jefferies, and the marquis of Wharton. According to the population return of the year 1811, the town contained 494 houfes and 2490 inhabitants: the parifh is extenfive, and includes feveral hamlets, which make an addition of 2266 to the population, and 449 to the number of houfes. The manor of Wycombe having paffed through a variety of families, was fold, together with the manors of Loakes and Windfors, or Chapelfee, by Thomas Archdale, efq. in 1700 to Henry Petty, lord Shelburne, who bequeathed all his eftates to his nephew, John Fitzmaurice, afterwards earl of Shelburne. His fon, who in 1784 was created earl Wycombe and marquis of Lanfdown, fold thefe manors by auction, which were purchafed by the prefent proprietor, lord Carrington. The manor-houfe of Loakes, fituated near the town, was confiderably enlarged and improved by lord Shelburne, and the marquis of Lanfdown beftowed much expence in laying out the gardens and pleafure-grounds. The houfe has been almoft wholly rebuilt by the prefent noble owner, from the defigns of James Wyatt: it is now called Wycombe-abbey. The parifh-church of High Wycombe is mentioned by Warton as having been built in the reign of Henry II.: the prefent fabric is of much later date, and the tower was built in 1522. Between the aifle and the chancel is an ancient oak fcreen, which, by an infcription, appears to have been put up in 1460, at the expence of the Redhead family. In the chancel is a monument to Henry Petty, earl of Shelburne, who died in 1751. It was executed by Scheemakers, at the expence of 2000*l.*, which was bequeathed by his lordfhip for that purpofe. In the fouth aifle is a very handfome monument by Carlini, for Sophia, countefs of Shelburne, (firft wife of the late marquis,) who died in 1791, with a female figure reclining on an urn. In the church are memorials of the families of Archdale, Lluelyn, Shrimpton, and Bradfhaw. William Bradfhaw, who died in 1614, was 103 years of age. In the church-yard is the tomb of Robert Williams, the late fexton, who died in 1793, at the age of 102. Two hofpitals for lepers were founded in this town in the early part of the 13th century: one of them was granted by queen Elizabeth to the corporation; and the lands are now applied to the maintenance of an hofpital or alms-houfe for poor people, and a grammar-fchool.

Wycombe, *Weft*, is a populous village and parifh in the hundred of Defborough, fituated about two miles N.W. by W. from High Wycombe, on the road to Oxford. It was anciently called Haverindon. The manor was from a remote period till the Reformation attached to the fee of Winchefter: the prefent proprietor is fir John Dafhwood King, who has a feat here, named Weft Wycombe-houfe, which was built by fir Francis Dafhwood, but was much enlarged,

enlarged, and furnifhed with a profufion of ornaments by his fon lord Le Defpencer. The parifh-church ftands on the fummit of a fteep hill, at a fmall diftance from the village, within the fcite of an ancient circular intrenchment. It was rebuilt in 1763, (except the tower and chancel, which are parts of a more ancient ftructure,) by lord Le Defpencer, who fitted it up in the Grecian ftyle: the ceiling is painted with Mofaic ornaments. Near the eaft end of the church is an hexagonal building, erected by his lordfhip. One fide of this building is infcribed to the memory of John, earl of Weftmoreland, and another to George, baron of Melcombe Regis, whofe legacy to lord Le Defpencer, for the purpofe of erecting a monument to his memory, was the caufe of his lordfhip's building this fingular maufoleum. Within it are feveral receffes for monuments, and niches for arms and bufts. The population of this parifh, in the return of the year 1811, is ftated to be 1362; the number of houfes 273. —Lyfons's Magna Britannia, vol. i. Buckinghamfhire, 1806. Beauties of England and Wales, vol. i. Buckinghamfhire, by J. Britton and E.W. Brayley, 1801.

WYDAW, a river of Denmark, which runs into the North fea, near Tondern, in the duchy of Slefwick.

WYDRAUGHT, a water-courfe, or water-paffage, to carry off the filth and fuillage of a houfe; properly a fink, or common-fewer.

WYE, in *Geography*, called by Leland, in his Itinerary, a "pratie market townlet," is now only a confiderable village of the county of Kent, England, as its market has been long difcontinued. In the Domefday-book it is written *Wi*, and by that appellation it was granted by the Conqueror to the abbey of Battle, in Suffex, which he had founded in remembrance of his victory over Harold, it having been previoufly a part of the demefne lands of the Saxon kings. "The Chronicles of Battle abbey affirm," fays Lambard, "that there were fometime two-and-twenty hundreths fubject to the jurifdiction of this manor." The extenfive grant of the royal manor of Wye, with all its appendages, liberties, and royal cuftoms, was confirmed to the abbey of Battle by different fovereigns, and it continued parcel of its poffeffions till the period of the diffolution. Queen Elizabeth, in her firft year, granted it, together with various eftates in the vicinity, to her kinfman, Henry Cary, lord Hunfdon, to hold *in capite* by knight's fervice. The church of this parifh was made collegiate by archbifhop Kemp, who was a native of the place, and is fuppofed to have rebuilt this edifice at the fame time that he founded the adjoining college, in the year 1447. It confifts of a nave, aifles, and chancel, with a large embattled tower at the fouth-eaft angle; the nave is feparated from the aifles by four pointed arches on each fide, rifing from eluftered columns; the chancel was rebuilt at the commencement of the laft century, and has a femicircular eaft end.

The ancient college, now the grammar-fchool, founded by archbifhop Kemp, ftands on the eaft fide of the churchyard. He endowed it for a provoft and fix fellows, "two of whom had an additional ftipend for the duty of the church, and care of a grammar-fchool," in which all fcholars, both rich and poor, were to be inftructed gratis. Another fchool was inftituted here about the year 1708, under a bequeft of lady Joanna Thornhill, who, among other charities to the poor of Wye, directed that the refidue of her eftates fhould be applied to the inftruction of their children. Sir George Wheeler added to this foundation, and gave the college as the refidence for the mafter of the grammar-fchool, and for the mafter and miftrefs of lady Thornhill's fchool. The college buildings form a quadrangle, and the old hall is a large vaulted room, now ufed for the fchool. The population of this parifh in the year 1811 confifted of 1322 perfons, who occupied 224 houfes. In this parifh is Ollantigh, where archbifhop Kemp was born in 1380, and where towards the end of his life he built a chapel, or oratory. Here alfo it is conjectured was born Thomas Kemp, bifhop of London, and nephew of the archbifhop. John Sawbridge, a patriotic alderman of London, was likewife a native of this place, where he was born March 17, 1732, and where he died in 1795. His fifter, Mrs. Macaulay Graham, an Englifh hiftorian, derived her birth from this place on the 23d of March 1731. (See GRAHAM, MACAULAY.) About one mile N.E. from Ollantigh, a Roman burying-place was difcovered in the year 1703, and feveral fkeletons, urns, and other veftiges of interments, have been difcovered, and are now preferved at Heppington, in this county.—Hafted's Hiftory, &c. of Kent, 12 vols. 8vo. Beauties of England, &c. Kent, by E. W. Brayley, 8vo. 1806.

WYE, a river of South Wales, is rendered particularly noted, in confequence of the high praifes beftowed on it by topographers, tourifts, and poets. The fhores of this famed ftream are diftinguifhed by bold, rocky, and woody fcenery, and adorned by feveral towns, feats, caftles, and abbeys. The poet Gray fays, "its banks are a fucceffion of namelefs beauties." Taking its fource on the fouth fide of the mountain called Plinlimmon, in Montgomeryfhire, within a quarter of a mile from the fpring-head of the river Severn, the river takes a courfe in general to the S.E. between the counties of Brecknock on the W. and Radnor on the E. Entering Herefordfhire, it winds by and partly through the capital of that county; and then turning fouthward, it forms the boundary between Gloucefterfhire on the E. and Monmouthfhire on the W., until it unites its ftream with that of the Severn, a few miles below Chepftow. At its fource, the fcenery is wild, romantic, and bare; but after defcending to Buallt, the fcenes are extremely beautiful. In the valley of Glafsbury, the ftream is fo confiderable as to have required in 1783 a ftone bridge of feven arches, which twelve years afterwards was fwept away by the floods. At Hay, where it enters Herefordfhire and receives the waters of the Dulas, the Wye is fo much increafed in the winter feafon as to be navigable for barges. From thence to Hereford it winds through a continuation of rich and beautiful fcenes, and paffes by many pleafant villages and country-feats. Bradwardine, a village, where in ancient times ftood a caftle, on the right or fouth bank, gave name to Thomas Bradwardine, archbifhop of Canterbury, who was ftyled from the depth of his learning "the profound doctor." About three miles lower down is Moccas-court, the modern refidence of fir George Cornwall, bart. About fix miles below Hereford the Wye receives the Lug, one of the three principal rivers of the county, flowing in general fouth-eaft from the borders of Radnorfhire. "Near the conflux of the Lux and Wye," fays Camden, "to the eaft, a hill called Marclay-hill did, in the year 1575, roufe itfelf as it were out of fleep, and for three days together, fhoving its prodigious body forward, with a horrible roaring noife, raifed itfelf, to the great aftonifhment of all beholders, to a higher place." Two miles below the influx of the Lug, but on the weft fide of the Wye, is Holme-Lacy, the ancient feat of the Scudamores, the heirefs of whom married the late duke of Norfolk. The manfion occupies the fcite of an abbey, which was founded in the time of Henry III. Five or fix miles lower down, and on the fame fide of the Wye, is Harewood, a remnant of the foreft of that name, felected

by

by Mafon as the fcene of his drama of Elfrida; for there Ethelwold, the confidante of king Edgar, had his caftle, in which the fair Elfrida was concealed. Five miles farther down, on the eaft bank of the river, is Rofs, confecrated in the poetry of Pope by his fafcinating defcription of what could be and actually was accomplifhed by the "Man of Rofs," with "five hundred pounds a year." The memory of this worthy man, John Kyrle, is preferved by a monument in the church of Rofs. On the weft fide of the river are the remains of Wilton caftle, a Norman ftructure, once the refidence of the Greys. Following the courfe of the Wye on the weft, on the fummit of a bold promontory clothed with wood appear the lofty towers of Goodrich caftle, of great antiquity; for in 1204 it was granted by king John to Marfhall, earl of Pembroke. The views from the caftle are extenfive and highly interefting. At Coldwell rocks the fcenery of the Wye is peculiarly grand, the prominences are overhung with oaks and fhrubs, and feparated by deep fhadowy dells. From Symond's-gate or Yat, the fummit of a lofty hill, the fpectator difcovers a fingularly grand view of the windings of the river, and its romantic banks. Soon afterwards, entering a fhort way into Monmouthfhire, the Wye bathes the walls of the capital, near which is Troy-houfe, the ancient feat of the duke of Beaufort, and affuming a fouthern direction, runs along the limit between that county and Gloucefterfhire. The courfe of the river, in the latter part of the range, is lefs irregular than that through Herefordfhire, but it is not lefs interefting. About a mile diftant from its eaft bank, on an eminence, ftands St. Briavel's caftle, once of great extent and great ftrength, erected by Miles, earl of Hereford, in the reign of Henry I. Lower down the ftream and on the weft bank is the curious village of Llandogo, difperfed among trees on the fide of a hill. Proceeding down the river by an eafy bending courfe, in the midft of very picturefque fcenery, appear the dilapidated and highly picturefque remains of Tintern abbey, at the opening of a valley on the weft bank. This venerable ruin is apparently inclofed by fteep hills and hanging woods, which are feparated by the broad ftream in the bottom. Paffing much fcenery equally beautiful, the eaft bank of the river prefents a fcreen of rocks, called Thorn and Black Cliffs, to which the tide reaches, and afterwards marfhy lands appear on both fides. Next appear the rocks belonging to the celebrated grounds of Piersfield. Thefe refemble the projecting baftions of a caftle, and powerfully reverberate founds that ftrike againft them. A little lower down is the Lover's Leap, a precipitous rock; and the next fweep of the river brings before the eye the noble remains of the caftle of Chepftow, perched on the fummit of a lofty perpendicular cliff, impending over the weft fide of the river. The fituation of the caftle and the town of Chepftow is peculiarly picturefque. The beauties of the fcene are, in the opinion of Mr. Wyndham, "fo excellent, that the moft exact critic in landfcape would fcarcely wifh to alter a pofition in the affemblage of woods, cliffs, ruins, and water." Chepftow caftle is undoubtedly ancient, and Roman-Britifh bricks are difcovered in the walls; but its foundation can be traced only to Fitzofborne, earl of Hereford, who erected it for the defence of the poffeffions he received from William of Normandy. Notwithftanding the height and rapidity of the tides at Chepftow, a bridge has long been eftablifhed there acrofs the Wye. It was formerly conftructed wholly of timber, but is now made of caft-iron. Although the tide be fenfibly perceived only about Tintern abbey, five miles above Chepftow, yet the water rifes in the river at this town to a very extraordinary height. Formerly not lefs than feventy feet, as it is afferted; but fifty-fix feet is the greateft rife obferved during the laft hundred years. The tide fetting up the Briftol channel from the Atlantic is, by the gradual contraction of its courfe, forced to fwell up in a very uncommon manner; and its progrefs is ftill farther impeded by the advance of the land on the north of the entrance of the Wye, up which river, as well as more directly up the Severn, it rufhes with peculiar force. In defcending the Wye from Chepftow, the high impending rocks have a very ftriking effect. At the conflux with the Severn, three miles below the town, the eftuary of the latter river appears, bounded by the diftant hills of Gloucefterfhire and Somerfetfhire. The general character of the river Wye is thus reprefented by Mr. Coxe: "It is diftinguifhed by its ferpentine courfe, the uniform breadth of its channel, and the fcenery of its banks. In the navigable part from Hereford downwards, the banks for the moft part rife abruptly from the edge of the water, and are clothed with forefts and broken cliffs. In fome places they approach fo near that the river occupies the whole intermediate fpace, and nothing is feen but wood, rock, and water: in others they alternately recede, and the eye catches an occafional glimpfe of hamlets, ruins, and detached buildings, partly feated on the margin of the ftream, and partly fcattered on the rifing grounds. The general character of the fcenery, however, is wildnefs and folitude: and if we except the populous diftrict of Monmouth, no river perhaps flows for fo long a courfe through a well-cultivated country, the banks of which exhibit fo few habitations." Large hoys fitted to navigate the Severn can, with the tide, afcend the Wye to Brookfwear, a populous village midway between Monmouth and Chepftow, where they receive from and transfer into fmall craft the various commodities with which they are loaded. The Wye as well as the Severn furnifhes a confiderable quantity of falmon.—Beauties of England and Wales, North Wales, by the Rev. J. Evans, 8vo. 1810. Ditto, Monmouthfhire, by J. Britton, 1808. Hiftorical Tour in Monmouthfhire, by the Rev. William Coxe, 2 vols. 4to. 1801. Obfervations on the River Wye, by the Rev. William Gilpin, 8vo. 1789.

Wye, a river of England, which runs into the Derwent, near Bakewell.—Alfo, a river of Maryland, which runs into the Chefapeak, N. lat. 38° 54′. W. long. 76° 20′.

WYENOKE, a town of Virginia.

WYERSDALE, Nether, a townfhip in the hundred of Amoundernefs, county palatine of Lancafter, England, is fituated four miles N.N.E. from Garftang, and was ftated in the return of the year 1811 to contain a population of 713 perfons, occupying 145 houfes.

Wyersdale, *Over*, a townfhip in the hundred of Lonfdale South of the Sands, Lancafhire, England, is fituated fix miles N.N.E. from Garftang, and in the year 1811 contained 154 houfes and 802 inhabitants. A colony of Ciftercian monks were for fome time fixed here, but about A.D. 1188 they removed into Ireland, and founded the abbey of Wythney.

Wyersdale *Foreft*. See Lancashire, *Forefts in*.

WYFFLERS, in *Military Language*, fubordinate officers in the Englifh infantry, whofe bufinefs, in the time of queen Elizabeth, appears to have been to drill the men, to inftruct them how to carry their arms, and to arrange them according to their ranks in proper order.

WYFORDBY, or Wyverby, in *Geography*, a fmall parifh in the hundred of Framland, county of Leicefter, England, is fituated three miles E. from Melton Mowbray; and in the population report of 1811 was returned as containing

taining 20 houſes, and 97 inhabitants. It includes the hamlet of Brentingby.

WYGBYGERA, a town of Sweden, in Angermannland; 30 miles N. of Hernoſand.

WYGELN, a high mountain of Norway.

WYHAM, a pariſh in the wapentake of Ludborough, in Lindſey diviſion of the county of Lincoln, England, is ſituated 7 miles N.N.W. from Louth; and was ſtated in the year 1811 to have a population of 87, occupying 10 houſes.

WYHOMICA, or WYHONIEC, a town of Lithuania; 20 miles N.N.E. of Pinſk.

WYK, a town of Sweden, in the province of Smaland; 65 miles N.N.W. of Calmar.

WYKA, a town of Sweden, in Dalecarlia; 14 miles S.E. of Fahlun.

WYKE, anciently denoted a farm, hamlet, or little village.

WYKE, in *Geography*, a tything in the pariſh of Worpleſdon, hundred of Woking, county of Surrey, England, is ſituated 6 miles W. by N. from Guildford, and was returned in the year 1811 as containing 30 houſes, and 125 inhabitants.

WYKE *Regis*, a pariſh in the hundred of the ſame name, in Dorcheſter diviſion of the county of Dorſet, England, is 2 miles W.S.W. from Weymouth. The population in the year 1811 was returned as 570, the number of houſes as 134. The church, which is the mother-church to Melcombe Regis, is a ſpacious building, with a lofty tower, ſerving as a land-mark. From this village there is a ferry to Portland iſle.

WYKE-*Hamon*, a pariſh in the hundred of Cleley, Northamptonſhire, England. The church is in ruins. The population is included with that of the adjoining pariſh of Wykens, or Wyke Dyve.

WYKEHAM, in *Biography*. See WILLIAM *of Wykeham*.

WYKEHAM, or *Wycombe*, in *Geography*, a townſhip in the hundred of Eaſt Goſcote, county of Leiceſter, England; 5 miles N.E. by N. from Melton Mowbray. The population, including the adjoining townſhip of Caldwell, was in 1811 ſtated to be 95, occupying 25 houſes.

WYKEHAM, a townſhip in the eaſt diviſion of the wapentake of Pickering Lythe, North Riding of the county of York, England, is 6 miles S.W. by W. from Scarborough; and in the year 1811 contained 87 houſes, and 511 inhabitants. About the year 1153, Pain Fitz Oſbert built and endowed a priory for Ciſtercian nuns at this place. At the diſſolution there were nine religious perſons in the houſe, with an eſtate of 25*l.* 17*s.* 6*d.* *per annum*. Henry VIII. granted the houſe to Francis Poole.

WYKEHAM, *Eaſt*, is a pariſh in the Wold diviſion of Louth-Eſke hundred, in Lindſey part of Lincolnſhire, England, ſituated 7 miles N.W. by W. from Louth. The church is in ruins. The population was ſtated, in the return of the year 1811, to be 23, the number of houſes 4.

WYKEHAM, *Weſt*, is a pariſh in the eaſt diviſion of the wapentake of Wraggoe, in Lindſey diviſion of Lincolnſhire, England, adjoining to the foregoing. The church is alſo in ruins.

WYKEN, a pariſh in the county of the city of Coventry, Warwickſhire, England, is 3 miles N.E. by E. from the city; and, according to the population return of the year 1811, contained 13 houſes, and 72 inhabitants.

WYKENS, or WYKE-DYVE, a pariſh in the hundred of Cleley, county of Northampton, England, ſituated 7 miles S.E. by S. from Towceſter, and 3 miles W.S.W. from Stony-Stratford, Bucks. This pariſh is united with that of Wyke-Hamon, and in 1811 the joint population was returned as 385, the number of houſes as 57.

WYL. See WEYL.

WYLAM, a townſhip in the pariſh of Ovingham, Tyne-dale-ward, county of Northumberland. In the year 1811 it contained 159 houſes, and 795 inhabitants; 9 miles W. from Newcaſtle.

WYLDE, JOHN, in *Biography*, the author, or rather the compiler of a tract on muſic in the MS. of Waltham Holy Croſs, now in the poſſeſſion of the marquis of Lanſdown, entitled "Muſica Guidonis Monachi." It is the firſt in the volume, but not written by Guido, as the title ſeems to imply, but an explanation of his principles; it is divided into two books, and appears to have been compiled by the præcentor of Waltham abbey, John Wylde, pr. "Quia juxta Sapientiſſimum Salomonem dura eſt." The author does not confine himſelf to the doctrines of Guido, but cites later writers. The baſis of the tract, however, is the Micrologus, and his other writings, in which he treats of the monochord, the ſcale, the harmonic hand, the explanation of which he calls *manual* muſic, eccleſiaſtical tones, ſolmiſation, clefs, with a battle between B flat and B natural, are the ſubjects of the firſt book, conſiſting of twenty-two chapters.

The ſecond book, or diſtinction, contains thirty-one chapters. In the firſt he ſpeaks of a Guido Minor, ſurnamed Augenſis, as a writer on the eccleſiaſtical chant. He had mentioned this author in the ſeventh chapter of the firſt book; but who he was, or when he lived, we are unable to diſcover. It ſeems, however, as if ſome ſuch muſical writer had exiſted, and that his name, by the ignorance or inattention of the ſcribes of ancient MSS., had been confounded with that of Guido d'Arezzo.

In ſeveral of the ſucceeding chapters he treats of intervals and their ſpecies, offering nothing new or ſingular, except where he draws a parallel between the tone and ſemitone, and Leah and Rachel, Jacob's wives, which, it is preſumed, will excite no great curioſity in our readers.

Attention is engaged, however, in the tenth chapter, by a "Cantilena," as the author calls it, of the Great Guido. It is a kind of ſolfeggio, or exerciſe for the voice, through all the intervals, which is only rendered valuable, perhaps, by the ſuppoſition of its having been produced by the celebrated author of the muſical alphabet. See SERRA.

WYLIA, in *Botany*, another new umbelliferous genus of profeſſor Hoffmann's, (ſee WENDIA,) dedicated by its author to Dr. J. Wylie, privy counſellor to the emperor of Ruſſia, inſpector of medicine and ſurgery in the Ruſſian army, &c. &c., author of a *Pharmacopæia Caſtrenſis Ruthena*, in which his highly commendable aim has been to indicate the medical properties, and to fix the names of the native plants of Ruſſia.—Hoffm. Gen. Plant. Umbellif. v. 1. 3. t. 2.—Claſs and order, *Pentandria Digynia*. Nat. Ord. *Umbellatæ*, Linn. *Umbelliferæ*, Juſſ.

Gen. Ch. *General Involucrum* of one ovato-lanceolate, membranous, half-claſping leaf, fringed with hairs; *partial* of five ovate, nearly entire, concave, two or three-ribbed leaves, bordered with a pellucid fringed membrane. *Perianth* of five minute teeth, permanent. *Cor.* univerſal irregular; flowers of the diſk perfect, fertile, as well as the female ones which form the radius; ſome male flowers are either interſperſed in the diſk, or diſpoſed in ſeparate umbels: *partial* of five petals; unequal in the flowers of the radius, the outermoſt very large, either obovate and flattened,

tened, or inversely heart-shaped, with a long claw; equal in those of the disk. *Stam.* Filaments five, thread-shaped, at first inflexed, and concealed in the hollows of the petals, afterwards prominent; anthers roundish. *Pist.* Germen ovate-oblong, more or less tapering; styles erect, thread-shaped, nearly equal, standing on a cup-shaped base; stigmas simple. *Peric.* Fruit linear-oblong, beaked, somewhat compressed, crowned with the erect, permanent styles, and their cup-like, slightly notched basis. *Seeds* two, linear-oblong, hispid, striated, the ribs elevated, continued into the beak with intermediate furrows; valves of the beak parallel to the fruit.

Eff. Ch. General and partial involucral leaves ovate. Flowers polygamous, radiant. Calyx five-toothed. *Fruit* oblong, somewhat compressed, beaked; valves of the beak parallel to the fruit.

Obs. The chief differences which have led professor Hoffmann to separate this genus from SCANDIX, (see that article,) appear to be the nearly entire leaves of the partial *involucrum*, which are laciniated in *Scandix;* the radiant *corolla*, and, as he says, the valves of the beak being parallel, not contrary to the fruit; that is, as we presume, compressed in a contrary direction in one genus to what they are in the other. For this we rely on the learned and judicious author not having materials sufficient to verify his observation. We must remark, that the *involucral leaves* in *Wylia*, though not laciniated, have a notch or two at the end, and precisely accord in texture with those of *Scandix*. Many of the umbels in this genus are simple, or occasionally two or three together, resembling a compound umbel.

1. W. *australis*. Southern Wylia. Hoffm. n. 1. t. 2. f. 1. (Scandix australis; Linn. Sp. Pl. 369. Sm. Fl. Græc. Sibth. t. 285, unpubl. See SCANDIX n. 6.)—Umbels simple, or in pairs, of few flowers. Radiant petals obovate, nearly entire. Beak of the fruit almost straight.—Native of fields in Italy and the Levant, as well as in Tauria, about Sudak, flowering in May. *Root* annual. *Herb* slender. *Stem* round, sometimes quite smooth, sometimes more or less hairy. *Leaves* triply pinnate, with linear acute segments, and hairy, or rather fringed *footstalks*. *Umbels* small and dense, on long stalks; the lower ones opposite to the leaves, solitary and simple; upper in pairs, rarely three together, and even in that case not constituting a real compound umbel, as an examination of specimens will readily shew. *Flowers* white, moderately radiant. Largest *petals* sometimes slightly emarginate. *Fruits* from six to ten perfected in each umbel, their beaks nearly or quite straight, quadrangular, rough with short erect bristles.

2. W. *radians*. Radiating Wylia. Hoffm. n. 2. t. 2. f. 2. (Scandix australis β; Marsch. Taur.-Caucas. v. 1. 424. S. falcata; Londes Journ. de la Soc. des Natural. de Moscou, for 1806, 57. t. 5.)—Umbels aggregate, from two to five, many-flowered. Radiant petals elongated, wavy. Beak of the fruit incurved.—Frequent in Tauria, flowering in May. This is considered by the authors who have described it as about equally related to the foregoing and to the *grandiflora*. We have no other guide than a beautiful engraving, copied by Hoffmann from the figure above cited, with the addition of the magnified and dissected fructification. By this it appears that the partial *umbels* are rather more numerously assembled, making more apparently compound *umbels*. The *flowers* are more conspicuously radiant. *Fruits* more numerous in each *umbel*, from twelve to twenty, with strongly incurved rough beaks. We confess ourselves unable to determine these two species clearly by the specific differences of professor Hoffmann, which we subjoin for the satisfaction of our readers.

W. *australis*, caule petiolis umbellisque hirsutis, corollis petalisque radiantibus obovatis integris.

W. *radians*, caule petiolisque pilosis, umbellis glabris, corollis petalis fructibusque radiantibus.

The hairiness is evidently variable, and the other characters, perhaps from some typographical error, do not contrast with each other.

3. W. *grandiflora*. Large-flowered Wylia. Hoffm. n. 3. t. 2. f. 3. (Scandix grandiflora; Linn. Sp. Pl. 369; see SCANDIX n. 10. Marsch. Taur.-Caucas. v. 1. 230.)—General umbels of from three to five very hairy rays. Radiant petals slightly emarginate.—Native of fields in Tartary and Georgia, flowering in May and June. Having discovered a specimen of this in our collection since the article SCANDIX was written, we are enabled to compare it with the descriptions of authors, and to select the following particulars:—The *root* is annual, tapering. *Stem* about a foot high, round, purplish, slightly branched, quite smooth in our specimen; Hoffmann says clothed with long hairs. *Leaves* much like the last; their *footstalks* somewhat hairy. *Umbels* terminal; the *general* ones sometimes on short stalks, each composed of from three to five long, slender, coarsely and abundantly hairy rays, with a leafy, simple or divided, linear leaf, in the place of a general involucrum. *Partial umbels* of numerous short smooth rays; their *involucrum* of several, mostly double-pointed, ovate, white-edged, fringed leaves. *Flowers* remarkably radiant; their largest *petals* obovate, not always emarginate, each furnished with a long claw. Beak of the *fruit* rather scaly, as Hoffmann delineates it, than hairy. His figures, in this and the other species, except *radians*, exhibit the parts of fructification only.

4. W. *iberica*. Georgian Wylia. Hoffm. n. 4. t. 2. f. 4. (Scandix iberica; Marsch. Taur.-Caucas. v. 1. 425. S. falcata; ibid. 230, excluding the synonym.)—General umbels of four or five very smooth rays. Radiant petals emarginate, with an inflexed point. Stem somewhat hairy at one side.—Native of Georgia. Annual. Very nearly related to the last in habit and size. The *stem* is, as in that, sometimes quite smooth. The rays of both general and partial *umbels* are said to be always very smooth. Radiant *petals* of a smaller proportion, and, as it seems to us, essentially distinguished by their sharp inflexed points. The beak of the *fruit* is described as marked with two hairy lines, and not hairy in every direction. We have seen no specimen.

WYLSTER, in *Geography*. See WILSTER.

WYMERING, a parish in the hundred of Portsdown, Hampshire, England, returned in the year 1811 as containing 121 houses, and 740 inhabitants; 4 miles W. from Havant.

WYMINGTON, or WIMMINGTON, a parish in the hundred of Willey, county of Bedford, England, is situated 12 miles N.W. by N. from the county town, and about 3 miles from Higham Ferrers, Northamptonshire. Wymington church, a fine structure, was built by John Curteys, then lord of the manor, and mayor of the staple at Calais, who died in 1391, as appears from an inscription on his tomb. The brasses of himself and his wife are on a slab of black marble under canopies, and are well preserved. The population of the parish, in the return of 1811, was stated to be 235, the number of houses 40.

WYMOA BAY, a bay on the S. coast of Atooi, one of the Sandwich islands. N. lat. 21° 57′. E. long. 200° 20′.

WYMONDHAM, or WINDHAM, a market-town in the hundred

hundred of Forehoe, and county of Norfolk, England, is ſituated 9 miles W.S.W. from Norwich, on the great road to London, from which it is diſtant 100 miles N.E. by E. This place has been ſuppoſed to be of Roman origin; and ſome writers have conſidered it as the Sitomagus of the Itinerary, though there are not the ſmalleſt traces to ſupport that opinion. The name is purely Saxon; and the conſequence of the town aroſe from the erection of a monaſtery here in the time of Henry I. A.D. 1130, by William de Albini, who amply endowed it with lands, which were confirmed with additions and privileges annexed by the reigning monarch. From the regiſter of St. Alban's, this religious houſe appears to have been originally founded as a cell for black monks of the Auguſtine order; and its annual revenues at the diſſolution amounted, according to Dugdale, to 211*l.* 16*s.* 6*d.* By the inquiſition made at that period, the monaſtery was found in a regular ſtate; and the abbot and monks in general were declared to have led blameleſs lives. The abbey-church was a large, handſome, cruciform building, erected ſoon after the year 1130. It conſiſted of a choir, nave, tranſept, north and ſouth aiſles, with a tower ſtanding in the centre, ſtill called the abbey-ſteeple, and another at the weſt end. When the monaſtery was deſtroyed, the ſouth aiſle, over which were lodgings for ſupernumerary monks, was demoliſhed: but the king granted the inhabitants leave to build another. Anxious to preſerve their noble church, they alſo obtained the following parts, which had been condemned by the act for removing ſuperſtitious buildings:—The abbey, ſteeple, veſtry, monks' lodgings over the ſouth aiſle, St. Margaret's chapel, the chapel of the Bleſſed Virgin, the chapel of St. Thomas à Becket, and the choir. Theſe were granted on condition that the inhabitants paid the king for the *lead* at the rate of 4*l. per* fodder, of twenty-four ſquare feet.

The preſent church conſiſts of a nave with aiſles, a large weſtern tower, and another at the interſection of the nave with the tranſepts. The ancient parts of the building diſplay ſemicircular arches with ſhort columns, large piers, &c. which appear to be parts of the original ſtructure. At the eaſt end, and on the ſouth ſide of the porch, are ſome fragments of walls. The north aiſle, porch, and towers, are of a much later ſtyle than the nave and ſouth aiſle. The church is curious, and highly intereſting to the architectural antiquary and draughtſman. In it is a large font, ornamented with bold ſculpture, and raiſed on ſteps. The remains of the founder were interred in the choir in 1156. The families of Albini, earls of Arundel, of Knevet, and of Clifton, are depoſited in this church. Several guilds were founded here, the revenues of which have been appropriated to other purpoſes. Wymondham pariſh is extenſive, and comprehends ſeveral hamlets, which are called the outſoken diviſion, whilſt the town is divided into ſeveral parts called the inſoken diviſion. Many of the inhabitants are employed in various branches of weaving. The diſtinguiſhed family of Wyndham, or Windham, derives its name from this place.

North of the town is Kimberly-hall, the ſeat of lord Wodehouſe. The houſe is ſeated in an extenſive and beautiful park, which contains a fine piece of water, and ſome noble maſſes of foreſt-trees. In the houſe is a portrait of Vandyck, by himſelf, when a young man.—Blomefield's Hiſtory, &c. of Norfolk, 11 vols. 8vo. Beauties of England, Norfolk; by J. Britton, 8vo. 1809.

Wymondham, a pariſh in the hundred of Framland, county of Leiceſter, England, ſituated 6 miles E. from Melton Mowbray, and 104 miles N.N.W. from London. It is very ancient, and was formerly ſurrounded with walls: the inhabitants ſtill poſſeſs an exemption originally granted to the duchy of Lancaſter. In the return of the year 1811, the population was ſtated to be 437, occupying 81 houſes.

WYMONDLEY, or Wymondesley, *Great*, a pariſh in the hundred of Brinkwater, county of Hertford, England, ſituated within three miles E.S.E. from Hitchin. The manor was given by William the Conqueror to a noble Norman, named Fitz-beck, by the ſervice of grand ſergeantry; that the lords of the ſaid manor ſhould preſent to the kings of England the firſt cup of drink at dinner on the day of their coronation: the cup becoming the property of the ſaid lords. This ſervice has continued with the manor: lieutenant-colonel Cracherood performed the office of cupbearer at the coronation of George III. The population of the pariſh was, in the return of 1811, ſtated to be 212, and the number of houſes 46.—Beauties of England and Wales, vol. vii. Hertfordſhire, by E. W. Brayley.

Wymondley, or *Wymondeſley*, *Little*, is alſo a pariſh in the ſame hundred, adjoining to Great Wymondley, and containing, in the year 1811, 34 houſes, and 188 inhabitants. A priory of Auſtin canons was founded here by Richard de Auguſtine, in the time of Henry III.: the ſcite was granted to James Needham, gent., clerk of the king's works, in whoſe deſcendants it continued till the death of George Needham, eſq. in 1726. It was then ſold to Samuel Vanderplank, eſq., and was lately the property of Chriſtopher Clitherowlſy, who married Mr. Vanderplank's granddaughter.

Wymondley-houſe, in this vicinity, formerly the reſidence of a private gentleman, is now an academy for the education of Proteſtant Diſſenting miniſters. This inſtitution originated at Northampton in 1729, by the endowment of William Coward, eſq. a Weſt India merchant. The celebrated Dr. Doddridge was the firſt tutor, which office he held twenty-two years. In 1752 the academy was removed to Daventry, and thence back to Northampton; and finally in 1799 to this place, having been previouſly united with an academy in London, under the ſucceſſive tuition of Mr. Eames, F.R.S., Dr. Jennings, Dr. Savage, Dr. Kippis, and Dr. Rees, ſupported by the ſame fund, and unfortunately for the intereſts of literature and ſcience diſcontinued. The library contains a valuable aſſemblage of upwards of 10,000 volumes of the beſt authors in divinity, criticiſm, claſſics, mathematics, topographical antiquities, &c. with a cabinet of medals, a collection of natural hiſtory, and other curioſities. This valuable library conſiſts principally of a rich collection of books, bequeathed by the late Rev. Mr. Miles, F.R.S., and appropriated to the London Academy, and augmented by numerous purchaſes.—Beauties of England and Wales, vol. vii. by E. W. Brayley. And Private Information.

WYNANTS, John, in *Biography*, an able and eminent landſcape-painter, born at Haerlem in 1600. Whether he were his own inſtructor or not does not appear, or how he qualified himſelf to attain that ſtation among the artiſts of his country which he ſo juſtly holds. His pictures are taken from the ſimple ſcenes of nature which ſurrounded his birth-place, and which he has repreſented with great vivacity and reality, though they ſometimes are overcharged in their contraſts of colouring. A ſandy bank, with broken patches of graſs and plants, with ſtunted trees beſide it, and a winding road paſſing over the bank, preſents from his pencil an agreeable and intereſting effect. Sometimes we find the entrance of a wood, with a cottage or hovel beſide

beside it, treated by him with great attention to the varied effect of colour in nature, and a dexterous management of chiaro-oscuro; and always with the most free and skilful touch, though generally upon a small scale. As he painted with facility, his works are not rare, though they bear a good price when in perfect preservation. Wynants established an academy, which produced many excellent painters. Among others of great celebrity, were Adrian Vandevelde and Philip Wouvermans, both of whom occasionally embellished their master's pictures with figures. He died in 1670, aged 70. He left numerous beautiful etchings of landscapes.

WYNNE, *Mrs.* CASSANDRA FREDERICA, the finest harpsichord player of her time. She was the daughter of signora Pompeati, the second female singer in Gluck's opera of "La Caduta de Giganti," performed in 1746, on the suppression of the rebellion; but though she nominally performed the part of second woman, she acted and sung in so masculine and violent a manner, that no female symptoms were discoverable. But this lady was better known afterwards by the name of Madame Cornellys, whose concerts, ridottas, assemblies, and masquerades, in Soho-square, were the gaiest and most fashionable amusements in London during many years.

The little Frederica, daughter of the Pompeati, was an élève of Paradie's, (some say his daughter,) and the first early player, the neatest, and the best which had ever appeared in our country during infancy, performing at six years old, with the utmost precision and firmness, propped up by cushions, the whole book of her master's twelve excellent lessons, probably composed expressly as progressive exercises for her use, with many lessons by Scarlatti and Alberti.

In 1769, when grown up, she went into Italy, where she was the wonder and subject of eloge in that mother and seat of arts. We have often heard her perform at different periods of her life, and continued to think her improved to the last.

WYNNE, ———, esq., a Yorkshire gentleman, one of the best dilettanti performers on the violin that we have heard. He was a man of fortune, and of an ancient family. To gratify his passion for music, he went into Italy early in life, where he married, and remained in different great cities till he had almost totally forgotten his mother-tongue. He likewise travelled through Germany, and having two daughters, he had always a music-master on his establishment, not only to instruct them, but to accompany himself. When he was last in England, he had Pfeifer with him for these purposes, a worthy German, and an excellent musician and performer on several instruments, who died in London of a consumption.

Besides being a good performer on the violin, Mr. Wynne had studied composition sufficiently to compose trios, which were far above the common run of trios at that time in point of taste and invention, and well put together.

WYNSBACH, in *Geography*, a town of Austria; 4 miles E. of Schwannastatt.

WYNSTER. See WINSTER.

WYOMING, a settlement and fort on the river Susquehanna. In the year 1778, this fort was attacked by a party of British and Indians. The garrison were soon overpowered, and fell a prey to Indian barbarity; after a bloody military execution of a great part, the rest were shut up in the barracks, to which they set fire, and consumed the whole; 2 miles above Wilkesbarre.

WYONOKE CREEK, a river of North Carolina, which runs into the sea, N. lat. 36° 30′.

WYRARDSBURY, or WRAYSBURY, a parish in the hundred of Stoke, and county of Buckingham, England, is situated near the banks of the Thames, 3 miles S.W. from Colnebrooke, and 3 miles N.W. from Staines, Middlesex. The manor belonged to the priory of Ankerwyke, in the same parish, which was founded in the reign of Henry II. for Benedictine nuns by Gilbert de Montfichet and his son Richard. In 1538 the priory was given to Bisham abbey, and after the dissolution it was granted to lord Windsor. Having afterwards reverted to the crown in exchange, it was given by Edward VI. in 1540 to sir Thomas Smith, the celebrated statesman, who resided at Ankerwyke. It was afterwards for many years the seat of the Salter family, of whom it was purchased by the Lees; and by marriage with an heiress came into the possession of sir Philip Harcourt, ancestor of the present proprietor, John Simon Harcourt, esq. There are no remains of the conventual buildings. Soon after the dissolution a mansion was built on the scite by lord Windsor, or sir Thomas Smith: the hall of this mansion still remains. Near the house is a remarkably large yew-tree, which at six feet from the ground measures thirty feet five inches in girth. In the parish-church are monuments of the Harcourt family; and also of Thomas Wright, esq. and Thomas Gill, esq. aldermen of London, who died within a fortnight of each other in the year 1798. The population return of the year 1811 states this parish to contain 120 houses, and 560 inhabitants. The parish was inclosed by an act of parliament passed in the year 1799: a parcel of the waste was allotted for the purpose of holding a fair on the Friday in Whitsun week, pursuant to ancient custom.—Lysons's Magna Britannia, vol. i. Buckinghamshire.

WYRE, a river of Lancashire, which runs into the Irish sea, 9 miles W. of Garstang. N. lat. 53° 53′. W. long. 2° 56′.—Also, a river of France, which joins the Semoy, 3 miles E. of Chiny.

WYRIL POINT, a cape of England, on the coast of Durham. N. lat. 55° 3′.

WYSAUKING CREEK, a river of Pennsylvania, which runs into the E. branch of the Susquehanna, N. lat. 41° 46′. W. long. 76° 27′.

WYSOCKS, a township of Pennsylvania, in the county of Luzerne, containing 619 inhabitants.

WYSOKIE, a town of Lithuania, in the palatinate of Brzesk; 16 miles N. of Brzesk.

WYSTIEZE, a town of Lithuania, in the palatinate of Brzesk; 8 miles N.E. of Brzesk.

WYSZOCK, a town of Lithuania, in the palatinate of Brzesk; 44 miles S.E. of Pinsk.

WYTA, or WITA *Plena*, signified a forfeiture of a hundred and twenty shillings. "Si pundbreche fiat in curia regis, plena wita sit; alibi, quinque marcæ."

To swear according to the wyte, *secundum witam jurare*, was to purge one's self by the oaths of so many witnesses, as the nature of the crime, and the punishment, or wyte, did require.

Hence, also, *bloodwite*, *legerwite*, *ferdwite*, *childwite*, *wardwite*, &c. See FERD-*Wite*, CHILD-*Wite*, &c.

WYTE, WYTA, or WITE, WITA, in our *Ancient Customs*, a pecuniary penalty, or mulct.

"Jurat secundum witam, quod nec fuerat furti conscius, nec coadjutor in eo." Leg. Inæ.

The Saxons had two kinds of punishments, *were* and *wyte*; the first for the more grievous offences.

The

The *wyte* was for the lefs heinous ones. It was not fixed to any certain fum; but left at liberty, to be varied according to the cafe.

Hence alfo *wyte*, or *wittree*, one of the terms of privilege granted our fportfmen; fignifying a freedom or immunity from fines or amerciaments: or, as it is vulgarly conceived, from being liable to be begged for fools, for lack of wit.

WYTHE, in *Law*, the fame as waif.

WYTHE, in *Geography*, a county of Virginia, between the river Kanhawa and North Carolina, with 8356 inhabitants, including 1157 flaves.

WYTHERS. See WITHERS.

WYTOOTACKEE, in *Geography*, an ifland in the South Pacific ocean, about 10 miles in circumference; difcovered by captain Bligh in 1789. S. lat. 18° 52′. E. long. 200° 19′.

WZETIN. See USETIN.

END OF VOL. XXXVIII.

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