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AND

NOTICES OF ALL PATENTS GRANTED FOR INVENTIONS.

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OF THE

ELEVENTH VOLUME, SECOND SERIES.

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An

Papers translated from Foreign Works.

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IN THE

ELEVENTH VOLUME, SECOND SERIES.

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THE

REPERTORY

OF

ARTS, MANUFACTURES,

AND

AGRICULTURE.

No. LXI. SECOND SERIES. June 1807.

Specification of the Patent granted to RICHARD FRIEND, *of the Broadway, St. Thomas's, Southwark, in the County of Surrey, Gun-Carriage-maker; for certain Improvements in the Construction and Working Gun and Carronade Carriages for Sea or Garrison Service; which Improvements are also applicable to many other Purposes.*

Dated Jan. 29, 1807.

With a Plate.

TO all to whom these presents shall come, &c. Now KNOW YE, that in compliance with the said proviso, I the said Richard Friend do hereby declare that my improvements in the construction and working gun and carronade carriages for sea or garrison service are as follow:

First, I so construct the carriage that the bed or bottom of it, when the gun is fired, shall slide back upon a slide or traversing platform, which I make (for a ship carriage) similar to the slide of a common carronade, with the addition of two iron plates for the wheels of the carriage to run upon, and is fixed to the ſhip's side in the same manner as the slide of a common carronade. For garrison service the slide is made similar to that for sea service, except that, instead of the plates at the fore-end of the slide, which are called breast-plates, I substitute an iron with two straps and an eye at the end, which I fix to a piece of wood fixed between the sides of the slide, extending to any length that may be required (or I fix it to the slide), the eye at the end hanging upon a pivot or bolt, fixed in the floor of the garrison; and the slide resting upon four wheels, may be traversed so as to point the gun in any direction. This slide, as also the slide for sea service, I hang in various other ways, as the nature of the ship or garrison may require.

Secondly. After the gun is fired, and the carriage is forced back upon the slide by the recoil, I raise the carriage upon four wheels by means of an iron spindle, with pinions upon it, and four iron levers or cranks, with cogs or teeth, at the end, which work in the pinions on the spindle, and the wheels running upon the plates of iron which I let into the slide, will enable the gun to be got forward again without tackle and fall or handspikes, and in considerably less time than the common carriage.

Thirdly. I make the carriage of two wood sides or brackets, a bed or bottom, and a transum or cross piece, framed together. I fix the iron spindle about the middle of the carriage, a little above the bed or bottom. It is made round, and passes through the sides or brackets, at the inside of which are two pinions of six (or any other convenient number of) teeth or cogs, and a half pinion of three (or any other convenient number of) teeth or cogs on the middle. The ends on the outside are made square to fix wrenches or handles to, to turn the spindle.

I fix

I fix the four iron levers or cranks to the bed or bottom of the carriage (by means of an iron bolt passing through them) two at the fore and two at the aft part of the carriage, on the inside of the sides or brackets. The two at the fore part I make with a hole at one end, through which, and along a groove or channel in the bed or bottom, an iron axle-tree passes; on the ends of which, at the outside of the levers or cranks, are two iron wheels. At the edge or circumference of the wheels is another hole, through which, and through the sides or brackets, and bed or bottom, a bolt passes, and serves as a bearing bolt or pivot for the levers or cranks to act upon, and also to hold the carriage together. The other end I make with three or any other number of teeth or cogs, which work in the pinions on the spindle. The two levers or cranks at the hind or aft part of the carriage, are made similar to the two at the fore part, only being reversed; that is to say, the hole through which the bearing-bolt passes is at the end; and the hole through which the axletree passes is at half the diameter of the wheel from the bearing-bolt; so that, by turning the spindle one way, the carriage will be raised upon its four wheels at once. I hold the carriage upon the slide by an iron pintail similar to that of a common carronade, the bottom part or body being round, with a T head or crutch, and which passes through the mortise or channel in the slide, the head or crutch hooking in the rebate underneath. The upper part or shank is square, and passes through a mortise in the bed or bottom; in the end of the shank is a mortise, and a brass roller fixed in it; through the mortise above the bed or bottom, and under the brass roller, passes a key or wedge, with a rack of three (or any number of) teeth or cogs at the end, which work in the cogs on the middle of the spindles; which, as it is turned, forces the key or wedge forward, so that the distance between the T head or crutch, and the key or wedge is lengthened in proportion as the carriage rises, and shortens again as the carriage is lowered. The iron wrenches or handles which turn the spindle, are held down by two hooks at the aft-end of the carriage, or by a latchet-wheel fixed to the spindle, and a pall fixed to the side or bracket (the iron spindle may be made square, and brass or other metal pinions fixed on it, instead of making it of solid iron). I fix an iron socket in the aft-end of the carriage for an iron bar to go into, to traverse the carriage any way. I fix breeching-rings, eye-bolts or loops, and cap squares, the same as to other carriages.

This carriage will not be so liable to decay as the common carronade carriage; as when the gun is housed it may be raised upon its wheels, which will let the air to it, and preserve the wood.

I also apply the aforesaid levers or cranks and spindle, to rope-maker's sledges, or to any thing heavy that is wanted to lie on a flat surface, and at times required to be moved, observing they must be proportioned according to the weight that is to be lifted, and the height it is to be raised.

The following reference to the annexed drawing for a ship carriage, will more fully explain the above specification.

Observe, the same figures and letters apply to plan, elevations, and sections, and the iron-work drawn separately by a double scale.

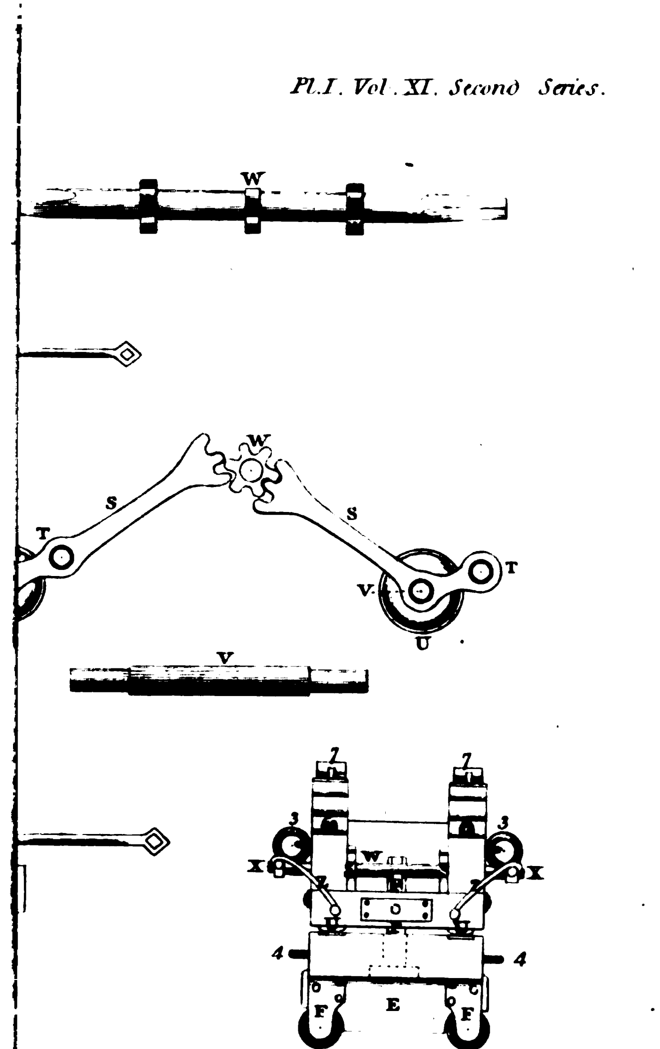
A A (Plate I.) are wood bearers which lay on the deck. B the chock which lies on the bearers A A, and is bolted to the ship's side or deck. C is an iron plate let into the chock B, and one the same on the underside. D is the slide or platform resting on the chock B. E is

E is a truck or hind block for the aft end of the slide D to rest upon. FF are iron plates let into the truck E, and two the same on the other side, with two iron wheels or rollers between them, to run upon the deck. GG are the breast-plates, which are let into the breast of the slide D, one at the top and one on the underside, and fastened on by six (or any other number of) rivets. H is the fighting-bolt, which passes through the front hole in the breast-plates GG, and through the front hole in the plates C, in the chock B, and hold the slide down upon it; I is the housing bolt which passes through the aft-hole of the bottom plate G, and plates C; this bolt is only to be used when the gun is to be housed and laid close to the ship's side. K K are iron plates let into the top of the slide D, for the wheels of the carriage to run upon. L is a mortise or channel in the slide D, and a rebate on the underside, with a plate of iron laid in it, of a convenient width and thickness. The letters M N N O constitute the carriage; M is the bed or bottom; N N are the sides or brackets; O is the transum or crosspiece framed into the sides or brackets N N, and a bolt passing through holds them together. P is the pintail which passes in the channel L, and through a mortise in the bed M and plates Q. R is a wedge or key with a rack of three teeth at the end, which passes under the brass roller in the pintail P, and at top of the bed M. S S S S are iron levers or cranks to throw the carriage on or off its wheels. T T are iron bolts which pass through the carriage, and through a hole in the levers for them to act upon. V V are iron axletrees which pass through a hole in the levers S S S S, and along a groove or channel in the bed or bottom M; on the ends are the iron wheels U U, which run upon the plates K K, and play up and down in holes cut in the bed or bottom

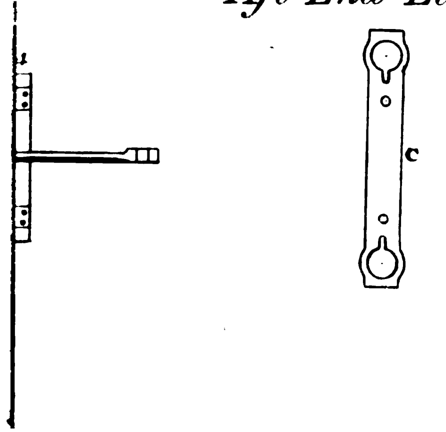
bottom M. W is a spindle with two pinions of six teeth (which work in the cogs of the levers SSSS); in the middle of the spindle is a half pinion, or three teeth or cogs, which work in the cogs of the key or wedge R; this spindle may be made square, and the pinions made of brass or other proper metal instead of iron; XX are iron wrenches which fix on the ends of the spindle W; YY are iron plates, through which the spindle W passes; ZZ are iron hooks to hold the wrenches XX down, which may be done by a latchet wheel on the spindle W, and a pall on the bracket N, instead of the hooks.

No. 1 is an iron socket in the aft end of the carriage. No. 2 is an iron bar that goes into the socket No. 1, to traverse the carriage any way. No. 3 3 are the breeching rings. No. 4 4 are eye-bolts or loops to lash the slide D fast. No. 5 5 are bolts which hold the slide together. No. 6 6 are eye-bolts or loops to lash the carriage fast. No. 7 7 are the cap squares which hold the gun in its place.

N. B. The wrenches XX when the gun is fired stand perpendicularly (or may be taken off) and the bed or bottom M lays flat upon and with the recoil slides back upon the slide D; when the gun is reloaded, the wrenches XX are pulled down to a horizontal direction, which turns the spindle W, and the cogs of the pinions working in the cogs of the levers SSSS, which bear or act upon the bolts TT, raise the carriage upon its four wheels, and at the same time the cogs on the middle of the spindle W force the key or wedge R from under the brass roller in the pintail P, so that the distance between the head or crutch of the pintail and the wedge R is lengthened in proportion as the carriage rises, and the hooks ZZ hold the wrenches XX down while the gun



Aft End Elevation.



gun is got forward, which, as before stated, may be done with ease without the use of tackle and fall, or handspikes, and in considerably less time than a common carriage. The traversing bar No. 2 is made to answer for a wrench X, as also are the wrenches X for the traversing bar No. 2, in case of either being any ways damaged.

In witness whereof, &c.

Observations by the Patentee.

Nothing surely can be a greater recommendation to a gun or carronade carriage for sea or garrison service than the few hands whereby the gun or carronade may be worked, (consequently leaving the more hands to work the ship, or for other supernumerary purposes,) the quickness with which the gun may be fired, and the small space of room which they take up in a ship or garrison, more particularly when these most valuable acquisitions can be obtained by such simple means as are described in my specification and drawings; by which it will appear that the carriage will take but little more room than the gun would of itself; and that by the simplicity of pulling down the wrench marked X, as shewn in the drawing, (which one man will accomplish with ease, for as the gun increases in length so the levers or cranks marked S increase in length, and consequently gain power in proportion to the weight of the gun,) the carriage will be raised upon its wheels, so that a gun of 30 cwt. may be pushed forward after firing by two men (or more in proportion as the gun increases in weight) in in less time than the common carriage, and without the use of tackle and fall, or handspikes. And in order that the seamen in the heat of an engagement may not fire the gun without lowering the carriage off its wheels, the hook marked Z or the pall (either of which may be applied) may be made to take off or to tie up, or may not be applied to the carriage at all, as may be found most convenient.

This carriage will be found very useful in case the gun should not with the recoil come sufficiently in port or inside the battery, as it may by raising it upon its wheels be brought in to reload with as little trouble as it is pushed out, so that the men will not be so much exposed to the fire of the enemy. The firing of the gun can take no effect whatever to injure the means whereby the gun is to be so easily worked.

I have a carriage of this invention, and a gun mounted, for the inspection of the public, at my manufactory, No. 11, Broadway, St. Thomas's, Southwark, where gun-carriages and agricultural implements of all descriptions, machines for working up old ropes into cordage to any length on board of ships, patterns for iron and brass founders, cart and waggon arms, tire and nails, and all sorts of smith's-work, are manufactured in the best manner, and on the shortest notice; and where any gentleman may be accommodated with materials, shop-room, and workmen, to execute any machinery under his own directions.

Specification

Specification of the Patent granted to JOHN MABERLY, *of Bedford Row, in the County of Middlesex, Gentleman; for making and constructing Tents, Poles, and other Machinery, so as to expel and carry off noxious and contaminated Air by a readier and more effectual Ventilation than can be accomplished by the Tents in common Use.* Dated March 7, 1807.

With Engravings.

TO all to whom these presents shall come, &c. NOW KNOW YE, that I the said John Maberly, in pursuance of the said proviso in the said letters patent, do hereby describe and ascertain the nature of my said invention, and in what manner the same is to be performed, as follows; that is to say: In the annexed drawings the same letters denote the same things throughout.

A (Plate II.) represents a cap or piece (made in preference of wood), of the form of a vase, or of any other suitable figure, of which Fig. 1 represents an upright section, and all the horizontal sections are circular.

Fig. 4. represents the largest horizontal section which is at or near the bottom of the vase. At D D, &c. are perforations which communicate obliquely with another central perforation E E, which is open at bottom, but does not proceed through the said vase at top. At B B and C C are certain sloped or conical surfaces surrounding the neck of the vase.

Fig. 2. represents, in a vertical section, the manner in which I fill up my tent poles. The external dark line represents an hollow pipe or cylinder of plate-iron, or other suitable metal; and the internal faintly shaded part represents a wooden tube or pipe, bored not quite through

 at

at the bottom, near N, where it is secured in the said pipe or cylinder by a pin, or by any other proper fastening. At H H are holes which pass through both the wood and metal, and communicate with the interior space G. And the lower part I of the metallic cylinder (where there is no lining of wood) is fastened by pins, or otherwise, upon the part K of the tent-pole K L, Fig 3.

Fig. 5. shews the upper part of a tent of the usual conical figure. The canvas of the same is securely fastened upon the conical surface B C (Fig. 1.) of the neck of the vase, and a piece of leather M is firmly fixed below the projecting part C, in order to cover and defend the place of junction from the weather. The tent-pole L being fixed in the socket I, is introduced by its upper part G, into the cavity E (which is lined with metal), where it bears against the shoulder F F, and supports the tent. Q Q represents part of the canvas which may be supposed to be continued to complete the tent. In the situation here described it will be easily understood that the heated air within the tent will rise to the vertex, or most elevated part of the said tent, where it will pass out through the holes H H, and through E and D D into the open air, and that by these means the ventilation will be promoted and kept up with more or less rapidity in proportion to the elevation of temperature; that is to say, in proportion to the necessity which there may be that the tent should be ventilated.

And I do hereby further declare, that in some cases I find it desirable to make, and I do accordingly make, my vase with a neck proceeding only to C C, and that I do in such cases fasten the tent-cloth to a separate piece or ring by itself; and the vase is not then attached or fixed to the cloth, as before; and I do also fix or make a shoulder or pin, or protuberance, at or near P, upon the

the metallic pipe or cylinder, for the purpose of supporting the tent by the said ring, instead of against the face or shoulder F F, as herein before first described.

And in the last described method of constructing and fitting up tents, according to my said invention, the tent-pole or poles is or are passed through the said ring; and the vase or vases A A is or are put on afterwards.

And farther, that in the construction of officers tents, or such as are not conical, I do pass the tent-poles, fitted up as aforesaid, and provided with the said shoulder-pin, or protuberance, at P, through two metallic rings, which are severally fixed and secured at the ends of the ridge-pole.

In witness whereof, &c.

Specification of the Patent granted to THOMAS PATY, *of St. Thomas's Watering, Kent Road, in the parish of St. Giles's, Camberwell, in the County of Surrey, Manufacturer; for a Method of spinning, dyeing, weaving, and manufacturing East India Sun-hemp into Carpets and Carpet Rugs.* Dated April 11, 1807.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso in the said letters patent contained, and the purport and true intent and meaning thereof, and of his Majesty's most gracious intentions, I the said Thomas Paty do by this instrument in writing, under my hand and seal duly executed, particularly describe the nature and process of the said method of dyeing, spinning, and manufacturing East India sun-hemp, which is done in the following manner. The sun-hemp must be taken from the bale as

 imported

imported from India, and dressed into three sorts on a cag and clearer: the first or longest sort is used for the purpose of being made and spun into yarn for the chain or warp of the carpet and carpet rugs. The second is in like manner spun into yarn, which is dyed and used for the pile of the carpets or carpet rugs. The third sort is spun into a coarser yarn for the shoot or weft. The yarn spun of the sun-hemp, for the purpose of being employed for the pile of the carpets or carpet rugs, is dyed in the skain various colours, such as blue, green, yellow, black, brown, purple, buff, red, mulberry, maroon, wood-green, and the various shades of these and other colours. And I particularly claim as my invention the application of the art of dyeing towards imparting the said colours and shades of colours to the sun-hemp of India, for which purpose I use the following drugs, dyeing stuffs, and materials, *viz.* cochineal, argol, old and young fustic, peach-wood, sumach, indigo, orchal, solution of tin, chamber-ley, alum, oil of vitriol, and copperas. The materials having been thus properly dyed and prepared, they are made in carpets or carpet-rugs in a loom, of whose component parts, and of the manner of using them, the following is a description. The outer frame consists of four posts, six feet six inches high, and four rails, five feet six inches long; but the length and breadth of the frame and loom may vary according to circumstances, and the size of the carpet or rug to be woven. The internal parts of the loom are, a breast-beam, a cloth-beam, and a yarn-beam; a harness made of twine with steel eyes, equal to thirty-two score of threads or yarn, which is sufficient for weaving a carpet three feet in width; for carpets of a greater width the harness must vary in proportion The reed is made of steel so as to

take

take two threads to a dent, equal to sixteen score of dents for carpets or carpet-rugs three feet in width. The hand-shuttle nine inches in length by four and a half in breadth, one pair of battens, bobbins for the different sorts of yarn, a sitting-bench, and two treadles, with a roller for the upper part of the harness, and pullies to be fixed higher or lower as occasion requires, are made in the usual manner. The warp or chain is in general dressed with starch made of flour and water, and in the beaming of it, is received through a raddle with iron teeth. The shuttle is worked by hand. The harness, consisting of four wings when at work, two wings being up and two down, parts two chains in half every time the shuttle passes through the centre. The pile is raised by means of a rod of iron, copper, or brass, with a sunk-in groove of about three-eighths of an inch. The rod varies from one and one-fourth of an inch to two inches in circumference, according to the length of pile required. The sun-yarn dyed and prepared for the pile is wound round the rod by hand, being threaded through every two threads of the chain or warp, and when struck up by the batten is cut with a sharp instrument down the groove of the rod; by which means the rod is immediately extricated from the dyed sun-yarn, the cut ends of which form the pile on the upper side of the carpet or carpet-rug. The shoot forms the ground or back. The rug or carpet is finished by chipping and trimming the pile with a pair of shears.

In witness whereof, &c.

Specification of the Patent granted to AMBROSE BOWDEN JOHNS, *of Plymouth, in the County of Devon, Bookseller; for certain Compositions, and a Mode of manufacturing the same, for covering and facing Houses and various other useful Purposes.* Dated December 22, 1806.

With Engravings.

TO all to whom these presents shall come, &c. Now KNOW YE, that in compliance with the said proviso, I the said Ambrose Bowden Johns do hereby declare that my said invention is described in the drawings and descriptions thereof hereunto annexed.

In witness whereof, &c.

Receipt No. 1. Take of limestone, or any other stone, powdered, or, what is preferable, road stuff, where stone is made use of for the purposes of making and repairing the road, and pass it through a sieve of moderate fineness, so as to let a sufficient quantity of sand pass with it: this may be ascertained by washing any quantity of the powder in clear water until you have deprived it of its earthy particles, by which means you will come at the quantity of sand that any given measure contains. The proportion of sand should never exceed one-half, otherwise you will have your composition too short, which is a great defect. Of this powder so prepared take six gallons, and add to it one quart of lime, which has been recently slacked; to it add a pint of the powder of burnt bones. When you have mixed the whole of these materials together, put them into the boiler, where they must remain until they are warm and dry: then add to them two gallons of tar, pitch, or resin, the former of which I prefer; boil them to a sufficient hardness for the purpose required: great care should be taken to prevent the burning

ing of the materials whilst boiling, by constantly stirring them, and for which purpose I have contrived an apparatus as shewn in the drawing A hereunto annexed. (See Plate II.)

Receipt No. 2. Take whiting, commonly called Spanish whiting, or lime that has been slacked for some time, or chalk reduced to powder, and pass any or either of these substances through a sieve of the same fineness as in No. 1, and to the material preferred add as much sand as will give a sufficient hardness for your purpose: of this take three gallons, and add to it one gallon of pitch, tar, or resin, proceeding in the same manner described in No. 1.

Receipt No. 3. Take clay of any kind, powder it, and pass it through a sieve as before described, add to it sand as above directed; of this take two gallons and a quart; add to it one quart of lime, which has been slacked for some time; to which must be added two quarts of tar, pitch, or resin, and boil it as before stated.

Receipt No. 4. Or take any calcareous or earthy substance, and add to it as much sand as you can without destroying its tenacity; then add to it one-fourth part of any pitchy or bituminous substance, and boil it as directed in No. 1.

When either of the above is boiled, you may toughen them by taking them out of the boiler on the hot plate B, in the annexed drawing, and by beating in them hair, hemp, or any other material of the like nature, in the same manner as hair is usually mixed with mortar when used for facing upright work; it must be mounted on paper, cloth, or similar substances.

The manner in which it is formed into sheets is as follows: when the composition is taken out of the boiler, and the toughening is beaten into it, you take a sufficient quantity to form your sheet of the size and thickness required, and work it into a long roll, on a sheet of lead, which

which must be kept warm by laying upon the hot plate B under which the flue to convey the heated air from the furnace passes; then beat it out into a flat sheet, and pass over it the preparatory roller, as shewn in drawing C, until you have made it of the thickness required.

When the sheet is thus formed, a board of sufficient size to receive the sheet when finished is passed through the rollers from behind, the nose of which board is chamfered away, so as easily to pass under the lead bearing the composition, which of course is still warm. The board bearing the composition on the lead is then passed back between the rollers, and comes out on the back side of the press, where are affixed cutters, as shewn on the drawing D, which are turned round by a pinion, taking in the great pinion which carries the rollers. These cutters slide on the bar, and may be put more or less apart as the sheet may be required of a greater or less width.

In all the foregoing receipts tar is preferred to any other bituminous substance.

Explanation of the Drawings.

(See Plate II.)

B, iron plate on which the lead rests. The shape of the bottom of the crock or boiler is marked by the dotted lines.

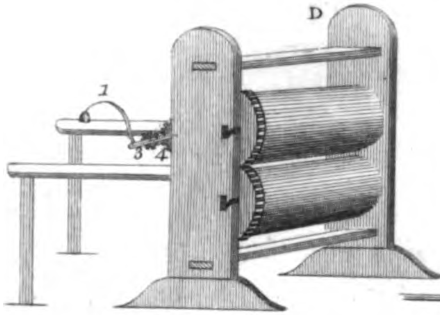
1, the lead which carries the cutters through the composition. 2, the bar, which being driven to and fro, drives the beaters in the boiler. The beaters are provided with flat iron plates at their feet, which travel on a pin, and scrape the bottom of the boiler. 3, the pinion which carries the cutters. 4, the pinion which carries the rollers.

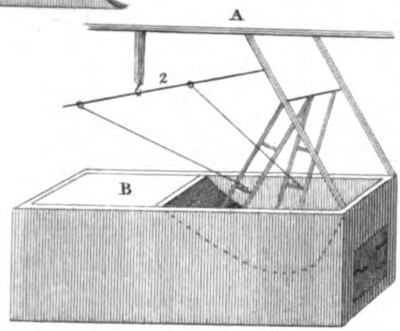
C, the preparatory roller loaded with stones.

W, the beaters on which the bar turn.

Specification

Pl. II. Vol. XI. Second Series.





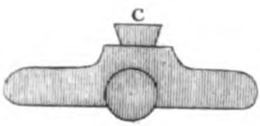


Fig. 5.

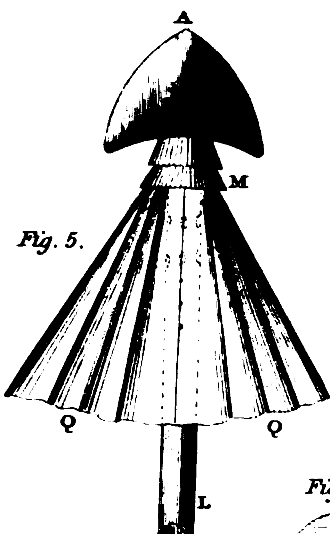


Fig. 1.

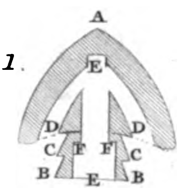


Fig. 2.

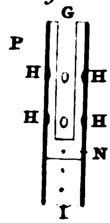
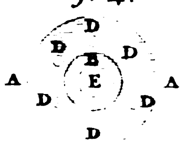


Fig. 3.

Fig. 4.



Specification of the Patent granted to John William Lloyd, *late of Brook-street, Grosvenor-square, in the County of Middlesex, but now of Bishop Wearmouth, in the County of Durham, Esquire; for an Invention of Antifriction Rollers or Wheels to assist all Sorts of Carriage Wheels.* Dated November 20, 1806.

With a Plate.

To all to whom these presents shall come, &c. Now know ye, that I the said John William Lloyd, in compliance with and in performance of the aforesaid proviso in the said in part recited Letters Patent contained, do by this present instrument, in writing, declare that my said invention is herein particularly described. Whereas the wheels of carriages commonly in their progressive motion turn around and bear upon a fixed axis or axle-tree, whereby very considerable heat and friction is occasioned to the axis or axle-tree, which greatly impedes the carriages so drawn, to the great strain and detriment of the animal or animals that draw them: Now, in order to prevent the aforementioned heat, and also to reduce the aforementioned friction occasioned by wheels turning round and bearing upon a fixed axis or axle-tree, I so form and contrive the axis or axle-tree, that it shall turn round with and bear between what I denominate antifriction rollers or wheels as described in the drawing Fig. 5. (Plate III.) which antifriction rollers or wheels I commonly caused to be made, and recommended to be made, in diameter as near one half the diameter of the wheel which they are meant to assist as may be found most convenient. If the diameter of the aforesaid antifriction rollers or wheels are increased beyond this rule, they will be inconvenient in various respects; if they are

 decreased

decreased the assistance they are meant to afford will be decreased also; but the dimensions of the aforementioned antifriction rollers or wheels may be varied according to the weight of the carriages they are applied to; the said antifriction rollers or wheels may be made of pig-iron cast, or of common iron, brass, mixed metal, or wood with a hoop round the rim, or of any other hard substance that may be thought more economical. The antifriction rollers or wheels may overlap each other, or their rims may face each other, as described in the drawing Figs. 5 and 18. Sometimes I cause the antifriction rollers or wheels to turn round on spindles, pins, or gudgeons (made of malled or pig-iron) as described in the drawing, Figs. 2 a, 2 d, and 4. Sometimes I make the antifriction rollers or wheels turn by pivots or axles, fixed through their centres; the points, ends, or extremities of which pivots or axles I introduce into and well secure in sockets firmly fixed in a frame, or some other steadfast, made of iron, or some other substance sufficiently strong to support them, as represented in the drawing, Figs. 12 and 18. When I cause the antifriction rollers or wheels to turn round by pivots or axes fixed through their centres and confined in sockets, as herein before described in the drawing, Figs. 12 and 18, I then commonly place such frame or steadfast under the bottom of the carriage which the antifriction rollers or wheels are meant to assist; and perhaps that manner of fixing them may be best suited to slow carriages, as carts and waggons. Antifriction rollers or wheels which turn on an axis, pin or gudgeon I commonly cause to be fixed on the bed of a mail-coach, or any other quick travelling carriage or gig, as represented in the drawings in Figs. 1 and 5. The axis, pin or gudgeon, whether it be fixed to the bed of the carriage or in any more convenient situation, must be fastened into

blocks

blocks of wood, or something as strong or stronger, and made firm by nut-screw bolts, wedges, iron staples, or iron bridges, as may be found most convenient. I sometimes, in order to strengthen the bed of the carriage and the blocks of wood affixed to it, cause a plate of iron or brass to be fixed thereon, with holes in the said plate of iron or brass, through which the shank of the axis, pin or gudgeon passes into the blocks of wood, and against which the shoulders of the axis, pin or gudgeon bear for additional support, as represented in the drawing, Fig. 3, to which plate I also sometimes fix a shelter to the antifriction rollers or wheels, as represented in the drawing, Fig. 16. I sometimes, the more to relieve friction, make the axis, pin or gudgeon with a tapering shoulder and screw, on a tapering socket (in form something like a cap or thimble), at the point of the axis, pin or gudgeon, into which the nave of the antifriction rollers or wheels enter, and thereby the antifriction rollers or wheels only bear on their extremities, and not on their centres; and to prevent the sockets unscrewing, I sometimes screw them through their sides by another screw, which binds against the axis, pin or gudgeon, and which method is preferable to a pin or lynch pin, that cannot bind more or less at pleasure, but which the cap-screws will do, and which caps I also sometimes fasten by nut-screws, as described in Figs. 2 a, 2 d, 10 and 11 in drawing. The antifriction rollers or wheels, from their construction and manner of action, do not require oil, but an oil-box may be let into the block attached to the bed of the carriage, as represented in the drawing, Fig. 17. In order to relieve the wheels of carriages from heating and wearing the fixed axle-tree as hitherto used, I cause the carriage-wheel and axis or axle-tree to turn round together, by means of a spring catch, bolt, pin-fork, or wedge, affixed to the naves of carriage wheels, which spring catch, bolt, pin-fork, or wedge, shuts into a notch, hole, or hollow, in the axis or axle-tree of the carriage wheels, which causes both axis and wheel to turn round together; but when the spring, catch, bolt, pin-fork, or wedge, is raised up from the notch, hole, or hollow in the axis or axle-tree, then the wheel only will turn on the axis or axle-tree as heretofore used, and then, by chaining the opposite wheel, a common drag is occasioned and formed as described Fig. 13 in drawing. The axis or axle-tree is formed as represented in the drawing, Fig. 13, and may be made of iron, brass, mixed metal, wood cased with iron, or of any sufficiently hard substance, the collars (to which I sometimes add a ring or washer), as represented in the drawing, Fig. 13, prevent the axis or axle-tree from driving or shifting from one side to the other, which is performed by the means of balls or rollers without a centre, fixed in a case or frame so as to turn all manner of ways, nut-screwed, bolted, or otherwise in the most firm manner possible fastened, to the bed or bottom of the carriage; but at the same time they must be fastened so as to be capable of being placed more or less wide as the placing and the dimensions of the antifriction rollers or wheels may require, on account of the said antifriction rollers or wheels being overlapped or not; which balls or rollers must be made of cast iron, brass, or mixed metal, or some other sufficiently hard substance, and being just free of the collar (with or without a washer), prevent both the collar and the ball from binding, heating, or wearing; and also the said balls or rollers, by being placed just free of the axis or axle-tree, prevent the axis or axletree from jumping or moving from its proper bearing, beneath and between, the antifriction rollers or wheels, as described in the drawing, Figs. 15 and 13.

In witness whereof, &c.

EXPLA-

EXPLANATION of DRAWINGS.

(Plate III.)

Figs. 1, the blocks attached to the bed of the carriage, to which the axis, pins, or gudgeon, and axle-trees, are fastened.

Figs. 2, letters *a* and *d* are axes, pins, or gudgeons, on which the antifriction rollers or wheels turn, either of which are to be used as may be most convenient.

Figs. 3, the plate through which the shank of the axis, pin, or gudgeon, letter *a*, Fig. 2, is supported in the blocks and bed of the carriage by screws.

Fig. 4, an axis fixed to the bed or frame of the carriage, fastened as a common axis or axletree is usually fixed, and on which the antifriction rollers or wheels may turn, if that method is preferred to turning on the axis, pin or gudgeon described Figs. 2, letters *a* or *d*; and if so then a pin or lynch-pin may be used.

Different descriptions of antifriction rollers or wheels are described Figs. 5, 6, 7, 8, 9.

Figs. 5, antifriction rollers or wheels with spokes.

Fig. 6, antifriction rollers or wheels concave on both sides.

Fig. 7, antifriction rollers or wheels neither convex nor concave on either side.

Fig. 8, antifriction rollers or wheels convex on one side only.

Fig. 9, antifriction rollers or wheels convex on both sides.

Fig. 10, the cap which screws on to the axis, pin or gudgeon, Fig. 2, letter *a*, and thereby keeps the antifriction rollers or wheels on the axis, pin or gudgeon, instead of a wedge-pin or lynch-pin.

Fig.

Fig. 11, the small screw which screws through the side of the cap Fig. 10, to prevent the cap unscrewing, and which answers to a nut-screw.

Fig. 12, the frame or steadfast, with sockets, in which the antifriction rollers or wheels are placed when they turn by pivots fixed through their centres; the antifriction rollers or wheels with pivots are described Figs. 18, 18.

Fig. 13, the axis or axletree with collars, shoulders, and a fork-notch or hole.

Fig. 14, the catch, spring-bolt, wedge-pin, or lynch-pin.

Fig. 15, the frame or case in which the ball or roller without a centre turns all manner of ways.

Fig. 16, the fence or shelter to the antifriction rollers or wheels which may be used if thought necessary.

Figs. 17, places for an oil-box or funnel to be placed if necessary.

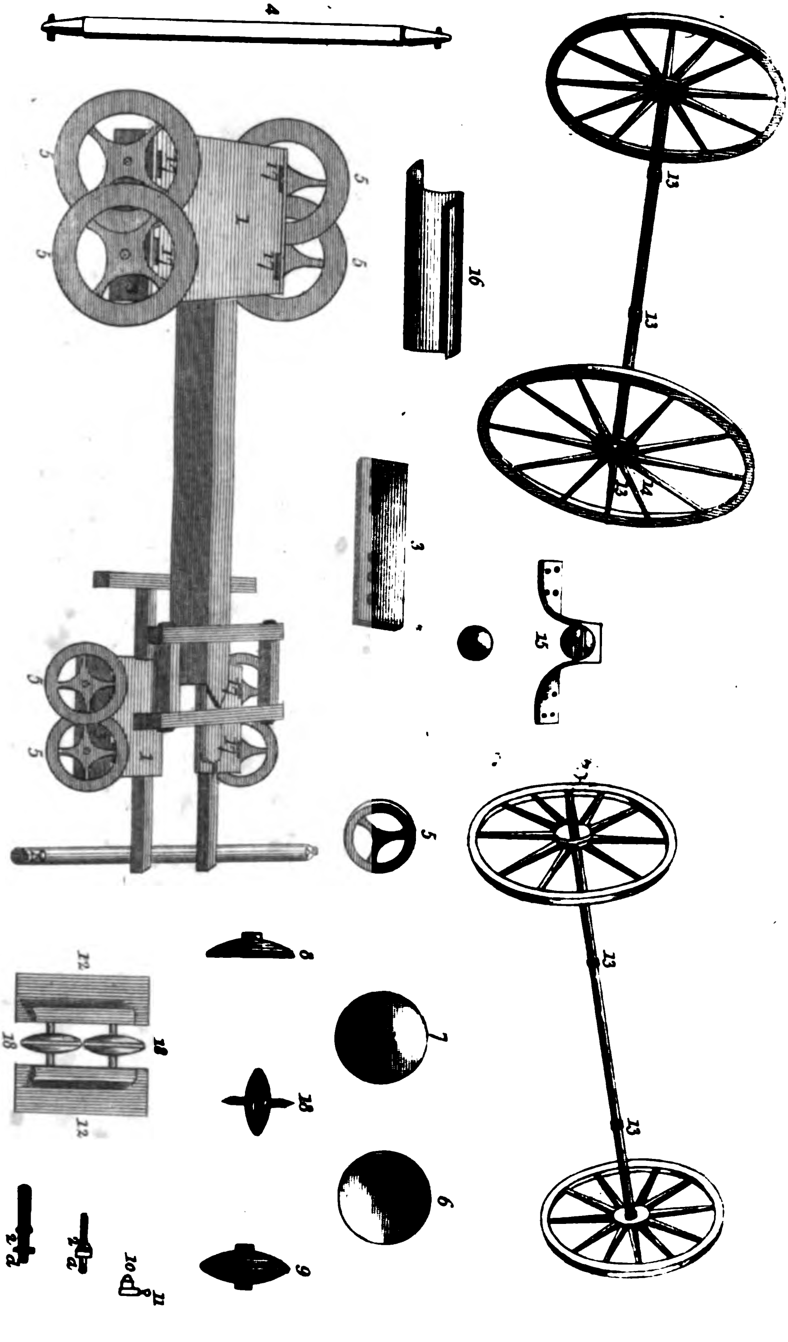
A new Method of ascertaining the Rate of the Velocity of a Ship under Sail. By Mr. J. W. Boswell.

Communicated to the Editors by the Author.

Gentlemen,

I SEND you the following account of a method of ascertaining the rate of the velocity of a ſhip under sail, which occurred to me about three years ago, and which I have often considered since without seeing any reason to alter my first opinion of its superiority to the usual method.

In stating any contrivance as perfectly novel, every one must in some degree run the risk of repeating what has occurred to others before, notwithstanding the utmost care which may be taken to obtain information on the subject from books, or colloquial enquiries, as it is absolutely impossible to be certain that the object of the



search has after all escaped discovery. If, however, any contrivance similar to that which is the object of this communication has been at a former period laid before the public, I can at least truly aver that I never have had the smallest intimation of it, or most certainly I should here state what I knew respecting it.

The usual method of determining the rate of a ship's velocity is, by throwing the implement called the log into the sea. which is contrived so as to make resistance sufficient to draw out a line attached to it, from a reel; the line has marks fastened to it at regular distances, and by the number of them drawn out in half a minute, the rate of the ship's way in any given time is ascertained.

The trouble of drawing in the line, and coiling it again on the reel, must render a frequent repetition of this process not a little disagreeable; and yet it is obvious that with winds of variable force, which are most common, if the rate of going is not frequently taken, the accuracy of the ship's reckoning cannot be much depended on.

A variety of mechanical perpetual logs have been invented, some of which are described in the collection of papers on Naval Architecture, published by the late Mr. Sewell, but none of them have been found to be of any considerable utility, and all were complicated and expensive. Some contrivances for ascertaining the rate of a ship's way by the rising of water in pipes, (placed so as that their contents should receive an impulse from the sea as the ship passed,) have been also made; and three methods are described in the sixth number of your very useful publication, the "*Retrospect of Philosophical and other Discoveries*," the defects of which there pointed out, shew that they are not sufficiently accurate for the purpose required.

The

The method which I have to propose for this operation is very simple, and of no charge whatever, and so like that to which sailors are used, that at least no objection can be made to it on account of its strangeness, difficulty, or expense.

The principle on which the efficacy of this method is founded, is the well known proportion which the resistance of any body moved through water bears to the velocity of its motion, which has frequently been determined to be equal to the square of the velocity.

The apparatus which I propose, may be a common log and line attached to one of the instruments for weighing by a spiral spring, sold at every ironmongers for a trifle; or, instead of this, a Roman statera may be used for the same purpose, or a common pair of scales; but to them the line should be fastened after passing under a small pulley. Instead of the common log, an instrument formed of a stick, like a walking stick, with four or more sheaves attached to it, at about the distance of a foot from each other, by thrusting it through their perforations would probably be better, as it would make more resistance in the water; any flat pieces of board would do as well as the sheaves, and they are only mentioned as being always at hand in ships.

Suppose now the last-mentioned implement drawn after the ship by a line, attached to whichever of the weighing instruments should be most convenient. It is evident that the resistance it would make to following the ship would support a certain weight on the statera, or scale, or contract the spring of the spring apparatus, in proportion to the velocity of the motion of the ship.

The quantity of this weight, at a certain velocity of the ship's motion, should be first ascertained by repeated trials, in which the common log might be used, to determine

mine the rate of the ship's way: and using these numbers afterwards as a standard of comparison, the actual velocity of the ship might be easily determined at any future time by merely finding the weight which the resistance of the new log, or implement described, was equal to, and extracting the square root of the number that denoted it; which would bear the same proportion to the number of miles which the ship then moved in an hour, that the square root of the weight in the standard experiment bore to the number of miles the ship was found to move in an hour by observation at the time of the experiment.

Thus, for example, suppose the resistance of the implement, or log, was found to balance four ounces at the time of the experiment, when the ship moved forwards three miles in an hour; if, at a future period, the weight which it raised was found to be sixteen ounces, the rate of the ship's way would then be six miles in an hour; for four, the square root of sixteen, is to six, in the same proportion that two is to three, or the weight raised by the resistance of the log to the rate of the ship's velocity in the standard experiment. Again, if the weight raised was nine ounces, the rate of the velocity would be $4\frac{1}{2}$ miles; if 25 ounces, $7\frac{1}{2}$ miles; and if 36 ounces 9 miles in an hour.

As in the standard experiment the resistance of the log might be diminished or increased at pleasure (by altering the quantity of its surface opposed to the water), it would much facilitate the computations to be made afterwards, if this were done until the number of ounces of the weight raised were a square number, as thus fractions would be in a great measure avoided.

Tables might also be easily constructed for this apparatus, by which the rate of the ship's way would be found at once, by looking for the weight raised in an opposite column, the standard experiment being first noted.

To prevent the pitching of the ship from affecting the computation, it would be best to have the instrument for ascertaining the resistance of the log placed as near the centre of motion of the ship as possible.

And as the rolling of the vessel would probably make weights and scales inconvenient to ascertain the resistance of the log, the common spring implement for weighing, or some other which was governed by a spring, so as to produce equal or superior accuracy, would be probably the best to use generally.

If the line let out were very short, the impulse of every wave might make some alteration in the weight; it would therefore be necessary to use a line of considerable length. It might also be a precaution of some use to wet the line well before taking the weight; as its variable length when wet and when dry might make some difference; after this remark it is almost needless to observe that the same length of line used in the standard experiment, should be always used afterwards.

As this method of ascertaining a ship's way is very easily tried, and might even afford some amusement in the long intervals of dull uniformity which sometimes occur in long voyages, it is to be hoped that some unprejudiced commander of a vessel may be found who will think it worth his attention: and if he should find it of the utility it appears to me to possess, he will obviously benefit the sea-service by making public the results of his experiments on the subject.

I am, Gentlemen,

Yours, &c.

JOHN WHITLEY BOSWELL.

Account

Account of a Method of cultivating Carrots, and applying them as Food for Cattle. By JOHN CHRISTIAN CURWEN, *Esq. of Workington-Hall, in Cumberland.*

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

The Gold Medal was voted to Mr. CURWEN *for this Communication.*

IN Mr. A. Young's valuable and interesting Report on the Agriculture of Suffolk, I was much struck with his account of the culture of carrots, and the advantages resulting from the application of them as food for horses.

From the very general opinion which prevails, that none but particular soils are applicable to the growth of carrots, the culture of them to any extent has been confined to small districts. I presume, therefore, that it may not be unacceptable to the Society to be informed of the success of trials in this matter upon a stiff loam, partaking in a great measure of clay.

Mr. Young's observations are confined to sowing by broad-cast, which can be successful solely in sandy soils. The method I have pursued has been to trench plough, and stitch up the ground intended for carrots, as soon as it was clear, leaving it in that state during winter, which greatly facilitates its working in the spring. In April I break it up by giving it three or four ploughings, harrowings, and rakings, which bring it into garden tilth. Previous to the last ploughing, I give from ten to fifteen cart-loads of ashes *per* acre. The second week in May I have it stitched up, and made ready for sowing; allowing three feet between each stitch; and I throw the ridges as high as they can be put. The top of th stitches are smoothed with a very light roller, so as to admit of a furrow being drawn with a hand-hoe.

The seed, ten days or a fortnight before it is used, is mixed with wet sand, and placed in some warm situation, so as to be in a full state of vegetation before it is sown. A fortnight is gained by this method, and the carrots are less liable to be injured by the weeds. The plough and harrow are kept at work during the whole summer. The plants are twice hand-weeded, and afterwards thinned. The expense attending this is considerable, but the value of the crop amply compensates it.

In 1804 I had an acre and a rood, which had been previously occupied by cabbages, and afterwards by tares. The soil was very heavy and strong. The tops of this crop were so abundant, that they would have fed twenty head of cattle for a month. I began cutting them too late, by which means I lost a great part. It is essentially necessary to get the carrots dry, to enable them to keep. I endeavour, if the weather be favourable, to have them up by the first or second week in October. I employ women to take them up with forks, which costs 10 *l.* The crop yielded 829 Winchester bushels, equal to 4143 stone (of 14 pounds). Estimating the carrots at 6*d.* *per* stone (the price of oats at that time) they were worth to me 103*l.*

Each working horse in my employ is allowed 8lb. of oats *per* day. One half was taken away, and supplied by an equal weight of carrots, and this was continued while they lasted. The general opinion was, that the horses improved in their condition upon this food.

In 1805 I had three acres and three roods of a similar soil sown with carrots, which had previously borne a crop of oats. The first part of the season was uncommonly cold, and afterwards unusually wet, which checked the

the growth of the tops, so that they never got to any size, and were eaten off by sheep. In order to facilitate the work, and at the same time to save expense, I made a trial of the plough to take off the earth from the carrots, and then setting in and turning them up.

The injury was trifling, and the expense not a tenth part what it had been. There were 108 carts, of 80 stone each, or 2246 stone *per* acre, which, at 6*d.* *per* stone, would amount to 60*l.* and upwards *per* acre. I have made use of them as in the preceding year, with the most complete success, and saved 60 bushels of oats *per* week, and shall be able to continue to do so for a fortnight or three weeks longer.

In the first trial an acre of carrots was equal in food to 23 of oats, allowing 60 Winchester bushels of oats *per* acre, and at three stone the bushel. On taking up the carrots a small piece was cut from the top of each, to prevent it from vegetating, and these were immediately used. The remainder were piled in rows two feet thick, and five feet high, leaving a space between each row for a free circulation of air. I do not doubt but that they would keep in this way for a length of time. I have always made immediate use of them, as old oats are more valuable than new, and, moreover, the saving of oats is in itself a matter of much import.

The success of these trials has determined me to extend the cultivation of carrots, and I have prepared ten acres for the ensuing season.

Mr. Young recommends carrots as a substitute for hay: when they can be procured with little or no expense, this may answer; but when the ground is to be prepared for them at a considerable expense, cheaper substitutes may be found. Though the expenses are great in cultivating

vating carrots, yet the giving of them in part instead of oats, will most abundantly repay them. The expense of each acre in sowing, cleaning, and housing, will not be short of 15*l.*

Whatever system can multiply the produce of one acre into that of two or more, is, I conceive, an object to a country where the consumption of the first necessary of life exceeds what is at present produced within the empire. In this point of view I flatter myself that the present paper may not be thought unworthy the attention of the Society.

We, Isaac Kendall, bailiff, and Thomas Moore, groom, to J. C. Curwen, Esq. do certify, that Mr. Curwen's working horses had 4lb. of carrots given them in the room of so much oats, from October 1805 to January 1806, being three months: that without the use of carrots Mr. Curwen allows his working horses from 8 to 12lb. of oats *per* day, according to the size and work of the horses; that the carrots answered every purpose, and that the horses were never in better condition than at the time when they were in use; and we believe that they would not have been better, nor fitter for work, with the whole allowance of oats; that the crops of carrots have been extremely good by Mr. Curwen's mode of management. The saving of oats was fifty-eight Winchester bushels *per* week by the use of carrots upon the food of seventy-six horses.

Workington, May 10, 1806.

Researches

Researches relating to the Oxydation of Iron. *By M.* Darso.

From the Journal de Physique.

It is ten years since a celebrated chemist (Proust), struck by the two combinations that are usually formed by metallic oxyds with acids, and supported besides by the two proportions of oxygen which the non-metallic combustibles commonly take up, advanced the opinion that *metals will combine with oxygen in two proportions only*; and although since that time several chemists have pretended that there were intermediate oxyds, and that lately the author of the *Statique Chimique* has stated, that he is not only acquainted with these intermediate oxyds, but, what is still more, that *the proportions of the oxygen with the metals vary, from the term in which combination is possible*, unto that in which it reaches the highest degree, &c.; Proust, nevertheless, considers the facts opposed to him as insufficient, and insists that nature has fixed these two terms of oxygenation invariable.

Although I do not view the question in the same light as Proust, I have great dependance on the labours and observations of the Madrid Professor; and I am inclined to think with him, not only that the proportions of oxygen are invariably determined by nature; but that most of the experiments on which the belief of the existence of intermediate oxydations are founded, possess not that perfect accuracy which such a discussion requires.

Being persuaded that any researches made with a view of clearing up this point of theory, would, if of no further use, at any rate prove serviceable to the advancement of the science, I determined to make some experiments on iron, as one of the metals best adapted to this purpose,

purpose. I shall relate them here in the same order as I made them, being persuaded that I cannot give them a better arrangement than that in which they were first suggested to my mind. Perhaps some of the details may be thought superfluous, and perhaps also some phenomena have escaped observation from my inexperience.

The two first methods that I proposed for finding the new oxyds of iron, were, first, to treat the red oxyd with oxygenating substances, and restraining the expansibility of the oxygen by pressure. This species of experiment succeeded very well with Sir James Hall, with respect to carbonic acid, and I had no doubt but that I should advance by this method the oxygenation of iron. Secondly, to submit iron wires to different discharges of electricity, and in atmospheres more or less charged with oxygen. But first I wished to be acquainted with the habitudes of iron treated in the manner hitherto practised.

Oxyds by Calcination.

I took one part of filings of iron and three of nitrate of potash, well pulverised; and after having mixed them, I put the whole into a crucible that I had previously made red hot. After it had sustained the fire for three quarters of an hour I withdrew the crucible, through which had passed a large portion of the potash and oxyd of iron; the mixture yielded, when cool, a brown mass, with some spots that were green and of different shades.

This mass, pulverised and washed at different times with boiling water, to deprive it of the alkali, yielded a brown powder very attractable by the magnet, which was not soluble in muriatic acid in the cold. Treated with heat in this acid, a little diluted with water, gave a colourless liquor, from which the alkalies precipitated a dark-brown oxyd, which was not changed by exposure to air, but which, in a few minutes, contracted so great a force

force of cohesion, that it was not soluble in cold muriatic acid, and which, dried in the air, was magnetic; it, in fact, preserved the same character that it had before its solution *.

As the loss which I had experienced, on account of the matter that had run through the crucibles, disabled me from appreciating with accuracy the quantity of oxygen of this magnetic oxyd; and as, on the other hand, its magnetism and its colour induced me to believe that it contained less oxygen than the red oxyd, which is obtained by calcining iron filings, I resolved to try this method, and to seize the moment in which the magnetic oxyd forms. For that purpose I put into a crucible 100 grains of iron-filings, and after having kept it in a strong fire for half an hour, and stirred it continually, I removed it, and found it to be 120 grains. I observed on this occasion that each grain of the filings, although covered by a crust of oxyd, contained a metallic kernel, and with the intention of laying bare the metal, and of accelerating the operation, I ground it in this half-oxydated state before it was returned to the fire. This operation, which I was

* I imagined at that time, that this oxyd was a peculiar one; but by what ensued I perceived that its colour and its magnetism proceeded from the great concentration of the solution, as well as that of the alkali employed to precipitate it, since, by diluting the alkali with water, or by using lime, strontian, or barytes water, the precipitates were entirely red.

By mixing, in a certain proportion, which may be learned by trial, the red and green solutions of iron, black magnetic precipitates are also obtained, which do not change by exposure to the air: but these two phænomena must not on that account be confounded, for there are some of these magnetic oxyds which do not contain an atom of green oxyd. The green salts of iron may likewise be precipitated in such a way that the precipitates will be black, magnetic, and unchangeable in the air.

 some-

sometimes obliged to repeat three or four times, succeeded very well, as will be seen by what follows.

By continuing the calcination, and by essaying it from time to time with muriatic acid, I perceived the magnetic oxyd succeed to the green, and that, when the 100 grains had taken from 30 to 36 of oxygen.

This experiment, which I have repeated several times, has constantly yielded the same results, except that now and then I have found some hundredths of oxyd, green and red. It is well known that it is impossible for the calcination to be so perfectly uniform as that all the molecules of iron can be equally exposed to the action of the caloric and the air: some parts adhering to the bottom of the crucible, and being covered by others, they have not so many points of contact with the air; others, on the contrary, always occupy the surface, and consequently take up more oxygen: neither are they of equal fineness; and even in their temperature there must be a difference, which, however trifling, will also contribute to a different degree of oxygenation. By continuing the calcination until the hundred grains had taken up thirty-eight of oxygen, the precipitates were entirely red, without manifesting any traces of magnetic oxyd. From this term unto that of forty-five and fifty, the oxygenation was very slow, and it would have become impossible, if I had not raised the temperature; by doing which, and renewing the air by means of a pair of bellows *, I carried the oxygenation to fifty-six. This operation is extremely long and troublesome; but if the surcharge of oxygen were of use to the arts, or to animal economy, it would be very easy to invent an apparatus that should much facilitate this operation.

* In order to weaken the action of the caloric on the air, and thus to facilitate its contact with the oxyd.

I treated

I treated this oxyd of fifty-six with acids; and I afterwards precipitated it by the alkalies and alkaline earths; I also treated the solutions with prussiates, galates, and phosphates, in order to see if I could discover any properties which would distinguish them from those of the oxyds that had preceded; but my labour was useless, and I might have expected it, since those of ,38 ,40 ,45 and ,48 exhibited no characters distinct from each other.

The only difference that I have observed among these oxyds is, that the reddish tinge of the oxyd becomes decided, and its magnetic property weakens in proportion as the calcination is advanced; but these properties belong more to the difference of the oxyds, than to their proportion of oxygen *.

This conformity of properties in the oxyds, among which the oxygen varies from twenty to forty hundredths, as I shall presently shew, proves that it is a mistaken notion to consider the formation of a different salt, as a distinguishing character of each degree of oxygenation. In fact, the oxygen has been considered to possess a much greater influence on the oxyds of iron than it really does (and I believe even on all metallic oxyds). It has been supposed that all the physical and chemical properties of oxyds of iron were owing to the oxygen; whereas, from my own observation, I am led to believe that it is of so passive a quality, that hardly any of these properties belong to it.

Notwithstanding the uniformity of circumstances to which I submitted the iron in these different calcinations, I observed, that when it had taken up ,28 of oxygen † the oxyd was sometimes entirely magnetic; whereas, on other occasions, having taken up ,30 and ,32 it afforded a

* See the end of the memoir.

† That is to say, that 100 grains of iron took up 28 of oxygen.

precipitate of a very deep green and homogeneous; in short, the red oxyd also sometimes appeared at ,28 and ,30. As I was more or less prepossessed in favour of the theory of the divisibility of bodies (on which I believe the greatest part of the phænomena depend) I did not hesitate to attribute to this cause the results I had obtained; but, in order to be more fully satisfied on this point, I took 300 grains of filings of three different degrees of fineness. and at the same time finer than that which I had previously used. Let us suppose that the proportion of fineness was as 3—2—1. I submitted to calcination the 100 grains that were coarsest, taking them from the fire every ten minutes, in order to grind them in a mortar; at the end of half an hour, and after having undergone three pulverisations, they had taken up 24—70 of oxygen, the colour became entirely red, the magnetic property was very feeble in them, and, dissolved in muriatic acid, they yielded red precipitates, like oxyds of 56.

I repeated the same experiment on 100 grains of the second degree of fineness, and when they had taken up ,21 of oxygen the oxyd manifested the same properties as the preceding.

Lastly, I submitted to the same experiment the last 100 grains, which were extremely fine, and which I had previously sifted, to render them more equal; but instead of taking them from the fire every ten minutes, as I had done in the preceding experiments, I removed these every five minutes, in order to diminish as much as possible the action of the oxygen. Indeed, during the space of a quarter of an hour they had taken up ,15 of oxygen, and the properties of this oxyd were the same as those in the two preceding oxyds *.

Thus

* There is sometimes 0,02, or 0,03, of green oxyd in it, which is not easily perceptible, and very difficult to separate, even when it is known

Thus we have a red oxyd made in fifteen minutes; it produces a fine blue, with alkaline prussiates; with gall-nuts its precipitate is black, or rather of a very deep blue; in short, no chemist will be able to distinguish it from the oxyd of 56, at least by employing the means that are now practised for distinguishing between the oxyds of iron.

All these facts prove the wisdom and profundity with which the learned author of the *Chemical Statics* (relying not on the elective attractions, but on the properties of oxygen and of metals) has said, that the proportions of oxygen with metals may vary from the term wherein the combination is possible until that in which it arrives to the highest degree of which it is susceptible, and that a multitude of circumstances may put a stop to, or promote, these proportions.

I have not pursued this experiment any further; but I believe that by favouring the division of the iron by all known means, and by opposing at the same time all obstacles to the action of the oxygen, we may obtain red oxyds of iron, with ,06 or ,08 of oxygen. And possibly, by preventing entirely the action of this principle, we may obtain powders of iron that may be dissoluble without effervescence in acids, and which may possess the same properties as the oxyds. As for myself, I am the more persuaded of its possibility, because I am rather inclined to doubt the generally received principle, that metals should be previously combined with oxygen in order to combine with acids. I regard this oxydation rather as a consequence of the means that we employ to divide metals, and to give them that degree of fineness that is re-

known to exist there; yet the separation may be easily effected, by digesting the oxyd for half an hour in muriatic acid, much diluted with water, which dissolves the green oxyd, or rather the iron that exists in it, and has no effect on the red oxyd.

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quisite for dissolving them in acids, than as a condition indispensible to their dissolution.

I propose, in the sequel, to make some experiments on this subject; and then I shall relate the motives that force me doubtfully to dissent from this principle.

Before I conclude my account of the oxyds of iron by calcination, I must be permitted to make an observation on the most interesting application of the oxyds of iron, that is, on their medicinal property. These oxyds are applied in numberless instances to the animal economy; but it is not yet known to which of the two principles of this combination their salutary effects are owing; and the faculty, until now, have been unable to make comparative and satisfactory observations on this subject, being unacquainted with the quantity of oxygen contained in the different oxyds of iron that are employed in medicine. Therefore they use indiscriminately, or with a blind preference, astringent saffron of Mars, operative saffron of Mars, Ethiop's Martial, vitriol of Mars, boules de Nancy; and many other preparations, in which the quantity of oxygen varies as much as two thirds. At present they know that all these saffrons, notwithstanding the uniformity of their colour, and their chemical properties, are of different degrees of oxydation, and that they will vary from some hundredths to beyond ,50. It is to be wished that some philosopher would make some observations tending to discover whether it is the oxygen or the iron that gives to this remedy its properties. Such a work would be very useful, since it would most probably enable them to augment or diminish, as convenient, the influence of the two substances.

Oxyds by Dissolution.

The solutions of iron have yielded results that are still more satisfactory, both because they confirm and render more

more clear those obtained by calcination, and because they are calculated to throw much light on a number of manufactures, and to simplify the chemical theory of iron. But notwithstanding my own confidence in these results, I offer them only as conjectures; they are so diametrically opposite to the present opinions respecting the dissolutions of iron, and I am always fearful of being led into error.

The inconstancy of the green oxyd that Lavoisier and M. Proust obtained when 100 grains of iron took up 37 of oxygen, and which, according to the experiments I have related, has varied from some hundredths to 32, should have led me to believe that the properties which distinguish this oxyd from the red oxyd were not owing to a fixed degree of oxygenation, but rather to a certain degree of density, which would permit the water or the acid, or both of them, to lodge in the interstices of each molecule; which occasions both the difference in the colour of these precipitates by the alkalies, by the prussiates of potash and galates, and their greater or less degree of solubility, which are the two sole properties that distinguish the green salt from the red.

This reasoning led me to examine not only the green and red oxyds, but at the same time the white oxyd lately announced by M. Thenard, respecting which I had advanced some doubts *. I am sorry to be obliged to raise

* I could not believe, even before I undertook this work, that some hundredths of oxygen were capable of modifying the colour of the oxyds to such a degree as to change them from white to green, black, &c. All these facts being now within my knowledge, tend to disprove the existence of this property in the oxygene; consequently I was suspicious of all precipitates that were much unlike in colour that of the oxyds of the same metal obtained by calcination.

raise doubts respecting the labours of philosophers whom I respect and esteem, but trust I shall promote their views if my observations are just.

Of the White Oxyd.

M. Thenard gives as the distinctive character of this oxyd, first, that it becomes green by exposure to the air; secondly, that the oxygenated muriatic acid changes it to green or yellow; thirdly, that when the precipitate is made in a bottle well corked, after having been stirred, in order to transform the white oxyd into green, an absorption will be perceived; which proves that a part of the oxygen of the air contained in the bottle combines with the white oxyd, and changes its colour. I must be allowed to appreciate these three facts.

Since the labours of Messrs. Fourcroy, Proust, and Berthollet, M. Thenard and all the chemists of the present day are of opinion that the change of colour in the precipitates does not, for the greatest part, indicate a different degree of oxygenation. The white colour is that which very often disguises the true colour of the oxyds in almost all the metals which are said to be susceptible of oxygenation, such as tin, mercury, copper, silver, lead, bismuth, and probably manganese. That depends on the quantity of acid that the precipitates

tion. If the white colour, I say, is the result of the combination of iron, with some hundredths of oxygen, why, in the course of the calcination of the iron, does not this colour appear? Why, in the calcination of manganese, copper, and bismuth, do we not see the same phenomenon? Besides, the only well-established white oxyds are those of antimony, zinc, and arsenic, which are white, whether obtained by acids or by calcination; and from the moment that they become white the colour is unchangeable, even by a considerable surcharge of oxygen.

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retain, and of which they are more or less easily deprived according to their nature, and still more according to the circumstances that take place during the precipitations. This is the case in which the white precipitate of iron appears to exist.

The conditions that are requisite in order to precipitate a green salt of iron white are, first, that the solution be very much concentrated; secondly, that the precipitating alkali be also sufficiently strong. These requisites did not escape the sagacity of M. Thenard, who advises, for the better success of the formation of the white oxyd, that some sulphuric acid, diluted with water, be boiled on an excess of iron filings. In fact, every time that an alkali a little concentrated is poured on a similar solution of iron, it seizes at first a part of the acid, and probably a little of the water; and it precipitates a white sulphate of iron, which often crystallizes, although irregularly, at the very moment even of the precipitation, and still preserves enough of acid to be soluble in water. It also invariably turns the syrup of violets green, and forms a red precipitate in turnsole water, as the salts of iron do with an excess of oxyd *.

It

* I have obtained several salts of iron which, when put in contact with the tincture of turnsole, immediately produce a red precipitate, and at the same time turns the syrup of violets green. The property of precipitating with the tincture of turnsole always indicates at least a neutral salt: and we should not confound the simple colouration with that which is accompanied by a precipitate, because these are two results that are entirely different. In the simple colouration the small portion of alkali from the tincture of turnsole combines with an excess of acid, and abandons the colouring part that it would otherwise modify: there is no doubt but that a salt which presents this phenomenon possesses an excess of acid, since it contains enough to saturate the alkali of the tincture without occasioning any precipitate; and it is

It is easy to prove this fact, by pouring a few drops of a similar solution into an excess of alkali. If the liquor be decanted after the white precipitate has been suffered to remain in it for eight or ten minutes, or, what is a still more certain way, if it be drawn off by means of a syphon, and some drops of water be afterwards put into it, to carry off the alkali that adheres to the surface of the precipitate and to the sides of the glass, there will remain a mass of sulphate of iron, a great part of which will dissolve in the water, and present all the properties that I have announced. I leave this precipitate to macerate or soak for twenty-four hours in the potash, and at the end of that time I still obtain soluble sulphate of iron.

In concentrated ammonia this result is still more evident, because as the density of the sulphate of iron that precipitates, is much greater than that of the ammonia, the precipitate gains the bottom of the glass, and a great part of it, by sticking to its sides, escapes from the posterior action of the alkali; this does not happen with the fixed concentrated alkalies, their density being more considerable than that of the ammonia; and it is owing to this circumstance that they envelope the precipitate on all sides. Hence it is that these dissolutions, which when concentrated produce a white precipitate, when they are diluted with water purified from the air by a long ebullition, precipitate of a green colour. It is for this reason that lime-water never affords white precipitates, even with

is on this principle that the use of this re-active is founded. When the colouring is accompanied by a precipitate, the alkali not finding an excess of acid to combine with, possesses itself of a part of that which held the oxyd in solution, and which in precipitating carries down the colouring part. What appears extraordinary is, that the oxyd of iron does not change the syrup of violets to a green colour, although the neutral salts of iron, or with excess, have that effect on it.

with greatly concentrated solutions. In short, it was this that occasioned me before to suspect that the muriates and nitrates of iron, which afford white precipitates like the alkalies, would give a green precipitate with the water of barytes and strontian, and which in fact has always taken place. We cannot attribute the green colour to a super-oxydation derived from the air engaged in the water of the barytes, of strontian, and of lime; for besides that the rapidity of the operation and the quantity of air that an equal bulk of distilled water is capable of containing, would not justify this supposition, I had the precaution to boil for an hour one half of the water that had been used to dissolve those three earths.

If instead of diluting the solution with water it were to be diluted with sulphuretted hydrogen, which cannot be suspected of oxydising, the result will be always the same: the precipitates that the alkalies form will always be green or black, and never white. It is true, as M. Thenard says, that by pouring sulphuretted hydrogen upon a red solution of iron, it produces white or green precipitates. However, I believe it is rather a consequence that M. Thenard draws from his own opinion of this white oxyd, than from any fact that he has observed. Finally, I am satisfied, that having repeated these experiments several times, by frequently changing the re-actives, and varying as much as possible the concurring circumstances, I have obtained green and black precipitates, only according to the concentration of the sulphuretted hydrogen and the quantity of sulphate of iron put in contact with it. If this assertion of M. Thenard is founded on a fact that he has himself observed, I own it is an anomaly for which I am unable to account, and which I cannot make to agree with the assemblage of facts that I have related.

If all these facts do not disprove the existence of the white oxyd, I can add one more; which not only completely disproves it, but even affects that of the green oxyd. Such is the result of the following experiment.

A bottle must be filled with three parts of ammonia and one of sulphate of iron, precipitating white, and it must be corked up immediately. At first it will form a white precipitate, which by shaking the bottle will dissolve in the ammonia. If the oxyd of iron be afterwards precipitated by means of water or of an acid, the precipitate will always be green or brown; but if, instead of precipitating it by one of these means, a small bent tube be adapted to the bottle, and it be submitted to a temperature capable of expelling the ammonia, this in volatilising will precipitate a black or brownish oxyd, which, redissolved in muriatic acid, will produce precipitates for the most part red. Now, here it is impossible to suspect a super-oxydation by the ammonia. Finally, there are red salts of iron with excess of oxyd, which are not only white and soluble as M. Thenard's salts, but which often crystallize; which are not deliquescent like the ordinary red salt of iron, and which besides presents other peculiarities. I shall detail them more fully in a memoir on another matter, where I shall advert to this subject. I shall also reserve until then, the explanation of the cause that some of the white precipitates, observed by M. Thenard, preserve their colour even after a long ebullition. It is a fact very well observed by this philosopher, but it is one in which oxygen has no part.

The changes which, according to M. Thenard, the oxygenated muriatic acid occasions, when poured into a sulphate of iron precipitated white, agree perfectly with my idea of this precipitate. As the oxygenated muriatic acid is so little soluble in water, and the sulphate of iron

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in question so much concentrated, it ensues, that if the first be not very abundant in the solution, the precipitate will be green, because the little oxygen that the muriatic acid contains can only change to red a small portion of green oxyd, which, being predominant, envelopes the small quantity of red oxyd that the oxygenated muriatic acid has formed, and does not permit it to shew itself. To the eye it appears as if the solution had been diluted with a quantity of water equal in bulk to the muriatic acid that is poured on it, which would, in the same manner, have changed the white precipitate to green. If, on the contrary, the oxygenated muriatic acid be very abundant, there is no doubt but that the solutions will become red, as is the case with all the green salts of iron.

With respect to the third fact, namely, that by making the precipitate in a bottle, and stopping it up immediately, there is an absorption, and that the remaining air extinguishes candles, I shall only say, that instead of absorption I have always obtained a disengagement, which has sometimes forced out the stopper. It is true, that after the white precipitate has changed to green or red, the remaining air will sometimes extinguish a candle, but that is owing to the disengagement of a principle, of which I shall presently speak.

Of the Green Oxyd.

The green oxyd obtained by the dissolution of iron in acids, presented me with three principal facts to examine: first, to determine how much oxygen the iron takes to pass by this means to the state of green oxyd; secondly, to account for its colour; and thirdly, to observe the influence of the atmospheric air upon these dissolutions.

To

To determine the proportion of oxygene, and to discover at the same time the influence of the atmospheric air, I took 90 grains of iron filings, which I divided into three equal parts; each of these were afterwards dissolved separately in muriatic acid diluted with water. When the dissolution was terminated, I precipitated by ammonia, 30 grains, which I washed and drained with the greatest expedition, and dried it at a temperature of nearly 120 degrees. When dry I found a brown oxyd attractable by the magnet, which weighed 36½ grains, and which, dissolved in muriatic acid, precipitated in red. I precipitated 30 other grains by ammonia, but with the intention of obtaining the red precipitate. I diluted the solution, before I added the ammonia, with five or six times its bulk of water at 50 degrees. This oxyd was in fact red, and dried like the preceding; it gave no signs of magnetism, although the total weight was only 36 grains.

Lastly, I precipitated the remaining 30 grains by ammonia also, and I used a very large vessel, in which I left the precipitate exposed to the air for the space of a month, stirring it twice every day. At the end of this time I dried it as the preceding, and it was red, gave no signs of magnetism, and weighed 36,2.

There was no other difference between these oxyds, except that the first was brown and magnetic, while the two others were red, and only became magnetic at a more elevated temperature.

Although I perceived, in the course of this experiment, that it was not calculated to determine with accuracy the quantity of oxygen that the green oxyd contains, in the solutions of iron by acids, on account of the oxygen that would combine with the green oxyd whilst drying at a temperature so elevated, and in so great a state of division;

sion; yet it confirms, however, two of the principal results obtained in the oxyds by calcination. This operation afforded red oxyds that contained only 15 or 20 parts of oxygen. The solution confirms this fact, by yielding red oxyd which contained only 0,20 of oxygen, comprising that which settles in it while drying.

Calcination produces red magnetic oxyds, and the solution gives the same result.

There are two methods of appreciating with extreme accuracy the quantity of oxygen the green oxyd obtained by dissolution contains. The first, and that which I should have preferred, if circumstances had permitted it, is, to dissolve a given quantity of iron in muriatic acid, and to collect carefully the hydrogen that is disengaged, which measured, and, for the greater certainty, burnt in Volta's Eudiometer, will give the quantity of oxygen combined with the iron. The second is, to dissolve a given quantity of iron in muriatic acid; and, after having precipitated it by an alkali, to dry it in a pneumatic apparatus, by means of a burning glass.

TO BE CONCLUDED IN OUR NEXT.

Facts relating to the History of Prussiates.

By M. PROUST.

From the ANNALES DE CHIMIE.

THE Prussian blue of commerce is seldom pure, as Scheele has already remarked.* There is often discovered in it, besides the alumine which forms a part of it, silex, carbonate, and sulphate of lime, sulphate of potash, phosphate of iron, the red oxyd of this metal, sulphur, oily ammonia, &c. To study therefore the nature of this combination, it is indispensible to use prussiate without

without alum, sufficiently washed with acids and boiling water. It appears, even from an observation of Berthollet's, that the prussiate of potash is capable of adhering with sufficient strength to the Prussian blue to resist the washings to a certain degree. I do not, however, think with him, that the surcharge of this salt should be considered as an element which is essential to it; for the blue which has been well prepared, and such as is sold in commerce, does not leave any traces of saline matter in the residue of its distillation.

The Prussian blue prepared without alum is coppery, like the fine indigo, and loses but 45 hundredths by combustion. Its residue is red oxyd, without any mixture of foreign matters.

Action of the Alkalies.

Caustic potash applied to the blue, leaves a residue which is only red oxyd confounded with alumine. Its tint is that of kermes, if the blue be of a fine quality: on the contrary, it is dark and earthy if it have been surcharged with alumine; so that it is easy to judge of its nature by the colour of its residue.

The acids, applied to a residue properly washed, extract no colour; this discovers that it is possible, in a single operation, to deprive the Prussian blue of all its acid; but it must for this purpose be finely pulverized, which is rather difficult. Drop some alkali into some water coloured by some newly-precipitated blue, and it completely discolours it; then the oxyd which separates from it gives not the least vestige of colour when moistened by an acid. In this process it often happens that the ocreous residue retains either some remains of the blue which has not been attacked by the alkali, or a mixture of prussiate of potash and alkaline ferruginous carbonate, or even these three substances compounded

compounded together. I shall examine two of these cases; from which it will be easy to judge of the third.

If, for example, a trial is made of an acid upon a residue well washed, and which still retains some blue, this latter is not discoverable, but in proportion as the acid removes the yellow oxyd. Between this oxyd and the Prussian blue there is no particular chemical point of union, as we have hitherto believed; however, nothing positively shews that the saline metallic combination, which we call prussiate of iron, is, like many others, susceptible of a *maximum* and *minimum* of acid and oxyd; and if the mixture of yellow and blue which these residues sometimes exhibit, be not green, as we are led to expect, it is because the yellow oxyd always covers the remains of the blue to a very great excess; at least I have never found it above from one to two hundredths.

I now pass to the second case. A residue cannot contain any remains of blue, if it has been well pulverized, but it easily retains the two salts I have mentioned above. If then an acid be applied to it, they both afford blue in abundance. We will examine farther the peculiar mixture of these two salts; but, if it has been washed with care, the acids will not produce the blue. Indeed no part of the experiment is so tedious as this washing, for I was obliged to renew the boiling water at least twenty times upon a single grain of residne before it was completely exhausted; but at last when it did take place the acids dissolved without producing any blue.

When these residues effervesce with the acids, it is because they contain carbonates of potash or lime. By washing, the first is separated from it; by applying vinegar after the washing, the second is discovered. Thus it is not the red oxyd which occasions this effervescence: it is not susceptible of combining with carbonic acid; consequently it cannot unite with the potash in exchánge of prussic acid that it had received. In nature as in art, the oxyd of iron, at the minimum only, is capable of uniting with carbonic acid.

One pound of the blue of commerce, of a fine quality, gives nine ounces and a half of crystallized prussiate of potash. It is not uncommon to find in the mother waters when left to themselves mutilated octeadrals of an inch in diameter. When this blue contains sulphuric acid, it requires no less than four crystallizations to purify the prussiate of all the sulphate of potash. These mother-waters contain alumine sometimes in abundance, sulphate and phosphate of potash, alkaline ferruginous carbonate, &c. We may judge by that, how important it is to use crystallized prussiates in the analysis, and not the simple ley of Prussian blue, as was formerly the practice. Prussiate of potash is unalterable in the air, dry or moist: the longest ebullition does not derange its nature; its taste is sweet, and rather salt, terminated by a slight impression of bitter; and alcohol does not dissolve it. If it be mixed with a solution, the prussiate separates like pearl-white snow, which preserves all its brilliancy when dry, and which resembles, if I am not mistaken, the silvered gauze of acetate of mercury. Re-dissolved in water it reproduces an ordinary solution of triple prussiate.

This salt, which I shall call *triple*, to distinguish it from simple prussiate of potash, is as steady in its attributes as the most perfect neutral salts. It is of a fine lemon colour, which never leaves it while it remains in that state; it ought besides to possess, as well as the two other characteristic properties of crystallizing and of forming blue with red oxyd, a portion of black oxyd,

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which makes an essential part of its constitution. Without this oxyd, subjected, like the two other elements of the triple prussiate, to an invariable proportion, this prussiate cannot in fact either crystallize or form a blue with solutions of iron, the bases of which are at the *maximum*. It is, in a word, from this same union, that the principle which saturates the potash of the triple salt, acquires, as Berthollet observes, properties which singularly augment its analogies with the acids.

Under this view it may be added, that the triple prussiate occupies the mean between the alkaline and the metallic salts. However, in reflecting on the properties of this salt, of which we shall speak below, it would be difficult to ascertain whethor it is to the prussic acid or to the simple prussiate collectively that the oxyd of iron adheres when it is raised to the state of triple prussiate. This much is certain, that we still by no means know what appearance or properties prussic acid would possess when united only with that exact dose of black oxyd by which it can form triple prussiate. By treating the prussic acid with this oxyd we are able to make Prussian blue, but not the kind of ferruginous acid which is proper to convert potash into triple salt; it is this which we must not lose sight of: for it is well known that Prussian blue is not of a nature to combine without residue with potash. In a word, the triple prussiate, less its alkaline base, is, if I may so express myself, a compound which we are not authorized to consider rather as a salt, the acid of which would have been particularly heightened by its union with the oxyd, than as a perfect combination in all its parts by this same oxyd.

One property which appears, in fact, to forbid us to admit the prussiate as a salt, the acid of which would exclusively unite to the black oxyd, is, that of resisting

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the power of alkaline hydrosulphurets. If these re-actives which attack all other known metallic salts are without action upon the triple prussiate, there are then, to a certain degree, grounds for presuming that the oxyd of iron may not be exclusively attached to the acid of the triple prussiate, at least, however, it must be believed, that the affinity which this acid has to the oxyd is not sufficiently powerful to defend it from the attack of sulphurets which all other oxyds are liable to. Finally, we shall see farther on, that an affinity equally extraordinary, notwithstanding until now it has been unexampled in chemistry, is not impossible. I now come to the experiment of the hydrosulphuret of potash upon the triple prussiate.

Hydrosulphuret and triple Prussiate.

Hydrosulphuret of potash or ammoniac, even with the assistance of heat, has no effect whatever on this salt. If it should contain any remains of ferruginous carbonate, it would be disengaged because the hydrosulphuret decomposes this latter; it is to be filtered if necessary, and the prussiate still crystallized under its usual form. A similar result led us to discover, as we had at first observed, a very particular and intimate combination between the three elements of triple prussiate. But we shall see these same hydrosulphurets contribute to our obtaining the white prussiate in all its purity, or that union in which the iron is at its *minimum* of oxydation, which I made known in my first memoir on Prussian blue.

White Prussiate.

Take on one hand, a bottle of green sulphate, much diluted; at the bottom of which put some grains of sulphuret of the same metal, in order to preserve the base

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at its *minimum*. On the other-hand, place to boil upon a lamp, a matras in which is put fifteen or eighteen grains of prussiate of potash, and from two to three ounces of hydrosulphureted water. Some seconds after the ebullition or steam has expelled the air which occupied the empty space of the matras, some of the solution of the sulphate is dropped into it; it presently produces a precipitate which makes the liquor white like milk, and which remains thus as long as the heat continues. This is the prussiate which I call *white prussiate;* and which Fourcroy. Vauquelin, Davy, &c. obtained without doubt, who having had regard to the conditions which insured them success, have discovered that the base of green sulphate may also become that of a prussiate different from that which has for its base the oxyd at the *maximum*. But, as in passing from one combination to the other, the black oxyd does not lose its disposition to superoxydate, we see, that as soon as the matras is out of the fire, the atmosphere resumes its action upon the milky mixture, rapidly produces waves, which begin by shading it, and finish by making it a most perfect blue.

This product may likewise be obtained in another manner. Some grains of prussiate of potash are dropped into a much diluted and boiling solution of green sulphate, and presently a precipitate appears, the white of which sustains the action of the air a little longer.

There are besides some other processes, which, although they may add nothing to our conviction, are nevertheless interesting, from the variety of the methods.

Two glasses are filled, one with nitrate of iron, the other with green sulphate much diluted. Afterwards a crystal of prussiate of potash is dropped into each of them. In the first, the crystal becomes instantly of a blue so deep

deep that it resembles black velvet. In the second, it loosens and falls into a white powder; but as before it was experimented on, it had imbibed some atmospheric air, the precipitate that resulted took the appearance of a piece of parsley cheese.

Two glasses are filled with boiling water; into one, some drops of prussiate are let fall; and a like quantity into the second; but to the latter some drops of hydro-sulphuret of potash or ammonia are likewise added. The two glasses being thus prepared, some nitrate of iron is dropped into them; the first gives, as may be expected, a complete blue; but the second offers the amusing spectacle of a precipitate, which, at first blue, rapidly loses its colour, and becomes white.

The theory of these facts is so evident that I shall not dwell upon them; nor shall I here recapitulate all the other experiments that I cited in my first memoir, to establish the existence of two prussiates of iron. If the prussiate at the *minimum* have no colour when not affected by the atmosphere, so neither has dried green sulphate. The absence of colour in one of these salts is certainly not more surprizing than in the other; and after all, if the red oxyd be obtained by applying the alkalies to the blue prussiates, it is, on the contrary, black oxyd that is extracted from the white prussiate. But these differences which the theory indicated before-hand, agree perfectly with those produced by the red and green oxyds in similar circumstances.

I advised, in my first memoir, to pour the prussiate of potash on the sulphate, in a bottle, in order to avoid, as far as possible, the mixture of the air with it; but it succeeds imperfectly: first, because the cold liquors always contain some air; and, secondly, because I had not then thought of the sulphureted hydrogen for purifying them; being

being at that time unacquainted with its effects on these salts.

If, for example, the solution of green sulphate be diluted with from three to four times its bulk of sulphuric or muriatic acid, the excess of these acids occasions no alteration in the result. The white prussiate failing in colour only from the absence of oxygen, one would imagine that similar additions would give it. The most highly-concentrated acids may be capable of removing the whiteness of prussiate, but they can never bring it to a perfect blue; neither will the marine acid boiled upon prussiate.

Yet this boiling acid is not without action on the white prussiate; and the following is what I have observed.

There is a portion of white prussiate destroyed, some prussic gas disengaged, and black oxyd is found in solution: then the small quantity of blue prussiate that is formed by the introduction of the air, during the interval of the mixtures, prevails over the white, and gives to the whole a greenish tinge.

The blue prussiate, boiled with the same acid, also affords prussic gas, and leaves some red oxyd, but less is destroyed than of the white prussiate. We may infer from these facts, that the muriatic acid, with the help of heat, is in strictness capable of decomposing the prussiates, and prevails with its accustomed energy over the prussic acid.

Prussiate of Potash and Acids.

Some marine, or weak sulphuric acid, is heated in a matras, with crystals of prussiate. When the ebullition commences, the gas escapes, it is received into a jar full of mercury, where it is burnt by holding the flame of a candle to it. Its fire varies from red to violet and yellow; during

during the dissipation of the gas the liquor thickens, by the production of a white precipitate, which changes to a blueish colour. The gas being totally separated, the mixture is thrown into boiling water, it is revived with oxygenated marine acid, it is washed, and the product dried in a capsule. Four experiments, made at different periods, yielded from thirty-four to thirty-five of perfect blue for the hundred of triple prussiate.

I now come to the consequences.

One hundred parts of Prussian blue, without alum, produce fifty-five of red oxyd by combustion. This same blue, destroyed by nitric acid, yields also fifty-four. It is therefore undoubted that the pure Prussian blue contains only from ,54 to ,55 of red oxyd. According to these results, 35 parts of blue should yield about seventeen of black oxyd, or nineteen of red oxyd. Hence it is, that formerly, when iron was separated from a solution by prussiate of potash, this salt added to the product the ,19 of red oxyd that resulted from its own decomposition; but the surcharge was still much greater, when, instead of crystallized prussiate, a simple alkaline ley of Prussian blue was used. The reason of this will be shewn presently.

When a ley of ordinary potash is put upon Prussian blue, a part of the alkaline carbonate becomes charged with red oxyd; the result is, a solution that answers to Sthaal's tincture of Mars, and of which pure potash is not susceptible. This solution, which is also prepared, by throwing some drops of nitrate into some liquid carbonate, will mix with the prussiate of potash, without occasioning the least change even by remaining in it. It is this ferruginous carbonate which, as I have before said, is present in the mother-waters. Actually, if an acid be added to a mixture of these salts, the precipitate is a perfect

perfect blue, because the new solution of oxyd, which replaces the ferruginous carbonate, decomposes in its turn the prussiate of potash, as any solution of iron whatever would do *.

When, therefore, a prussic ley is employed in an analysis instead of crystallized prussiate, it is, in fact, adding to the product, first the red oxyd, which makes a part of the ferruginous carbonate, and then the black oxyd, which is an habitual element of the triple prussiate, which this ley would contain.

The chemists recognized in good time the evil of these leys, although they did not at first perceive that they contained two very different ferruginous combinations; the carbonate of which we are speaking, and the triple prussiate. Many even, seeing the blue that they produce with acids, believe that this blue exists in them naturally; in short, whether oxyd or Prussian blue, they sought to precipitate it without however touching the alkaline prussiate which they believe to be furnished with the blueing property, without owing it to the iron. From their labours we have the receipts for precipitated leys that are to be found in all chemical works. But, since the researches of Scheele and Berthollet, it has been discovered that these receipts are not sufficiently conducive to the desired end; for it is easy to see that it is not sufficient to free a ley from the oxyd that the carbonate would introduce into it: it still remains to be defended from the black oxyd that belongs to the triple prussiate, and which would be the less suspected to exist in it, because the addition of the acids, without the intervention of light or heat, could not render sensible the products of its decomposition.

* It is the mixture of these salts which gives to the mother-waters of soda the property of producing Prussian blue when an acid is added to them.

I shall not stay to analize the phenomena that occurred during the preparation of the leys, warm or cold, because now that every one is convinced of the inutility of prussiates for estimating iron in analyses, the details cannot be very interesting. I shall also pass over the proposed test-liquors, with ammonia, lime, magnesia, &c. because they are themselves triple prussiates, which we cannot use with confidence, inasmuch that they are not equal to the counter-proof proposed by Berthollet. I shall only add, because it ought to be recorded in the history of the science, that when a chemist, after purifying a lessive by an acid, can still extract from it a test-liquor or Prussian lessive, we may be assured that he has not completely attained the entire separation of the iron, as he imagines he has done; for it is certain that all lessive that will still give blue with a solution of red oxyd contains black oxyd also, since without the help of this oxyd there would be no dyeing prussiate; or, in other words, all prussiate of potash that has not been trebled by the black oxyd; consequently the pure and simple prussiate of potash is not capable of forming a blue with a solution, the oxyd of which is at the *maximum*, and which is commonly the case with those that proceed from an analytical labour. This is a fact which Scheele has perfectly substantiated. The saturated lessives or alkaline prussiates, I repeat then, cannot actually serve as re-agents, inasmuch that a portion of black oxyd renders them triple salts, the red oxyd being only capable of supplying the black oxyd for this purpose. In short, we may also conclude from this, that the alkaline prussiates or earthy triple salts ought not for the future to be classed among the re-agents that are useful in analyses, since they are incapable of discovering the iron in a solution without adding to the result; or at most they will rank among those which, like the turnsole, gall nuts,

nuts, &c. are only so far re-actives, that they will indicate that such and such principles exist.

The aqueous sulphuric acid applied to the triple prussiate furnishes the same results as the muriatic. 100 parts of prussiate restores by this means from ,15 to ,16 of sulphate of potash. If we could know exactly how much of the alkalies are contained in the sulphate, we might deduce from its estimation the base of the prussiate of potash. 100 parts of crystals of prussiate lose ten of water by distillation.

In order to complete its decomposition by the acids, the ebullition must be kept up for at least half an hour, to expel the gas entirely, and obtain the complete separation of the white prussiate that forms during the operation.

The prussiate of potash dissolved in muriatic acid cold, without being decomposed; this mixture requires, as Berthollet has discovered, the concurrence of light or heat. Vinegar, aided by ebullition, also decomposes it; the prussic gas escapes, and the white prussiate forms: it does not change to blue so rapidly as with the preceding acids: in fine, this prussiate, which does not appear until the moment in which the ternary combination begins to be disorganized, ascertains by its whiteness that it is really only the oxyd at the *minimum* which can enter into the formation of the triple prussiate: it is one of these facts, respecting which Scheele has left nothing farther to be desired: notwithstanding which, the distinction of oxyds in this case is a point to which the chemists who have followed him have not given the attention that it merits.

TO BE CONTINUED IN OUR NEXT.

Report made to the National Institute on the Results of M. CLOUET's *Experiments on the different States of Iron, and for the Conversion of Iron into Cast-Steel.*

By M. GUYTON.

From the ANNALES DE CHIMIE.

WE shall begin by reviewing the state of the art in this country; we shall afterwards analize the work of M. Clouet; and, lastly, we shall relate the experiments that we judged necessary to be made to enable us to form our opinion.

First. Since the researches of Réaumur enlightened the practice of making cast-steel and steel by cementation, the theory of the conversion of iron into steel was not advanced, notwithstanding the valuable and numberless experiments of Bergman, Rinman, Priestley, &c. It has not been certainly known, for many years, that the carbon in various proportions constitutes iron in the states of grey-cast, white-cast, and steel. This period is fixed by the publication of the joint work of Messrs. Vandermonde, Monge, and Berthollet, in the memoir of the Academy of Sciences in 1786; and the concentration of all the facts leading to this conclusion, are to be found under the article *Acier*, in the *Dictionnaire de Chimie de l'Encyclopédie Methodique.*

The English, however, who have long furnished us with steel of cementation, still retained the exclusive privilege of manufacturing for all Europe a third kind of steel, known by the name of *cast-steel*, and which was not invented before the year 1750; and although the use of it is confined to a certain description of instruments and

and fine articles, it still forms a valuable branch of national industry.

It must not be supposed that the advantage of naturalizing this art among ourselves has not been well understood, for the old government often held out encouragement to those who conceived the hope of attaining this object. Jars has described, in his Metallurgical Travels, the manner in which this operation is executed at Sheffield, excepting the composition of the flux, which they keep secret: a multitude of experiments have been made with a view of discovering it; and there are few chemists who have not obtained in their furnaces ingots of five or six decigrams of steel, perfectly melted; on this subject we might cite our own observations. Chalut, an officer of artillery, was convinced that every kind of glass might be employed in this operation, except that which has lead or arsenic in its composition; and since 1788 M. Clouet has published, in the "Journal de Physique," experiments tending to demonstrate the possibility of casting steel, and even of converting iron, by a single operation, into cast-steel.

It is true that the experiments of the laboratory do not always enable us to introduce successful processes into manufactories; and most of those authors who have written on this subject having reserved the secret of their invention, it was impossible to appreciate their value. Such were, among others, the conclusions of Messrs. Berthollet, Lavoisier, and Hassenfratz, on the processes of Laplace, which processes besides appear to make the quality of steel rather to depend on the quality of the iron improved by his method, than on a new method of effecting the conversion, and especially of fabricating what is properly called *cast-steel*.

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We also see that, in the account of the fabrication arranged and published in the same year, in consequence of a decree of the committee of public safety, Messrs. Vandermonde, Monge, and Berthollet, who were well informed of all the experiments that had been made on this subject, after having carefully reviewed the whole, declare that they can only offer conjectures as to the method of giving to cast-steel an extraordinary degree of hardness, and a grain perfectly uniform in the whole mass.

Indeed we do not yet know of a single establishment in France that has attempted to introduce into foreign commerce cast-steel of its own manufacture in competition with the English; or that is even able to supply the demands of the republic, which, for articles that require steel of this quality, are obliged to give higher prices in proportion to its scarcity.

Such was the state of our knowledge, and of our practice on this subject when M. Clouet resumed the experiments that had formerly occupied him, and executed on a larger scale, at the house of the conservatory of arts and the mineralogical school, the fusion of various kinds of steel, and the immediate conversion of iron into cast-steel.

In order to enable the Institute to judge of the important additions these operations may produce to the theory of the art, and the augmentation of national industry, we shall present to it the examination of the memoir remitted to us by Clouet, and we shall submit to the inspection of the Institute the products of the operations, and the instruments that have been made from them.

2d. The memoir of Cloud is intituled, *Results of Experiments on the different states of Iron.*

He

He first directed his attention to the combinations of iron and charcoal. One 32d part of charcoal is, he says, sufficient to convert iron into steel; one 6th part of the weight of iron yields a steel more fusible, and still malleable; beyond this proportion it approaches nearer to the state of cast iron, and no longer possesses sufficient tenacity; by still augmenting the dose of charcoal, the fusibility is increased, and it at length passes to the state of grey cast iron.

The particular cast-iron resulting from the combination of iron and glass, was the second object of his attention. Glass enters but in a very small quantity into this compound: and yet its properties are changed. This iron, although very soft to the file, when heated only to a cherry-red, breaks under the hammer; when poured into an ingot mould it contracts considerably; and when it comes to be formed into plates the operation of tempering gives them the grain of steel, and renders them more brittle, without adding to their hardness.

Charcoal in powder, added to the glass, augments its fusibility, and changes the result; but the dose sensibly influences the nature of the product. From one 30th to one 20th of the weight of iron affords a very hard steel, which may be forged at a low red heat, and has all the properties of cast-steel: by employing more charcoal the products are similar to those of smelting furnaces.

The attraction of iron for carbon, continues M. Clouet, is such, that at a very high temperature it will take it even from oxygen. He proves this by the following experiment: Put into a crucible some iron cut into small pieces, with a mixture of equal parts of carbonate of lime and clay; raise the heat to the degree necessary to weld the iron; keep up this fire for an hour or more, according

according to the size of the crucible, the matter, when poured into an ingot mould, will be the steel of the same quality as cast-steel.

This observation guided M. Clouet in his search for a process applicable to the fabrication of this kind of steel; but we must confine ourselves in this place to a relation of the facts included in his memoir.

The *oxyds of iron* are equally susceptible of passing through the states of soft iron, steel and cast iron, according to the proportions of charcoal employed. The black oxyd of iron, the state of which appears to be the most uniform, becomes iron, when treated in the crucible with an equal bulk of charcoal in powder: by doubling this quantity it becomes steel. A progressive augmentation gives to it the characters of white and grey cast-iron.

Lastly. M. Clouet observed the same transitions, and always depending on the respective quantities, by treating

Cast-iron and oxyd of iron.

Cast-iron and forged-iron.

Oxyd of iron and iron.

Oxyd of iron and steel.

It requires no more than one-fifth of cast-iron to convert iron into steel.

The iron and the oxyd do not unite intimately: the black oxyd mixed with half the quantity of charcoal that it would require for its reduction affords a soft iron, but possessing little tenacity, of a black colour, and most regularly grained when broken.

One-sixth of oxyd restores common steel to the state of iron, by treating them together, either in the forge or by cementation.

At

At the end of this memoir M. Clouet has given some observations on the method of producing cast-steel, and on the furnaces proper for this purpose.

He determines the nature of the fluxes, the degree of heat, the quality of the crucibles, the precautions to be taken in casting the ingot, the method of forging this kind of steel, the processes to be followed in experiments at a common forge, on two kilogrammes of matter, and the proportions to be given to a reverberating furnace intended to heat at one time four crucibles, each containing from twelve to thirteen kilogrammes of steel.

He remarks, that the ingredients of saline glass cannot be directly employed in this process; that glass, when too fusible, renders the steel difficult to forge; that the steel when kept too long in fusion takes up more glass than is proper; lastly, that the melted matter should be stirred, and the glass taken off carefully before it is cast, that it may not mix with the steel.

After having given the precise observations of M. Clouet, and the practical consequences that he infers from them, it would only remain for us to submit some of the products of his operations, if we did not think it proper to subjoin the results of our own experiments, made by following his processes for the conversion of iron into cast-steel, and to describe at the same time the principal circumstances.

Thirdly. The members of the Mineralogical Council having permitted us to make use of the forge in their laboratory, we put into an Hessian crucible, luted on the outside, six hectogrammes of filings of horse-nails and four of a mixture of equal parts of carbonate of lime (white marble), and baked clay produced from an Hessian crucible; the whole was reduced to a powder.

The mixture was put into a crucible placed on a support in the middle of the forge, the fire of which is kept up through three tubes.

In the first experiment we perceived in about an hour and a half, that the matter was melted; but the crucible had a crack on one side, that extended to almost its whole length, and prevented the mass from being cast.

The operation repeated in the same forge produced an ingot; it forms a small square bar of iron, of from 26 to 27 millimetres.

TO BE CONCLUDED IN OUR NEXT.

Intelligence

Intelligence relating to Arts, Manufactures, &c.

(Authentic Communications for this Department of our Work will be thankfully received.)

Report on the Woollen Manufacture.

AS the House of Commons have thought the state of the Woollen Manufacture of England a subject of sufficient importance to engage their attention, we conceive that we cannot submit to our readers any more authentic or more desirable intelligence than the substance of the Report made by a Committee of the House. We have however condensed it as much as possible, without omitting any of the statements which were of general application.

Report to the House of Commons from the Committee appointed to consider the State of the Woollen Manufacture of England.

The Committee express their satisfaction of finding themselves able to inform the House, that the attention of Parliament has not been called to the Woollen Manufacture in consequence of any decay of its prosperity; which has, on the contrary, been gradually increasing, till at length, while the home consumption has kept pace with the growing population and wealth of the country, the exports of woollen goods have reached to the amount of six million of pounds official, or nine millions real value.

They then proceed to notice the circumstances which led to this discussion, in order to elucidate the causes which in so flourishing a condition of the Woollen Manufacture had brought it under the consideration of Parliament; and report that, in July 1802, considerable riots and outrages took place in Wiltshire and Somersetshire in consequence of an attempt to set up a machine for dressing cloth, called "*a gig-mill*," which was extremely obnoxious to the workmen, and was represented to be the same machine which was prohibited by that name in an antient statute; though considerable doubts existed whether the gig-mill prohibited in that statute be the same machine which now bears the denomination.

Attention having been drawn by this circumstance to the antient laws respecting the Woollen Manufacture, it appears that various penal laws still remained unrepealed, besides that which annexed a penalty to the use of the gig-mill, and that, though for a long course of years they had become obsolete, they might still be called into force; and many masters, who had become obnoxious to their workmen, being threatened with prosecutions for the penalties incurred by the non-observance of them, it became natural, and even necessary, for the master clothiers to look to Parliament for relief. Accordingly application was made to the House of Commons in 1803 for the repeal of these statutes, by many persons concerned in this manufacture; and, on the other hand, various classes also engaged in it presented counter-petitions. The House appointed a Committee to consider the allegations on both sides: the case was investigated, and the evidence reported to the House. The Sessions, however, was far advanced, and it became too late, previous to the Prorogation, to form a satisfactory judgment of this complicated question: the expediency was therefore adopted of suspending the penal laws for a year, with an intention of resuming the consideration of the subject in the ensuing Session; and this suspension was continued till the 25th of March

March 1807, and has been since extended to the same period of 1808. But this was obviously only a temporary policy, and therefore, with a view to final and permanent decision of this great question, in which the interests and feelings of so valuable a part of the community were involved, the subject, together with the petitions, was referred to the consideration of a Committee.

Under these circumstances the Committee proceeded to a careful examination of the various Acts of Parliament (in all 70) which are still in force; and considering how far, at the present day, and in the existing state of the commerce and manufactures of the country, it might be adviseable either to suffer them to continue in operation, or, on the other hand, to explain, alter, or repeal them, they classed all the laws relating to the Woollen Manufacture under the following heads:—1st. Laws for regulating, in various particulars, the conduct of masters and workmen in the Woollen Manufacture, and preventing frauds and embezzlements by journeymen and others. —2d. Laws for preventing the exportation of certain materials and implements used in the Woollen Manufacture. —3d. Laws which controul the manufacturers in the making and selling of cloth, more particularly those which prohibit the use of certain articles of machinery; and also a statute, commonly called "The Weavers' Act," which in certain cases limits the number of looms to be employed in one building: under this class also is arranged the 5 Eliz. ch. 4, or the Apprentice Law, so far as it respects the carrying on the Woollen Manufacture; and several local laws of more or less limited extent, providing against the over-stretching of cloth, and other similar frauds, by requiring it to be stamped and sealed by sworn officers appointed for those purposes.

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The Committee thought the laws comprised in the *first* class wise and salutary; and that this character appeared to belong in a special degree to one very antient statute, which has been amended and enforced by several subsequent Acts, particularly by the 29 Geo. II. ch. 33, for preventing the payment of workmen in goods instead of money; and therefore recommended that all these should remain in force.—They extend also the same recommendation to the laws comprised within the *second* class; these having all been passed in the reign of his present Majesty, and appearing to be founded in sound policy, and to be peculiarly applicable to the present circumstances of this country.—The *third* class is by far the most numerous: many laws of this class are of a very early date, and their contents are such as might be expected from the nature of the commercial principles which prevailed at the periods when they were severally passed. Their general object is to provide against the use of articles or processes, and to prevent the commission of frauds, which it was conceived would be injurious to the quality of the cloth, and (to say nothing of the home-consumer) would, by impairing the credit of our staple manufacture, obstruct its sale in foreign parts. Again, there are others of this class of laws which bear some traces of a jealousy of the manufacturing in favour of the landed interest of the country. Of these statutes many had been amended, and in part repealed, soon after their enactment, and the remainder had sunk into oblivion, and been considered as obsolete.

Considering the different principles of commerce, the Committee did not think it necessary to enter into a detail of the reasons on which they recommend to the House the repeal of the general mass of the above laws, as being at this day not only unnecessary, but, if enforced

forced, utterly inexpedient, or rather extremely injurious. "Least of all," say they, "can such regulations be deemed requisite at the present period, when our manufactures of woollen goods are in the highest credit both at home and abroad, and when the demand for them, great as it already is, appears to be still increasing."

Great differences of opinion having prevailed with respect to some of these statutes, the Committee thought it right to enter more in detail into the consideration of them. One of these is the 5 and 6 Edw. VI. for putting down gig-mills. Witnesses were called to prove that the machine now used under the denomination of the gig-mill, for the purpose, after the cloth comes from the fulling-mill, of raising the nap or wool, (being the very machine, it is contended, against which the antient statute was directed,) is highly injurious to the quality and texture of the cloth; that therefore the law of Edward, for prohibiting its use, ought, if necessary, to be explained and enforced. Evidence of a similar nature and tendency was given respecting the injurious effects of another machine, as yet not much in use, called "The Shearing-Frame," the purpose of which is to cut off the nap or wool after it has been raised, an operation which has hitherto been performed by hand by a particular class of men, called, from their occupation, croppers, shear-men, or cloth-workers. The introduction of this machine was opposed from an idea that it would throw a considerable number of hands out of work.

With respect to the actual effects on the cloth of the gig-mill and the shearing-frame, the Committee report, that decisive evidence has been adduced before them by merchants and manufacturers of the highest credit, and of the greatest experience, to prove that these machines, (especially

(especially the gig-mill, which has been longer and more generally established, under proper regulations, and when carefully employed,) finish the cloth in the most perfect manner; and that manufacturers residing in parts of the country where the gig-mill is not used, frequently send their cloths to a distance to be dressed by it; and the Committee learned, from the information of one of their own members, that by an express stipulation the use of it has been required by the consumers of cloth in a particular foreign market, where it has enhanced their credit and improved their sale. It also appeared in evidence, that alarms, similar to the present, had existed among the workmen at the introduction of several of the machines now in general use, which have gradually subsided as prejudice died away, and the machines are now established, without, as it appears, impairing the comforts, or lessening the numbers of the workmen.

The Committee remark with much satisfaction, that in many instances in which it was apprehended that the introduction of particular machines would throw such a number of people out of employment as to occasion great distress, the result has been very different; for, besides the new occupations for which the attendance on such machines has given occasion, a fresh demand for labour to an immense extent has arisen out of the increased sale of the article, consequent on the cheapness and superior quality of the manufacture; and they think that the system of patents, by which the inventor of any new machine secures to himself for a time the exclusive benefits of his discovery, while at the end of the term they are thrown open to the public, provides in most cases against its too sudden and general establishment, by which a number of workmen might at once be thrown out of employment.

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They next observe, that if the principles on which the use of these particular machines is objected to were once admitted, it would be impossible to define the limit, or to foresee the extent of their application; and that if Parliament had acted on such principles fifty years ago, the Woollen Manufacture would never have attained to nearly its present extent. That the rapid and prodigious increase of late years in the manufactures and commerce of this country is universally known, as well as the effects of that increase on our revenue and national strength. And that in considering the immediate causes of that augmentation, it appears to the Committee, it is principally to be ascribed, under the favour of Providence, to the general spirit of enterprise and industry among a free and enlightened people, left to the unrestrained exercise of their talents in the employment of a vast capital; pushing to the utmost the principle of the division of labour, calling in all the resources of scientific research and mechanical ingenuity; and, finally, availing themselves of all the benefits to be derived from visiting foreign countries, not only for forming new, and confirming old, commercial connections, but for obtaining a personal knowledge of the wants, the taste, the habits, the discoveries, and improvements, the productions and fabricks of other civilized nations, and by thus bringing home facts and suggestions perfecting our existing manufactures, and adding new ones to our domestic stock; opening at the same time new markets for the product of our manufacturing and commercial industry, and qualifying ourselves for supplying them.

The Committee declare it to be their opinion, that by these means alone, and, above all, by the effect of machinery in improving the quality and cheapening the fabrication of our various articles of export, that with a

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continually accumulating weight of taxes, and with all the necessaries and comforts of life gradually increasing in price, the effects of which on the wages of labour could not but be very considerable, our commerce and manufactures have also been increasing in such a degree as to surpass the most sanguine calculations of the ablest political writers who have speculated on the improvements of a future age.

It appeared to them also to be an important consideration, of which we should never lose sight, that we are at this day surrounded by powerful and civilized nations, who are intent on cultivating their mauufactures, and pushing their commerce, and who are more eager to become our competitors in trade, from having witnessed the astonishing effects of our commercial prosperity; and that the attempts which have been made to carry over to foreign countries our machines and implements, and to tempt our artisans to settle in them, evince the importance of machinery, under the direction of a man of approved skill both in constructing and using them; and add, that it is needless to remark how much these attempts would be favoured by our throwing any obstructions in the way of enterprize and ingenuity, and the free application of capital in this country; or that any machines, which should be prohibited here, would infallibly find their way into foreign nations. They therefore cannot but include among the laws of which they recommend the repeal the 5 and 6 Edw. VI. for putting down gig-mills, and also all the other statutes which prohibit, though less directly, the use of particular articles of machinery.

The Committee also recommend the repeal of all the Acts comprized in the third class, controuling the making

making and selling of cloth, excepting only those which prohibit its exportation in an unwrought state.

With respect to the statute, called "The Weaver's Act," (2 and 3 Phil. and Mary,) which, among other regulations, limits the number of looms which persons residing in villages may keep in one house, though its repeal is solicited by petitioners of one class, yet it is highly valued, and the repeal of it strongly opposed by another very respectable class of petitioners. And in order that the House might enter more distinctly into the reasonings which belong to this part of the subject, the Committee state that there are three different modes of carrying on the Woollen Manufacture—that of the master clothier of the West of England, the factory, and the domestic system; and they enter at considerable length into the merits and disadvantages of each: but as the information detailed, and the observations drawn from it, are mostly of local application only, we proceed to the result of the investigation; in which, while they freely recognize the merits and value of the domestic system, they at the same time feel it their duty to declare it as their decided opinion, that the apprehensions entertained of its being rooted out by the factory system, are, at present at least, wholly without foundation; for, happily, the merchant, no less than the domestic manufacturer, finds his interest and convenience promoted by the domestic system. While it continues, he is able to carry on his trade with far less capital than if he were to be the manufacturer of all his own cloth; and they are happy in being able to produce one irrefragable fact in corroboration of the sentiments they have expressed on this question. This is, that the quantity of cloth manufactured by the domestic system has increased immensely of late years, not only in itself, but as compared with the

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quantity made in factories: it appearing from the returns made for the last fourteen years to the justices of Yorkshire at Pontefract session, that in the year 1792, the greatest year of export then known, there were manufactured 190,332 pieces of broad, and 150,666 pieces of narrow cloth, while the quantity of cloth manufactured in 1805 amounted to 300,237 pieces of broad, and 165,847 pieces of narrow cloth. It is besides, they admit, an acknowledged fact, that the owners of factories are often among the most extensive purchasers at the cloth halls, where they buy from the domestic clothier the articles manufactured by him at home, in order to answer a great and sudden demand; while under their own superintendance they make their fancy goods, and any articles of a newer, more costly, or more delicate quality, to which they are enabled, in consequence of the domestic system, to apply a much larger proportion of their capital. Thus the two systems, instead of rivalling, are mutual aids to each other; each supplying the other's defects, and promoting the other's prosperity.' The Committee, therefore, feel it to be their duty to recommend the repeal of 2 and 3 Phil. and Mary, or the Weavers Act.

In directing their attention to the system of apprenticeship, the Committee place the 5 Eliz. ch. 4. among those statutes which controul the manufacturer in the making of his cloth, inasmuch as it describes the peculiar description of persons who shall alone be suffered to employ either themselves or others in the Woollen Manufacture, by prohibiting the engaging or working in it to all who have not served a regular apprenticeship under indentures, or as apprentices (for the law makes this distinction) for the term of seven years. They observe, that apprenticeship is obviously more congenial to the

domestic

domestic than the factory-system, and that it of course prevails more in the North than in the West of England; and the Yorkshire manufacturers candidly allow that they wish to retain this law on account of its tending to embarrass the factory-system, and thereby to counteract its growth. The Committee, however, considering that the manufacturers of that part where apprenticeships most prevail, have not been uniformly steady in their conduct in this particular, but have admitted of many relaxations, and remarking that the manufactures in other parts are executed with no less skill, though many persons are employed in them who have not served regular apprenticeships; and, adverting to the various considerations laid before them, would by no means wish absolutely to prohibit apprenticeships, or, by rendering them illegal, to prevent their being entered into, where any persons, whether in a commercial or a moral view, find them suited to their circumstances, or agreeable to their inclinations; they yet feel it their duty, so far as regards the Woollen Manufacture, to recommend the repeal of those clauses of the 5 Eliz. ch. 4, which renders apprenticeships compulsory.

The Committee considered the Stamping Laws, as they are called, intended chiefly for securing the just measure of cloth; and these laws are various for different districts. They had not, however, been able to obtain sufficient information to enable them to form a satisfactory judgment on this point; in which the opinion even of intelligent and experienced men appear in some degree to differ. They think that the different circumstances of the North and the West of England may require a correspnoding difference in the legal regulations to be enforced in them respectively. In the North of England, where by far the larger part of the manufac-

ture

ture is sold in a crowded market, and in an unfinished state, sound policy may perhaps be thought to prescribe some regulations of this sort. But in the West of England, where the circumstances are different, the same reasonings do not apply, and therefore, so far as the West of England is concerned, the Committee recommend their repeal.

They would have here closed their report, but in the progress of their inquiries some circumstances came to the knowledge of the Committee, which, whether regarded in their relation to the well-being of Woollen Manufactures, or that of the country at large, appeared to be of a highly-interesting nature. They then give an account of the existence in the clothing district of Yorkshire, of an institution or society consisting chiefly of clothworkers or shearmen; and though it was alledged that the object of the institution, and of the payments made to it, was to effect and conduct the application made to Parliament for preventing the repeal of laws which the parties conceived to be necessary to the prosperity of the manufacture, yet various circumstances concurred to render this explanation far from satisfactory, and strongly to suggest the idea of a connection with some other transaction which had taken place not long before in the manufacturing district. An account is then subjoined of various illegal and incendiary combinations, and an anonymous letter is inserted, directed to one of the fire-offices in London, desiring them not to insure any factories where machines were employed, for they would inevitably be destroyed; and an allusion was made to a particular factory, which had been destroyed by fire but a short time before. This letter was attended with the singular circumstance of being dated the same day on which a general secret meeting of the institution of cloth-workers

workers was held at Leeds. The Committee remark how liable such institutions are to be abused, when originally formed for an innocent, and even a meritorious purpose, and adduce the history of this very institution as an example; the funds of which were originally applied to the relief of the sick, though they were afterwards diverted to very different purposes. "It must be obvious," say they, "to any considerate and experienced mind, how naturally in societies of this sort designing and bad men, men of daring spirits and discontented tempers, naturally acquire the ascendency; how surely also they extend influence till by degrees they obtain the direction of the whole body. The least of the evils to be apprehended (though an evil of itself abundanly sufficient to accomplish the ruin, not only of any particular branch of trade, but even of the whole commercial greatness of our country) is, the progressive rise of wages, which among all classes of workmen must be the inevitable, though gradual, result of such a society's operations."

The Committee next proceed to remark, that such institutions are, in their ultimate tendencies, still more alarming in a political than in a commercial point of view. They conceive it would be departing from their proper province, if they were to suggest an opinion as to the expediency of any alteration in the existing laws against illegal combinations; but as the summary view here exhibited discloses the existence of a systematic and organized plan, they conceive they would have been wanting in their public duty if they had closed this report without laying before the House the general outline of the information they had obtained on the subject. It deserves, in their judgement, the most deliberate and serious consideration of Parliament.

List of Patents for Inventions, &c.

(Continued from Vol. X. Page 464.)

RUDOLPHE CABANEL, of Lambeth, Surrey, Engineer; for improvements in the construction of wheels and axle-trees, by which will be obtained the following and other advantages: the carriage will be less liable to overturn; and, in consequence of the friction being almost wholly done away, will move with much less power or labour of the horses; the necessary oil or grease being supplied without separating the wheel from the axle, are so securely attached as to obviate the frequent accident of the wheels coming off, and should they be injured, any other wheel, whether cart, coach, or waggon, may be substituted as a temporary resource, and a wheel or wheels may be shifted at pleasure. Dated May 5, 1807.

JAMES WOODS, of Ormskirk, Lancashire, Chair-maker; for a machine for churning milk and cream, and which may be used as a pump. Dated May 9, 1807.

WILLIAM CUBITT, of Walsham, Norfolk, Engineer; for a method of equalizing the motion of the sails of windmills. Dated May 9, 1807.

FRANCIS FROME, of Spring-Gardens, Westminster, Middlesex, Gentleman; for an improved portable boot-jack, with a guard to prevent the possibility of any accident to the legs or ankles in pulling off the boots. Dated May 11, 1807.

WILLIAM BAINBRIDGE, of Holborn, London, Musical Instrument-maker; for improvements on the flageolet or English flute. Dated May 14, 1807.

JOHN ROEBUCK, of Warren-street, St. Pancras, Middlesex, Civil Engineer; for improvements in a machine called *The Caledonian Balance.* Dated May 14, 1807.

CHESTER GOULD, of Walworth, Surrey, Gent.; for improvements on a machine for mangling linen and other articles required to be mangled. Dated May 26, 1807.

THE

REPERTORY

OF

ARTS, MANUFACTURES,

AND

AGRICULTURE.

No. LXII. SECOND SERIES. July 1807.

Specification of the Patent granted to WILLIAM CUBITT, *of Bacton Wood Mills, North Walsham, in the County of Norfolk, Engineer; for a Method of equalizing the Motion of the Sails of Windmills.* Dated May 9, 1807.

With a Plate.

TO all to whom these presents shall come, &c. Now KNOW YE, that in compliance with the said proviso, I the said William Cubitt do hereby describe my new method of equalizing the motion of windmill sails in manner following; that is to say: My invention consists in applying to windmills an apparatus or contrivance which shall cause the vanes, constructed or formed in a new and peculiar manner, to regulate themselves, so as to preserve an uniform velocity under those circumstances in which the wind would otherwise irregularly impel them, as is the case with the sails or vanes of mills of the present construction. I accomplish this object by forming the vanes (for the sake of lightness) with fewer cross bars or shrouds than in the common method, and filling up the remaining open space with small flat surfaces, formed either of boards or sheet iron painted, or any other fit substance (though I prefer and recommend them to be made of a framing of wood, covered over with canvas). I hang or suspend the same on their ends by gudgeons, pivots, centres, or any other convenient method, so as to open and shut like valves (for which reason I shall hereafter so call them;) preferring always to have the centre of motion as near the upper longitudinal edge of the valve as possible, as shewn in the drawing *b b*, Fig. 1, (Plate IV.) which exhibits a valve detached. I apply these valves to vanes of the present construction, by suspending them to the cross bars or shrouds of the vane by their longitudinal edges, fastened thereto by joints or otherwise, as may be preferred. These vanes constructed of valves as above described, and which are represented in the drawing Fig. 2, present a greater or less surface to the wind, according as it acts with more or less force on them; and if the wind be very strong or high, the valves by its impulse would turn their edges to it, and their surfaces parallel to the direction of the wind. The vanes would consequently remain stationary, or at least have but little motion; but to obviate this circumstance taking place, I apply an apparatus which shall cause the valves always to present their flat surfaces to the wind, or such portion of their surfaces as may be desirable. The apparatus which I have usually applied is exhibited in the drawings Figs. 3 and 4, which last figure shews two modes of performing this object; though it must be evident that various other means may be applied to produce the same effect on the valves; and I therefore do not mean to confine myself to those precise modes of effecting it, but consider it unnecessary here to detail

detail others, as the examples exhibited in the drawings fully ascertain the sort of apparatus requisite.

Description of the Drawings.

(Plate IV.)

Fig. 2 represents a set of vanes, in which A A shew the valves turned to the wind, and their surfaces all exposed at right angles with the direction of the wind. B B exhibit the vanes as close reefed, or the valves with their edges to the wind, so that it can have no effect upon them except on their edges, which must be trifling. In the drawing the vanes are exhibited as having the whip down the middle, with valves on both sides; but it is evident that the vanes may be constructed with the whip placed in the usual way, and have valves on one side only, which is the method I usually adopt in applying them to vanes of the present form.

Fig. 3 represents a side view of the apparatus for regulating the valves; and Fig. 4 is a section of the same, exhibiting two methods of performing this operation. A represents the shaft, which is bored through its centre to admit an iron rod B to pass freely through it: one end of this rod is made to turn in a box C, which is fastened to a toothed rack D, whose teeth take into those of a pinion E, upon the axis of which is a sheave F, with a groove on its circumference to receive a rope G, to which is hung a weight, shewn at H, Fig. 3, and which must be sufficient to regulate the force of the wind upon the valves, though no precise quantity of weight can be herein specified, as the same must be adjusted by experiment, or by the quantity of work to be performed by the mill. On the top of the rack D is a roller I, which serves to keep the rack and pinion in the proper depth of gear. The end of the rod B, which turns in the box C,

 has

has a knob or onion on it, by which it can be moved endwise while it is turning in the box C. In the other end of the rod is fixed a boss or plate of iron K, with a gudgeon projecting from each side, on which are the bridles or leaders L L, which permit the levers M M to describe a curve with their ends while the iron rod B moves in a straight line. N N are two studs or props fixed to the stock O of the sail; on the ends of which props the levers M M move, and communicate their motion to the racks PP, the teeth of which take into the pinions Q Q, on the axis of which (according to one method herein exhibited, Fig. 5,) is fixed a strong iron stud R, which is attached to a rack or slider S. Iron studs or levers are fixed at one end in this slider S by a pin or gudgeon, and at the other made fast to the valves *a*, which move on gudgeons as before described.

The other method of regulating the valves is shewn at Fig. 6, where, instead of the studs or levers, the valves may be moved by having pinions fixed to them, and working with teeth in a rack or slider, as at T. V V are rollers to keep the racks P in their gear. The operation of this apparatus will be clearly comprehended by imagining that if the hook 4 on the rope G be pulled down to 5, the sheave F with the pinion E will turn at the same time, putting in motion the rack D with the rod B, which will bring the levers M M into the position represented by the dotted lines: the racks P will have turned the pinions Q till the sliders S and T with the studs or levers, or racks, (according to whichever method may be used,) bring the valves into the position of the dotted lines, in which position they are represented as having all their surfaces to the wind; therefore, if a sufficient weight be hung to the hook 4, the weight will decend to 5, and keep the valves in the situation of the dotted

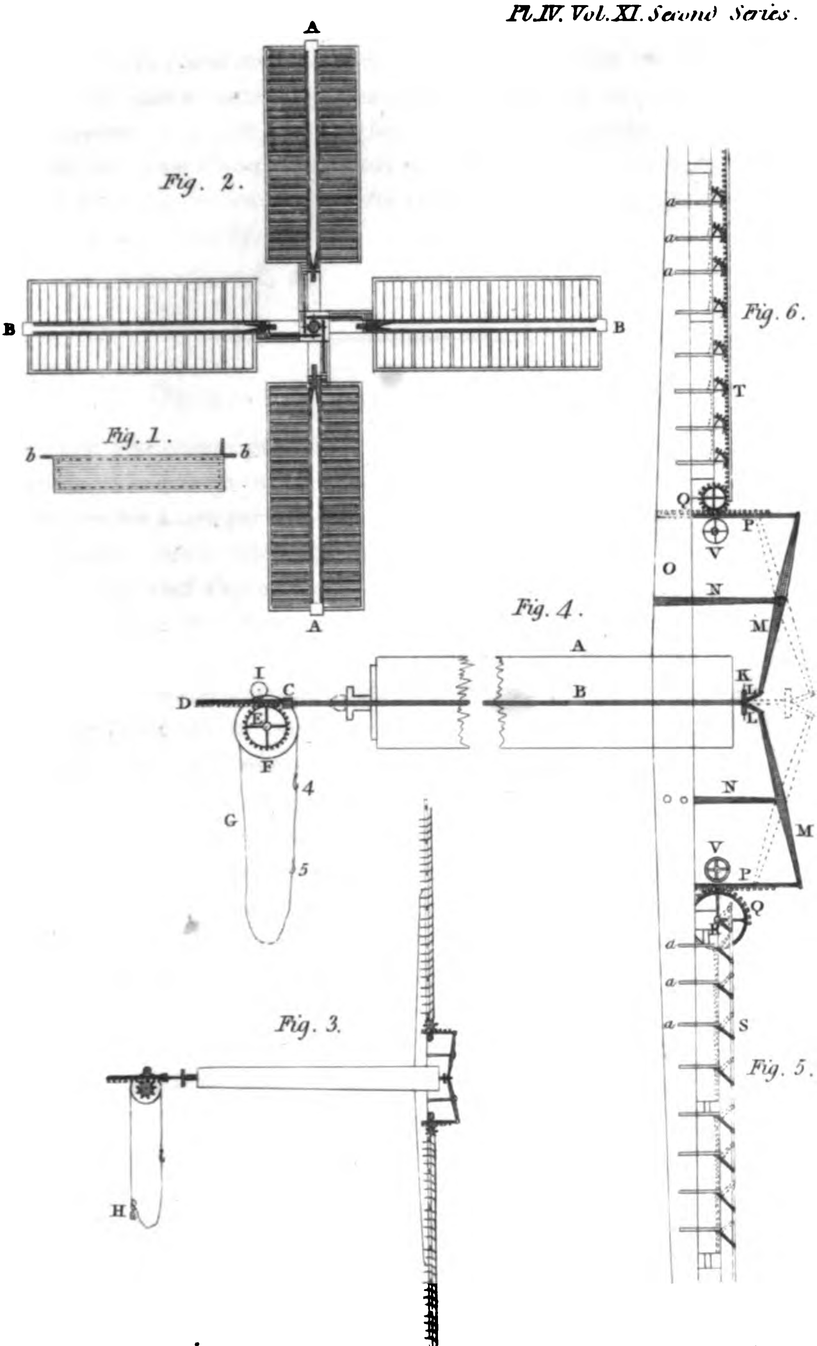


Fig. 2.
A
B
B
A
Fig. 1.
b
b
Fig. 4.
A
B
D
I
C
E
F
G
4
5
K
L
L
Fig. 3.
H
Fig. 6.
T
Q
P
V
O
N
M
N
M
V
P
Q
R
S
a
Fig. 5.

dotted lines; and supposing the wind to blow upon them with too much force in this state, they will turn on their gudgeons, and raise the weights, so that the superfluous wind will pass through or between them, without exerting an irregular force upon the vanes, so as to produce an unequal velocity.

In witness whereof, &c.

Observations by the Patentee.

The advantages peculiar to this new method of equalizing the motion of windmill sails will appear more striking by a comparison with the inconveniences of those heretofore used, whether those of the common sort or those that reef themselves by means of their centrifugal force. The first require the constant attention of the miller to every gale of wind that comes; and it is frequently with the greatest difficulty and danger that he can get his cloth in quickly enough to avoid the storm; which if he successfully accomplishes, it is with the loss of much time. With the second, though they save the time and trouble of stopping to reef, they are by no means void of danger, as the sails receive the whole impulse of the gale, and attain a very great velocity before they can reef themselves at all, and thereby cause a motion in the mill as unequal as the wind which turns it; besides the extra wear and tear of the machinery, which suffers very much from such unequal motion. And should a mill of either of these constructions be left standing still with all the cloth out, and be taken with a sudden gale of wind, great risk is run of losing all the sails; whereas in such case these sails of mine are perfectly safe, as there can never be more force exerted upon the sails

sails in any gale than is sufficient to do the work of the mill, whether they be in motion or at rest, without ever altering their angle of weather.

Another great advantage is, that when they are close reefed they do not present so much surface to the wind as those of any other construction, let them be taken in any direction whatever.

In addition to the aforesaid advantages, which are peculiar to my improved sails, the ease and expedition with which they may be reefed and clothed by hand is an additional recommendation to them, especially as it requires neither judgment nor experience in the person who does it; for by taking off the weight and pulling the rope, all the sails may be close reefed in the short space of three or four seconds. I therefore submit it to the public, as a necessary and most valuable acquisition to all those whose business depends on windmills, not doubting but it will be found upon trial to be an invention of real utility, to preserve the mills, and render their motion as steady as that of watermills.

I would also strongly recommend it to those gentlemen whose interest consists in having large marshes drained by windmills, to apply these patent sails to that purpose, as they might be left at work night or day perfectly safe without any one to attend them.

Persons desirous of adopting this improved method of equalizing the motion of windmills will be treated with on reasonable terms, and immediate attention will be given to any applications addressed to me, either personally or by letter.

Specification

Specification of the Patent granted to SAMUEL PHELPS, *of Cuper's Bridge, Lambeth, in the County of Surrey, Esq.; for a Method of making Kelp, Barilla, or other vegetable or mineral Alkali by Fermentation or other Means, in Addition to Combustion.* Dated June 17, 1806.

TO all to whom these presents shall come, &c. Now KNOW YE, that in compliance with the said proviso I the said Samuel Phelps do hereby declare that my said invention, and the manner in which the same is to be performed, is described in manner following; that is to say: I cut or collect kali, salicornia, sea wrack, or other plants or weeds which afford the mineral alkali; or furmitary, wormwood, heath, or other plants or weeds which afford the vegetable alkali; and after slightly drying the same, by exposure to the air, or by any other cheap and convenient means, I mix the said plants or weeds with straw, light dung, hay, or any dried plants or weeds, in order to give a greater tenacity or firmness to the mass. And I do form the same into stacks, like hay and thatch, or cover it, in order that the whole may be defended from rain, and may undergo the spontaneous chemical change called fermentation, putrefaction or rotting, or by whatever words or terms the said change may be designated and known. And when the said spontaneous change hath taken place, I do burn the mass in an open pit, or kiln, or furnace, in the usual manner, with the addition of wood, or any other fuel which shall not be of such a nature as to render the ashes impure and unfit to afford a good alkali; and towards the end of the combustion I raise the fire, so as to fuse the saline residue. Or otherwise, when the stacks have remained till very completely rotten, I do separate a part of the alkali by first

first exposing the mass to the air to dry and become carbonated, and then separating the saline matter by lixiviation and evaporation; and, lastly, by incineration in the pit, kiln, or furnace, and the subsequent treatment as usually practised, and herein-before described as practised along with my said invention.

And farther, in order that my said improved method may be more fully and completely understood, I do declare that I have ascertained, by long observation and experiments, that the product of alkali in wet seasons is much less in quantity than that which is obtained from plants of the same nature and quality without exposure to the action of rains; and that the cause of the said effect is, that the alkali doth naturally exude from the plants during exposure to the air, and is carried off from time to time by the showers that fall, so that the plant or weed becomes exhausted previous to the combustion to which it is afterwards subjected.

And I do farther declare, that the fermentative or putrefactive process which takes place in the said plants or weeds, when stacked and defended from the weather according to my said method, doth prevent the said waste and exhausting of the alkali; and that the whole treatment herein directed to be adopted and used, with regard to the said plants or weeds, doth favour the general action of the chemical affinities, so as to afford a greater quantity of alkali from like quantities of the said plants or weeds than is afforded by the ordinary methods of extracting, producing, or making the said alkali.

In witness whereof, &c.

Specification

Specification of the Patent granted to WILLIAM SHOTWELL, *of the City of New York, in America, now residing in London, Merchant; for certain Machines, and Improvements upon Machines, for the Purpose of bleaching, washing, and cleansing Linen, and every other Article that can be done by Hand, and which are applicable to divers other Purposes.*

Dated April 21, 1807.

With Engravings.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said William Shotwell do hereby declare that my said invention is described as follows; that is to say: I construct a wooden box of such dimensions as I may deem proper for the purpose desired; but generally I prefer to make it oblong, of about three feet and a half in length, fourteen inches wide, and about fourteen inches deep, taking care to put the same together so as to render it water-tight, but making a small hole through the bottom, near to one end, to draw off the water when done with, which hole is at other times stopped up by a bung or other contrivance. To this box I affix legs or feet, so as to raise it about three feet from the ground; and I cover it over with boards laid crosswise about four and a half inches at each end, and which I make to project outwards to any extent, and also over each side so as to form a table. The remaining open space I cover over with two flaps, excepting a space of about nine eighths of an inch; one of these flaps I hang with hinges to the outward or back side, so as to form a door to lift up, and the other is simply laid in grooves, and fastened down by wooden bolts, or otherwise. Into the open space between the boards I introduce a compresser or washing implement, generally of the shape exhibited in the drawings, Fig. 1 and 2 (Plate V.), though any other sort may be used if thought proper; and to the top of this compresser or washing implement I attach a lever in the manner shewn at B in the drawing Fig. 3 and 4, though it is evident that any other mode of propelling the compresser or washing implement may be employed, or the lever may be attached in any other way, if more convenient.

Instead of having the compresser or washing implement on the above plan, the box may be entirely covered over with boards, flaps, or doors, as before mentioned; and pieces of wood may be nailed, or otherwise fastened, to the inside, so as to form ridges or cleets about one and a half inch from the top, on which the compresser or washing implement may be suspended and made to slide; the whole of the upper part of the compresser or washing implement will in this case be needless, and the lower part, which will be in the box, is to be affixed to a lengthened piece of wood C (Fig. 3), which is to be brought through a hole made in the end of the machine, opposite to that at which the lever B is placed. This lengthened piece of wood is connected with the lever in the manner shewn by the dotted lines C D in the drawing Fig. 3, or in any other way most convenient.

The foul linen to be washed by this machine is evidently to be placed on each side of the compresser or washing implement, which is to be propelled backwards and forwards, either by a lever as before described, or by any other mechanical contrivance that may be preferred.

If

If it be convenient to admit steam into the machine, the water therein will be kept to a proper heat, and the cloaths will be whiter or better bleached than in the usual way of washing, without the application of steam. The steam may be introduced into the washing machine by means of a pipe communicating therewith and the boiler or copper, or in any other convenient mode; and in some cases, instead of using a copper or boiler, I heat the water, or generate steam, by causing an iron, or other, proper pipe communicating with the cistern or reservoir of cold water, to pass through a fire placed between such cistern or reservoir and the washing machine, which I believe to be a new method of procuring steam. In case steam should be generated more abundantly than can be readily condensed by the water in the washing machine, a hole should be contrived in the top of the machine to permit its escape. If required, this washing machine may, with a trifling alteration, be made to act as a churn. In such case I take away the lower part of the compresser or washing implement, and substitute a suitable dash, which is all the variation required.

Description of the Drawings.

(Figs. 1, 2, 3, and 4, Plate V.)

Fig. 1 exhibits a side view of the compresser or washing implement.

Fig. 2 exhibits a front view of the same, or that part which faces the end of the machine.

Fig. 3 is a side view of the machine complete. A the oblong box, with small inclinations at each end, as shewn at the dotted lines *a a*, which cause the linen to turn more about than they otherwise would every time the compresser or washing implement approaches them. B shews one way of connecting the lever to the compresser or washing implement, and the dotted lines C D exhibit another mode. E shews a mortise to support a tenant board, on which the lever B works, which is more clearly shewn by Fig. 4, which is an end view of the washing machine.

I construct another sort of machine in the following manner, viz. Instead of making, as before described, an oblong box, I form a barrel or box, which I place horizontally on axes at each end, which I prefer to make to turn in friction-boxes, constructed in a new and advantageous way, as will be hereinafter described; and which I propose as an improvement on Beetham's washing machine, and every other washing machine where axles are used; and the same is turned round by a crank at either axle, as may be judged proper, or by any other way; and I place the said barrel or box on a proper and convenient framing, as may be seen by Fig. 5 and 6 in the drawing, to which I generally attach a box or other convenient substitute immediately under the washing barrel or box A, to receive the dirty water or suds from the barrel or box, in which there is a hole B to permit its escape into the box D, in which there is also a hole to draw off the same when done with. In the aforesaid barrel or box I also make another hole C, sufficiently large to put in and take out the cloaths or other articles to be cleansed or washed, which I stop up with a cork or metallic or other bung, and which I usually secure by a bar, one end of which I put under a square staple, and the other end keep pressed down by pushing it under a half staple, though the hole may be stopped up and secured by any other mode equally convenient. On the inside of this barrel or box I affix one or more ribs, as in in the common horizontal barrel churn, only where they have holes I avoid them, excepting one that it may be proper to have next the bung B'. I take care also to round off all sharp corners that might injure the cloaths, and that the ribs and every part of the inside of the barrel be made perfectly smooth and free from splinters. Instead of ribs as above described, the effect desired from them might be obtained by attaching smooth wooden pins or pegs to the interior of the barrel. When steam is to be employed in this machine, as in the one before described, the same must be introduced through one of the axes, which must be perforated for that purpose, and the other axis should also be perforated to permit the escape of any superabundance.

If required, this revolving machine may be applied to condense steam for various useful purposes; it should then be constructed either entirely plain on the inside, or so as that when it has a little water in it, and is turned round on its axis, it produces something like a shower. In such cases, the barrel may be made either of wood, or any thin metallic substance, which I prefer. For the above purpose, the machine is of course to be placed in cold water, so that as great a portion of the exterior surface of the barrel or box as may be judged proper shall continually revolve in cold water; or any other means may be adopted at pleasure to produce this effect.

My new and improved method of applying friction rollers varies from the usual mode, inasmuch as that, instead of fixing them to turn on individual axes, I place them loosely within a brass or other case or cylinder, and permit them merely to revolve round the axle; and I secure them from getting out of their proper place by having a small groove or grooves, say of about one eighth

eighth of an inch wide and deep, cut round the circumference of each roller, into which a projection or tongue, cast or made in the interior surface of the outer case or cylinder for that purpose, is inserted, which nearly fills up the groove or grooves in the rollers, and thereby prevents the rollers from moving to either side; or I accomplish the same end by making or casting the outer case or cylinder with a rim on each side or end projecting a small matter towards the centre, which rims are to be made with holes as near the outer cylinder as possible, to permit wet to escape. When I apply them to purposes where it would be proper to preserve oil or grease among the rollers, the rims attached to the cylinder should be made with a turning inwards of about one eighth of an inch, so as to form a groove; and the rims should of course in such case have no holes. The rollers must also be made smaller at both ends, so that they may traverse freely under this groove or turning in; and it will be necessary to leave a space through one of the grooves, sufficiently large for the ends of the rollers to pass through into the cylinder, which space should be closed up after all the rollers have been put in, though it may be left open.

I purpose to apply these friction boxes to various other purposes, such as mill machinery, and sheaves for ships' blocks, and indeed in all cases where the diminution of friction be desirable.

I propose affixing the friction boxes in the washing machines, or in any other apparatus or machinery in which they may be employed, in a manner which will save much time and labour usually bestowed in fixing them in the way now commonly practised, which I believe to be a new invention; though, having practised it in America, under the sanction of a patent I obtained in that

that country, I am not certain that it may not from that cause have been made known in England previous to the date of this patent; and therefore I do not absolutely claim it as a part of my present patent. I cast or make the outer surface of the cylinder with small prominences or other irregularities, so as to make it rough; and I make the interior of the place wherein the friction box is to be inserted also rough or irregular, by cross carps or any other convenient means, and fill up the space between the two rough surfaces by pouring in fused metal, which, when cold, will be sufficiently hard to answer the purpose intended, but yet not so brittle as to be liable to crack when in use. The solder or mixture I generally use consists of 25lb. of pewter, and 1lb. of regulus of antimony. The above mode may be employed for the affixing every other sort of bush or box.

In witness whereof, &c.

Specification of the Patent granted to JAMES WOODS, *of Ormskirk, in the County of Lancaster, Chair-maker; for a Machine for churning Milk and Cream, and which may be used as a Pump.* Dated May 9, 1807.

With an Engraving.

TO all to whom these presents shall come, &c. Now KNOW YE, that my said invention consists in working the common churn by an apparatus with which the cream or milk can be agitated with more regularity, less fatigue, and considerably more effect than in the common way.

This apparatus is described as follows.

A B C

A B C D E F G, Fig. 7, (Plate V.) is a frame of wood, firmly put together, and made of the proper strength and dimensions which in all cases will be too obvious to require description. H I is a long beam or lever fastened to the upright piece E by a strong hinge, and passing through a long mortise, made in the upper half of the piece G. K L a beam about thirty-six inches long, passing through the long mortise in the piece G, and turning on a metallic centre, at about twelve inches from the end K, and whose bushes are fixed on each side of the mortise. To the end K is hung a weight, or a box to contain weights, sufficient to raise the beam H I, with the proper velocity, by the end L pressing against the under side of it. At the end of the beam L three friction rollers are fixed ; one to run against each side of the long lever, and the other underneath it. M is a rod of iron, fixed at each end by hinges to the upright piece G, and the box of weights, in order to give steadiness to its motion. At the end of the top piece E F a spiral spring is fixed to prevent noise by the beam striking against the end of the top piece ; and a similar spring is fixed in the mortise of the pillar G just above the centre of the beam K L, to break the blow, and to prevent noise there also.

In witness whereof, &c.

Specification

Fig. 7.

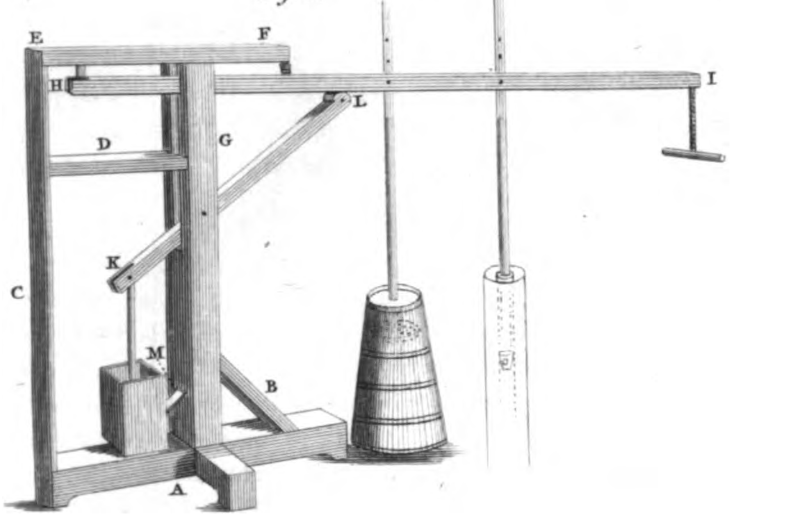


Fig. 2.

Fig. 5.

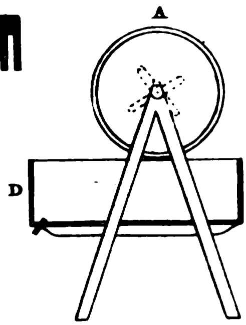


Fig. 4.

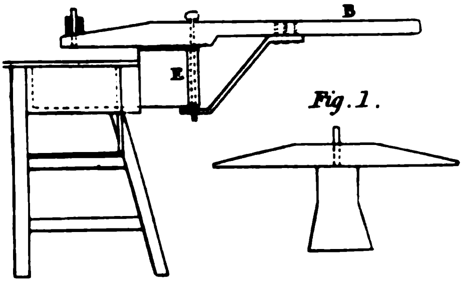


Fig. 1.

Fig. 6.

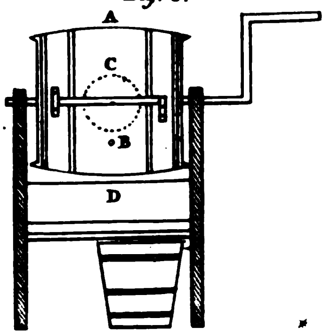
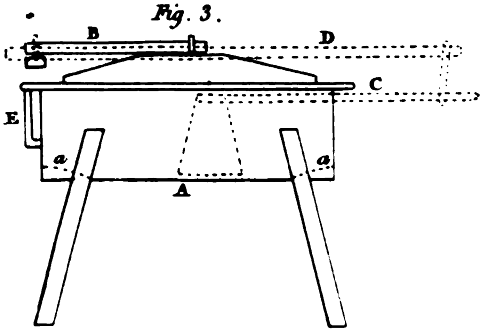


Fig. 3.



Specification of the Patent granted to Elihu White, *of Threadneedle-street, in the City of London, Gentleman; for a Machine for casting or founding Types, Letters, Spaces, and Quadrates, usually made use of in Printing.*

Dated October 23, 1806.

With a Plate.

To all to whom these presents shall come, &c. Now know ye, that in compliance with the said proviso, I the said Elihu White do hereby declare that my said invention is described in manner following; that is to say: With four pieces of brass I construct a square frame, described in the drawing hereunto annexed. (See Plate VI.) A A are two side bits or pieces. B the head block, and C the heel block. On the under-side of each of the side bits I secure a plate of metal, making it to project within the square frame; a part of one of which is seen in the drawing marked I. These I call sliding ways; and they are made to extend nearly up to the head block. These ways support a broad plate of metal, called the slider plate; the two ends of which rest on the slider ways, and are fitted to slide back and forward on the same. This slider plate is not seen in the drawing, because covered by the other apparatus. On the upper side of this plate, and along the edge farthest from the head block, I place a narrow bar of metal, rising sufficiently above the plate to form an exact surface with the two side bits A A. The back part of this bar is seen at G. Over the bar I place a broad thin bar of metal marked E, the ends of which rest on the side bits A A. The slider plate, the bar G, and the bar E, are screwed together. The space between the side bits AA I fill with narrow bits of metal, running parallel with the side bit, as described in the drawing marked M and F. These I distinguish by the names of male and female sliders. These sliders rest on the slider plate, and form an exact surface with the two side bits A A, as is shewn in the drawing. The depth of these sliders is precisely equal to the length of the body of the letter to be cast in the machine, and the thickness of the male sliders I make precisely equal to the size of the body of the letter I wish the machine to cast. No exactness is requisite in the thickness of the female sliders. The end of the sliders farthest from the head block B pass under the bar E, and each female slider is held by a screw or pin passing through the bar E and slider, and unto the slider plate below. The female sliders reach from the bar G to the head block B, when the slider plate is moved forward as far as the machinery will admit; but the male sliders, although they pass under the bar E, do not reach the bar G by about one inch. In the upper edge of each male slider is a stud or pin, about half an inch in height, marked N. Across the sliders I place a regulating bar marked L L, which is intire at its two ends, but open, or perforated with a long hole or space in the middle, and is secured to the two side bits by screws. In the anterior or foremost part of the said regulating bar L, I place a row of adjusting screws X, for the purpose of stopping the studs of the male sliders, each respectively according to the face of the letter intended to be cast; or the said regulation may be effected by notches cut in the edge of the bar, or by pieces of a fit thickness respectively screwed on, or fixed, or properly applied in their places. And I do also in preference (though the same is of less consequence) make the same kinds of adjustment at the posterior or other edge of the said opening, in order

der that all the letters may be pushed out at the same time. The studs of the male sliders in the drawing appear through the opening in this bar. On the bar G is secured or fastened a piece of metal marked P P. The large screw D, which passed through the heel block C, is fastened to the piece P P by a key S; and as the slider plate, and the bar G, and the bar E, and the sliders F P, are all thus secured together, the whole will be made to slide back and forward on the sliding ways I, and under the bar L, at pleasure, by turning the screw D. If the screw be turned to the right, the whole will be carried forward until the studs in the male sliders come in contact with the front or foremost half of the regulating bar, or the screws which pass through it, which will prevent their reaching the head block; whereas the female sliders having no studs to obstruct their progress, will be driven home against the head block, by which means certain spaces, T T T T T, &c. will be left open along the head block, for the body of the latter; and by turning the screw to the left the whole will be drawn back until the studs meet the after-half of the regulating bar, by which they will be stopped; while the female sliders will still move back until the letters are quite clear of the sliders, so as to fall or be taken out. W W represent two wedge-formed pieces fixed in the angles between the side pieces of the frame and the head block, which, by acting against the outer female sliders at the end of the rim, do cause the whole set of sliders to apply themselves firmly against each other, and render the spaces or cavities T T, &c. more perfect and fit to receive the metal. Or the effect of the said wedge-pieces may be produced by springs, or any other suitable re-action. To the outer and lower edge of the head block, or nearly at

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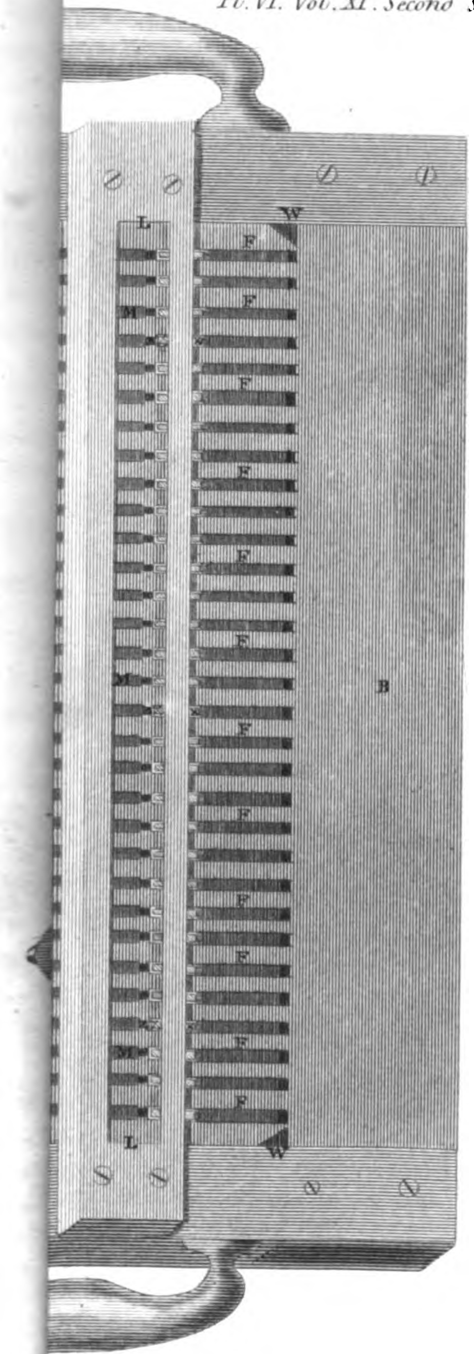
that part, I fix a broad bar of metal, moveable on a hinge or joints, the pins, axes, or pivots of which are parallel to the said edge. I call this bar the matrix bar. It is something wider than the head block, and about the same length; and in or upon the face of the matrix bar opposite to B is a wide groove, into which is fitted a metallic box, or long cell, capable of holding as many matrixes as the machine will cast letters at a single cast. The said matrixes are secured in the box by wedges or screws or by any other fit method. When letters are to be cast, the bar containing the matrix box is pressed up to the under part or face of the head block and sliders, and will then bring the matrixes exactly under the spaces T T, &c. kept open by the sliders of the body of the letters, and ready to receive the metal when poured therein. On the upper side of the head block, and in a line with its inner face or edge T T, &c. I secure a square bar of metal, forming one half of a kind of trough to receive and conduct the metal to the spaces T T, &c. The other half of the said trough lies across the ends of the sliders, and is connected at the two extremities to two bars or guides, which are fitted to slide upon the side pieces A A of the frame, and are screwed to the bar E, so as that the said last-mentioned half shall be moveable back and forward at the same time, and by the same action which moves the sliders, and shall be applied against the other half when the sliders have moved as far forward as the construction of the machinery will admit. In the two halves of the matrix bar are cut apertures through which the metal is poured into the moulds to make the types.

And, lastly, I do hereby declare that the parts of the said machine are capable of being altered in various particulars,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ticulars, not only in the respective forms, materials, and dimensions thereof, but in the means and methods of framing, moving, guiding, and adjusting the same'; and that the said alterations are such as will readily be perceived without farther explanation by any competent workman.

And farther, that the method of using the said machine for the purposes aforesaid is sufficiently manifest from the description herein-before given.

In witness whereof, &c.

Description of a Boat contrived so as to possess superior Staunchness and Strength. By Mr. J. W. Boswell.

Communicated to the Editors by the Author.

Gentlemen,

After what I have mentioned in former Papers inserted in your very useful work of motives and intentions in the communication of inventions, it will, I hope, be unnecessary to add any more on the subject, and I shall therefore at once proceed to my object.

While the ship Economy (described in the Repertory of Arts, &c. vol. IV. p. 430) was on the stocks, I had a boat made to tow in planks, timber, &c. to be used in the ship while building, and afterwards to serve her at sea. It occurred to me then that, as boats were extremely liable to become leaky from their frequent removal out of the water, some improvement in the joining of their seams, to diminish this evil, would be very desirable. The thinness of the boards used for boats would not admit of rabbeting, or the contrivance mentioned for this purpose in the Specification of my Patent (vide your 2d vol. p. 81); and,

and, except for large boats, this circumstance would even prevent the use of carvel building in their construction, as very thin boards or planks could not retain the oakum in the seams of boats thus formed, exclusive of the difficulty of caulking them at all. Clinch-building, which is in general use for small or light boats, seemed to me, on the other hand, to have a very material defect; for, as the planks in this mode of building lap a little way over each other, the oakum driven up between them by the wedge-shaped caulking irons must operate with considerable power to open the seams and force the planks asunder by the very operation intended to close their interstices. To form a boat of equally thin plank or board as was used for clinch building, with a similar seam to that of carvel building, and which should retain the oakum well, and not be liable to have it forced through in caulking, was the principal object in view in contriving the boat which I had then made for the Economy; and the method in which this was done, both effected this purpose, and added considerably to the strength of the boat, as shall be more fully explained farther on.

The boat was constructed in the following manner. The frame was laid down in the method usual for a carvel-built boat, only that greater spaces were given between the timbers or ribs. The stern pieces and apron were formed together of the same piece of timber; the stern boards were rabbeted together, and left unusually thick at the external edges (while the internal parts were dubbed thin with the adze) to admit of the ends of the planks being rabbeted also at where they joined these boards, as well as on the stern piece and in the stern post; both these last were also scarphed to the keel in such a way as to leave a rabbet all round them at the joint, to prevent the leakage which frequently takes place in these parts.

A plank

A plank was laid over the keel the whole length, on which the ribs were let down so as to be flush or even with it. It projected about an inch at each side from the keel; the next planks at each side were joined to this outside, and close to the keel, so that its edges lapped over them. After these two first planks were fitted, but before they were finally fastened on, narrow slips of the same thickness as the plank, and about two inches broad, were at both sides let into the ribs their own thickness, at such a distance from the keel that, when the first planks were laid on, they reached exactly to the middle of those slips; similar slips were in like manner let into the ribs all the way up to the gunnel at regular intervals, corresponding to the breadth of each plank; so that the middle of each slip lay exactly over the seam of the two adjoining planks at the inside. To these slips the planks were secured by rivetting nails, in the manner usual for clinch building; but, as the planks were all flush outside, and were joined edge to edge as in a carvel-built boat, the seams admitted of being caulked in the same manner; while the slips, being close behind the seams inside, prevented the oakum from being driven through from the thinness of the planks, and at the same time secured more firmly what was driven into the seams by the gripe they had on that portion of the oakum which had passed the seams inside, and had turned up at right angles between the slips and the planks.

This method of constructing the boat not only made it very staunch, but also increased its strength greatly, in proportion to the materials used. The increase of thickness of the side at the parts where the slips were laid inside the seams, gave it there an additional strength to resist shocks in that direction, in the proportion that the square of the double thickness of plank exceeded that of the single thickness, or equal to three times the strength

of

of the single plank, as is explained in the Specification of my Patent (vol. IV. p. 430), where the same principle is applied to the framing of ships.

The strength of the boat lengthways vertically was also increased considerably, both by the direct strength of the slips in that direction, and by the increased firmness which the framing of the boat acquired by those slips being let in on the ribs, as before explained.

The boat described was built in June 1803, in the yard of Mr. I. Ewer at Bursledon, near Southampton. It remained at Bursledon till April 14, 1804, during which time it was seen by many people, who particularly examined its construction. It was then brought round to London with the ship Economy, and lay with the ship opposite Union-stairs, in the River, for some months, where it was seen by all those who came to view the patent framing of the ship (which was advertised for public inspection). When the ship was put into the dock of Messrs. Young and Wallis, near Globe-stairs, Redriff, to receive her sheathing, the boat accompanied her, and was again viewed by many people in that dock. It also lay in the West India dock with the ship for some time previous to her sailing for Grenada and Trinidad, which took place about the 18th of August 1804. As the ship took out a large launch to be left at Grenada, and her commander, Mr. Alexander Smith, thought the boat described was too heavy for a jolly boat, he left it behind in care of Mr. Forest, boat-builder, Broad-street, Redcliff, near Redcliff-cross, and took out with him a jolly boat in its stead. The boat described remained some months at Mr. Forest's wharf, where she was again inspected by many builders and mariners, until Mr. Forest sold her to the master of a vessel, who took her out of the River in the beginning of 1805.

The

This very public exhibition of the boat in London and other parts of the kingdom for a year and half, in 1803 and 1804, is, I hope, sufficient to fully establish my claim to the invention of her construction, of the date of which there are so many hundred witnesses. I have been thus particular in the account of what related to her, as Mr. Wilson, of Richard-street, Commercial-road, has sent into the Society for the Encouragement of Arts, &c. a model of a life-boat, the internal framing of which is precisely the same as that of the boat described, which I had constructed for the ship Economy, for which he was rewarded with a medal at the public meeting of the Society, the 26th of last May; at which time I claimed that part of the plan of the model as my invention before his Grace the Duke of Norfolk, and stated such of the particulars here recited as could be done in the few moments allowed me when called up to receive the gold medal, with which the Society honoured me for the invention of a capstan, which operates without surging.

It doubtlessly often happens that the same thing may be invented by different people successively, who know nothing of what has been done by others. This, I cannot at present positively state from absolute facts, might not have been the case with Mr. Wilson; but the following presumptive evidence is so strong against it, that it leaves this matter hardly possible.

It is not very likely that, in the part of the town where Mr. Wilson lives, so near the part of the River where my boat was publicly exhibited so many months, but that, in talking of his plan to his acquaintance, he should not meet some one who could describe my boat to him.

A man capable of inventing a particular arrangement of parts, of superior advantage in constructing a boat, will certainly be able to adapt his invention to all additions he may make to his boat. Now, in Mr. Wilson's model, the lockers, or hollow benches, which he has added outside the boat, to make it fit for a life-boat, are put together without any attempt to introduce into their framing the principle which is used in the construction of the body of the boat. These buoyant lockers are in the model, on the contrary, formed in a very inartificial manner, perfectly similar to that used for making packing-boxes, of boards nailed together at their edges, and to partitions nailed to the boat from the inside; which construction, if imitated in a large boat, must render those lockers always leaky, on the buoyancy of which the only superiority of the boat in safety over any other alone depends.

Mr. Wilson has been unfortunate in the claim to invention in the second part of his model as well as the first; for those buoyant lockers placed outside his boat come under the description of the "hollow projecting gunnels for boats," for which Mr. Lionel Lukin obtained a patent in 1785, the specification of which is in the third volume of the first series of your Repertory of Arts; in which he expressly mentioned that these projecting gunnels, as he calls them, are to be made outside the boat, are to be either *hollow*, or filled with cork or other light materials, are to project least at the head and stern, and most in the middle. In other particulars they are also very similar to Mr. Wilson's model; and the very title of the patent declares Mr. Lukin's projecting gunnels to be for the same purpose as Mr. Wilson's buoyant lockers, namely, to prevent boats or small vessels from oversetting or sinking.

I beg leave to mention, in concluding, that neither now, nor when I before claimed publicly this mode of constructing boats as my invention, had I the smallest intention of throwing

throwing the least imputation on the Society for rewarding Mr. Wilson for the inventions of others. Gentlemen remote in residence and connection from shipping concerns may be supposed unacquainted with the facts I have stated, without any want of attention on their parts; on the contrary, I shall ever be happy to declare my respect for the Society for the Encouragement of Arts, &c. and to acknowledge my obligations to them for ancient as well as recent favours.

It must be evident, from what is tated, that Mr. Ewer, of Bursledon, Hampshire, ship-builder, in whose yard my boat was built; J. Payne, shipwright, of same place, who built it; or Mr. Forest, boat-builder, near Redcliff-cross, London, who had the boat on his premises so long, are all perfectly well qualified to make boats on this construction, which appears to me to have the merit of uniting staunchness and lightness to strength in a very superior degree.

I am, Gentlemen,

Yours, &c.

JOHN WHITLEY BOSWELL.

On the Revival of an Obsolete Mode of managing Strawberries.

By the Rt. Hon. Sir JOSEPH BANKS, *Bart. K.B. P.R.S, &c.*

From the TRANSACTIONS of the HORTICULTURAL SOCIETY of LONDON.

THE custom of laying straw under Strawberry Plants, when their fruit begins to swell, is probably very old in this country: the name of the fruit bears testimony in favour of this conjecture, for the plant has no relation to straw in any other way, and no other European language

 applies

applies the idea of straw in any shape to the name of the berry, or to the plant that bears it.

When Sir Joseph Banks came to Spring Grove, in 1779, he found this practice in the garden. John Smith, the gardener, well known among his brethren as a man of more than ordinary abilities in the profession, had used it there many years; he learned it soon after he came to London from Scotland; probably at the Neat Houses, where he first worked among the market gardeners; it is therefore clearly an old practice, though now almost obsolete.

Its use in preserving a crop is very extensive: it shades the roots from the sun; prevents the waste of moisture by evaporation, and consequently, in dry times, when watering is necessary, makes a less quantity of water suffice than would be used if the sun could act immediately on the surface of the mould; besides, it keeps the leaning fruit from resting on the earth, and gives the whole an air of neatness as well as an effect of real cleanliness, which should never be wanting in a gentleman's garden.

The Strawberry beds in that garden at Spring Grove, which has been measured for the purpose of ascertaining the expence incurred by this method of management, are about 75 feet long, and five feet wide, each containing three rows of plants, and of course requiring four rows of straw to be laid under them. The whole consists of 600 feet of beds, or 1800 feet of Strawberry Plants, of different sorts, in rows. The strawing of these beds consumed this year, 1806, the long straw of 26 trusses, for the short straw being as good for litter as the long straw, but less applicable to this use, is taken out; if we allow then on the original 26 trusses, six for the short straw taken out and applied to other uses, 20 trusses will remain,

main, which cost this year 10*d*. a truss, or 16*s*. 8*d*. being one penny for every nine feet of Strawberries in rows.

From this original expenditure the value of the manure made by the straw when taken from the beds must be deducted, as the whole of it goes undiminished to the dunghill as soon as the crop is over. The cost of this practice therefore cannot be considered as heavy. In the present year, not a single shower fell at Spring Grove, from the time the straw was laid down till the crop of Scarlets were nearly finished, at the end of June. The expense of strawing was therefore many times repaid by the saving made in the labour of watering, and the profit of this saving was immediately brought to account in increase of other crops, by the use of water spared from the Strawberries, and besides, the berries themselves were, under this management, as fair and nearly as large as in ordinary years, but the general complaint of the gardeners this year was, that the Scarlets did not reach half their natural size, and of course required twice as many to fill a pottle as would do it in a good year.

In wet years the straw is of less importance in this point of view, but in years moderately wet, the use of strawing sometimes makes watering wholly unnecessary, when gardeners who do not straw are under the necessity of resorting to it, and we all know if watering is once begun, it cannot be left off till rain enough has fallen to give the ground a thorough soaking.

Even in wet years the straw does considerable service, heavy rains never fail to dash up abundance of mould, and fix it upon the berries; this is entirely prevented, as well as the dirtiness of those berries that lean down upon the earth, so that the whole crop is kept pure and clean: no earthy taste will be observed in eating the fruit that has been strawed, and the cream which is sometimes soiled

soiled when mixed with Strawberries, by the dirt that adheres to them, especially in the early part of the season, will retain to the last drop that unsullied red and white which gives almost as much satisfaction to the eye while we are eating it, as the taste of that most excellent mixture does to the palate.

An Essay on the Influence of Frost, and other Varieties of bad Weather, on the ripening of Corn.

By the late BENJAMIN BELL, *Esq.*

From the PRIZE ESSAYS and TRANSACTIONS of the HIGHLAND SOCIETY of SCOTLAND.

I WAS first induced to consider this subject with attention in Autumn 1782, when, at the usual season of the corns in this country being all got home, none of them were ready for cutting. In the spring and summer of that year, the weather was for the most part cold and wet, and therefore very unfavourable to vegetation. The crops, accordingly, were weak during the whole season; so that when frost took place early in Autumn, they were very generally in a situation ill fitted to bear it, few of them, except wheat, being at that period better than chaff; and excepting in well-sheltered early grounds, all of them were so green, that there was reason to fear they would not ripen sufficiently either for being used as food, or for seed in the following spring.

On some of the best grounds in Mid-Lothian, even of those contiguous to Edinburgh, many of the crops of pease were only in blossom in the end of September; and large fields of oats, as well as barley, after being repeatedly exposed to frosts, in September, October, and November,

vember, were not cut till the end of the last of these months.

Being afraid, when this was the case in our best corn districts, that in others of greater height, and liable accordingly to severer degrees of cold, the corn would be still worse; and thinking, therefore, that an early importation from more favourable climates should be encouraged for seed in the following spring, I began early in the season to obtain reports of the state and progress of the crops in various parts of Scotland, as well as in many of the Northern counties of England. From the whole of which it appeared, even so early as the month of September, that the farmers in those districts were generally afraid that the corns of that year's growth would not be fit for seed.

I had reason, however, at that time to believe, from having seen that corns in every state of their growth could resist severe degrees of cold, that they would be perfectly fit for seed, if they should become sufficiently full; for I had known corn, even when nearly ripe, exposed repeatedly to frost, without being apparently hurt by it. I also knew that corns continue even to fill in frost; and in the course of that season I was much pleased to find, even in the coldest state of the weather, that although the corns did not acquire their usual ripe appearance, yet in all low situations, that is, in such as were not higher than three hundred feet above the level of the sea, they continued to fill, and at last to become little inferior in bulk to the same kinds of corn in ordinary years.

But in order to discover the exact degree of maturity that corns can reach while exposed to frost before being ripe, and to learn with certainty whether corns in this situation, as well as those that are ripe, are rendered

unfit

unfit for seed by exposure to frost, various experiments were made, of which the following is an account; and nearly about the same time similar experiments were made by two of my most respectable friends, the late Doctors Cullen and Roebuck, and with the same general result.

Experiment I.

On the 1st of October 1782, twelve full-grown stalks were cut in a large field of oats, and twelve in a field of barley. In both fields the crop was entirely green, the corn quite soft, and it did not appear to be more than a fourth part full. From each stalk twelve seeds were taken of those that were best filled, being 144 of oats, and as many of barley; and after being dried in a moderate heat, the barley and oats were put into separate paper bags; and each of them marked No. 1.

On the 20th of October, and again on the 12th of November, the same number of seeds were taken from the same number of stalks, both of barley and oats, gathered in the same fields; and all of them being dried in the same manner with the first, the barley and oats that were cut on the 20th of October, were marked No. 2. and the others No. 3.

On the oats being weighed, No. 2. was just twice the weight of No. 1; No. 3. was nearly three times the weight of No. 1; and No. 2. as well as No. 3. of barley had improved in a still greater degree. But although the oats and barley of both fields appeared to be tolerably full when those of No. 3. were cut, they never acquired a ripe appearance. Although neither of the crops were cut till the end of November, still they continued of a dark colour; and on the corn being dried, none of it was so full as it ought to have been, although all of it yielded more flour or meal than had been expected under the circumstances

circumstances that I have stated; but on being tried with oats and barley that were full and ripe, neither of them were so heavy by a fourth part.

The oats and barley Nos. 1. 2. and 3. were kept, with the view of discovering how far they were fit for seed; and wifhing to know whether the other seeds commonly sown by farmers in this country, were hurt by frost, the following trial was made of them in spring 1783.

Experiment II.

On the 2d of February 1783, twelve pots, filled with rich garden mould, were placed in a hot-bed; and being numbered, that an account might be kept of the result, the following seeds were planted in each of them. In No. 1. twenty seeds were planted of the oats marked No. 1. in the preceding experiment. The same number of oats marked in that experiment No. 2. were planted in No. 2, and in No. 3. twenty seeds of oats of No. 3. In No. 4. twenty seeds were planted of barley No. 1.; in No. 5. twenty of barley No. 2.; and twenty of barley No. 3. in the pot marked No. 6. Twenty seeds of barley taken from a farm in a high district, that was much exposed to severe frosts during its growth, and that was not half the weight of good barley, were planted in No. 7. The same number of oats, also from a high district, that were much exposed to frost during the last part of their growth, and not half the weight of good oats, were planted in No. 8.; twenty seeds of pease were planted in No. 9.; twenty of tares in No. 10.; one hundred of red clover in No. 11.; and one hundred of white clover in No. 12.

The pease and tares were among the best that grew in the neighbourhood of Edinburgh in 1782; but they were small, fhrivelled, and had been exposed to much frost both during their growth, and after being cut; and although the clover seeds were the best that could be procured from London, of crop 1782, none of them were good.

The barley and clover were first perceived above the surface. A few of each of them were observed on the fifth day, and on the ninth, eighty plants of white clover, and sixty-four of red, were in full leaf, and no more of them ever appeared.

On the twelfth day from the time of their being sown, eleven plants of barley were perceived in No. 4. In No. 5, thirteen; fourteen in No. 6, and nine in No. 7, all upwards of an inch in height. On the same day, five of the pease in No. 9, and four plants of tares in No. 10, appeared above the surface. On the fourteenth day some of the oats began to appear, and on the seventeenth ten plants were perceived in No. 1, twelve in No. 2, fifteen in No. 3, and nine in No. 8, all about an inch in height.

This experiment being made at the same time by a friend with seeds taken from the same parcels, and the result being nearly the same in both, I did not think it necessary to repeat it: and as it did not appear that any of the other seeds would vegetate by allowing them to remain in the earth, the experiment, in both instances was at this period allowed to terminate. The seeds were accordingly searched out, when all of them were found nearly in the state in which they were planted.

From these trials, it appeared that oats and barley, while still in a green state, will bear considerable degrees of frost; that they both continue to acquire additional weight, although they are exposed to frost, and that this exposure does not destroy the principle of vegetation in either of them; for in Experiment II. it was found, that of twenty seeds of barley, and the same number of oats, which

which had all been repeatedly exposed to frost, fourteen of the one and fifteen of the other speedily germinated; and even that a large proportion both of barley and oats vegetated, that were not only exposed to frosts, but that were cut before being half filled, and while they contained therefore a very small proportion of flour or nourishment.

Pease and tares, as well as clover, appeared by these experiments to suffer more severely by frosts, than barley or oats. I knew indeed, that this was the common opinion of farmers; and having heard that farmers in high districts were resolved to sow a much larger quantity of seed on the whole of their grounds than usual, not only of barley and oats, but of pease, tares and clover, it did not appear that any advantage could be gained by making the result of these experiments public.

It occurred to me, however, on farther considering this matter, that these experiments were not carried sufficiently far: They did not even determine the chief point that I had in view, namely, the propriety of trusting to seed that had been exposed, during its growth, to frost and other varieties of bad weather. That this might be proved with certainty, the experiments, I perceived, should be made in an open field, and not by the seeds being forced with artificial heat, and sown in rich mould, which might make seeds vegetate that would not grow in cold poor grounds, such as many of our corns are too frequently sown in.

It also appeared, that in order to render the experiment fair and decisive, those seeds that were exposed to frost during their growth, and not entirely full, should be compared with those that were full and ripe, when sown in similar circumstances. With this view the following experiment was made in the month of July, 1783.

Experiment III.

On the 4th of July, the twelve pots used in Experiment II. together with fourteen others, were filled with soil taken from a field which at that time was under a crop of oats, after being two years in grass. But although the oats were the last crop in the rotation of this field, the soil was not worn out; for the person on whose ground the experiment was made, was of opinion, that at no period of his possession is it consistent with the interest of a farmer, that his grounds should be in an exhausted condition; a maxim in farming that in all circumstances may be considered as a good one, and even more advantageous to farmers than proprietors.

The pots were all numbered, and in the first twelve the same number and kind of seeds were planted as in Experiment II. each kind being taken from the same quantity with those that were used in that Experiment.

In No. 13. twenty seeds were planted of oats. In No. 14, twenty of barley, and in No. 15, the same number of wheat, that were all nearly equally full with ripe corn, but which had not the healthy aspect of corn when perfectly ripe, from their having been much exposed to rain, frost, and snows, during the last few weeks of their growth. In No. 16, twenty seeds of wheat; in No. 17, twenty of barley; and in No. 18, twenty of oats, all from the South of England, where, owing to the earliness of the harvest, the corns were cut and carried home, before the frosts became severe. In No. 19, twenty seeds of wheat were planted; twenty of barley in No. 20, and in No. 21, twenty of oats that were all full and apparently ripe, of crop 1782, but exposed to severe frost in the field before they were carried. In No. 22, twenty seeds of tares were planted; in No. 23, twenty of field pease, and in in No. 24, twenty of tick or horse beans, the pease, tares and beans having been all fully ripe in 1781, and never exposed to frost; and in No. 25, twenty tick beans were planted, that were nearly equally full with the others, but which were often exposed to frost during their growth, as well as after they were cut in Autumn 1782. In No. 26, one hundred seeds of red clover were sown, and in No. 27, the same number of white clover, both fully ripe, from parcels of good seed, that had been kept two or three years. In this, as well as in Experiment II. the clover seeds were sown on the surface, and lightly covered with earth. All the other seeds were planted at the depth of an inch, the beans only excepted, which were two inches deep.

This being done, all the pots were placed in the field of oats from whence the soil was taken with which they were filled. Each of the pots had an opening in its bottom to permit superabundant quantities of rain to pass off; and in this state they were all sunk in the earth nearly to half their depth, and without any more being done to them.

On the seventh day after the seeds were sown, several plants of both kinds, of clover, as well as of barley, appeared above the surface; some of the pease and tares on the eighth, and the wheat, oats, and beans in succession, the wheat on the eleventh day, the oats on the fourteenth, and the beans not till the end of the third week.

In several of the pots many of the seeds did not vegetate, as appears by the following account of them taken on the twenty-sixth day from the time of their being planted, and none of them appeared thereafter.

Nine plants of oats appeared in No. 1, ten in No. 2, twelve in No. 3, seven in No. 8, eighteen in No. 13, twenty

twenty in No. 18. In No 4, eight plants of barley; eleven in No. 5; twelve in No. 6; six in No. 7; seventeen in No. 14; twenty in No. 17; and twenty in No. 20. Four of tares in No. 10; eighteen in No. 22; twenty pease in No. 23; twenty beans in No. 24; fifteen in No 25; sixty of red clover in No. 11; ninety-six in No. 26; seventy of white clover in No. 12; and ninety-five in No. 27. All the seeds of wheat in No. 15, were found to have vegetated, the number of plants being exactly twenty. And this was also the case with the wheat in Nos. 16 and 19.

But while the difference was thus considerable in the number of plants that appeared above the surface, it was still more evident in the vigour of the plants, in their colour, and number of shoots that sprung from them.

The plants of clover, pease, tares, and beans, were all large and healthy, when the seed had not suffered with bad weather, and this was still more remarkably the case with the oats, barley, and wheat, which had not been exposed to frost. In all of them, the plants were not only more vigorous, and of a more deep green colour, but their stems were much more numerous than in any of the others, insomuch that in Nos. 16, 17, and 18, they varied from three, to eight and ten, while few of those in Nos. 1, 2, 3, 4, 5, 6, 7, and 8, which had all been exposed to frost, yielded more than a single stem.

TO BE CONCLUDED IN OUR NEXT.

Researches

Researches relating to the Oxydation of Iron.

By M. DARSO.

(Concluded from Page 47.)

(Concluded from Page 47.)

Influence of the Air on Solutions of Iron.

ALL the false impressions that have prevailed respecting iron, in the pneumatic theory, arise from having attributed the colour, and other properties which distinguish the green and red salts from each other, to a difference of oxygenation. This difference once established in principle, nothing was more natural than to impute to the same cause the transition of the salts of iron from red to green, by their exposure to the air, especially as the circumstances which sometimes accompany this phenomenon are peculiarly favourable to such an interpretation.

The authority of Scheele has given additional weight to this illusion. This celebrated chemist has observed, that by dissolving some green sulphate of iron in water, there usually remains a deposit of green * oxyd, which he concludes is occasioned by the air contained in the water super-oxydizing a part of the green oxyd, and thus becoming red, its saturating power is augmented, and causes the precipitate. He then gives this process as a method of estimating the quantity of air contained in any water whatever. Although I have great respect for the authority of this illustrious chemist, I beg leave to observe, that even supposing this phenomenon to be owing to a super-oxydation by the air contained in the water, the method of estimating the quantity by this means is not accurate, because the quantity of the precipitate would not depend solely on the quantity of red

* We apprehend this should be red.

oxyd

oxyd formed by the air, but rather on the degree of acidity of the sulphate, which, according to the opinion of Scheele, we must suppose to be always uniform; but this supposition is contradicted by experiment. Thus, supposing the super-oxydizing action of the air, a pint of water poured into a pound of very acid, green sulphate, would leave no deposit at all; whilst a pint of the same water, poured into another green sulphate, having little or no acid, would leave a deposit rather abundant. Besides, the explication of this phenomenon is faulty in itself, because it takes place as well with water which is perfectly free from air as that which is aërated. I made comparative experiments on this fact with two equal parts of distilled water, the one perfectly purified from air, and the other artificially saturated with it; the results were always the same. If the crystals of sulphate that I employed were white, there was no deposit; but if they were green, it formed a deposit that was of equal bulk in the one as in the other of these solutions; so that the process of Scheele is calculated rather to discover, to a certain degree, the acidity of the green salts of iron, than to appreciate the air contained in the water.

It may be objected to this, that, according to the experiments of Dr. Carradori, boiled water always retains a little air; but, besides that I have lately repeated this experiment with water purified from air, by Carradori's method, and that the success has been the same, the experiments of Henry, Humboldt, Gay Lussac, and particularly of Dalton, on the absorption of gas by water, terminate this discussion without farther demonstration. According to Dalton, to whom I refer because he was more immediately occupied with this object, water saturated with atmospheric air contains but 2,012 to 100 of its

its bulk, of which 0,778 is oxygen and 1,234 azote. Consequently 100 cubic inches of water contain nearly two-thirds of an inch of oxygen. Now if we consider that the greatest part of this gas is disengaged by ebullition, and if, besides, correction be made for the heterogeneous substances, which, according to Lambert and Saussure, always contain air, we shall see that the influence of the oxygen contained in the water, even when we suppose the water to be saturated with it, is nugatory in the present case: for if we pour a green salt of iron with excess of oxyd into 100 cubic inches of water at 60°, it will form a precipitate of at least fifteen or twenty grains of red oxyd, which cannot proceed from the oxygen of the air contained in the water.

In addition to this experiment, and the facts that the ammoniacal solution of the green sulphate changes to the red without giving any signs of the presence of oxygen, and that the precipitate which, although exposed to the air for a month, did not advance its oxygenation 0,01, I made several other experiments to the same end, and they have all demonstrated that the super-oxydizing action of the air upon solutions of iron is of no effect, at least at the usual temperature of the atmosphere. I shall relate two of these experiments, which I believe to be the most conclusive.

1. I dissolved, in circumstances perfectly similar, two equal parts of iron: I put one of these solutions into a glass jar of three inches diameter, and I then plunged into it one end of a bent tube, that was terminated by a ball, pierced with small holes, like a watering-pot *, through which I caused the atmospheric air to pass for seven hours with some intervals. At the end of three

* I thought by this means to increase the points of contact of the water with the oxyd.

days I compared these two solutions by different means; and I found that the solution which had been aërated was perfectly equal to the other, which was not sensibly altered, although the temperature was at 12°. 2°. I also caused, with the help of an apparatus, nearly the same, three pints of oxygenated gas, to pass through a solution of ten grains of iron; and although the temperature was at 25°, this gas had no effect on the solution.

On the Colouring of the Green Oxyd.

By pouring some drops of alkali into a solution of iron a little diluted, I observed that each molecule of oxyd was formed of a pellicle extremely thin, which inclosed some kind of fluid; and I accounted for the green colour by the difference of density between this pellicle and the fluid that it contained. I also attributed to the breaking of these vesicles, by the expansion of the fluid contained in them, the alteration in the green solutions when exposed for some days to a temperature of 20°. I also attributed to the pressure exercised on these vesicles the fact, that these same solutions underwent no change in bottles quite full and well corked; but I could not reconcile with this theory the changes produced in green solutions of iron by oxygenated muriatic acid, and those which sulphureted hydrogen occasioned in the red solutions. The nature of the constituent principles of these re-actives renders the mode of action which has been attributed to them so plausible in these two experiments, that I should have assented to it if all the facts that I have related had not before apprised me that oxygen has no influence on the green or red colour of the oxyds of iron. I therefore intended making some experiments for the purpose of observing the manner in which these two re-agents act, when I recollected a fact, observed at the commencement of of this research, which has prevented a continuance of those errors into which I had previously fallen.

In all the iron that I have hitherto used in my experiments, I have found a substance in the form of a white precipitate, which remains unchanged by exposure to the air, yields by prussiate of potash an emerald green precipitate, and is, I believe, what Bergman named *siderite*, rather than phosphate of iron. On the other hand, I obtained from some red salts of iron a white precipitate, that sometimes crystallized in leaves, very soft to the touch, which the most experienced mineralogist would mistake for the chalk of Briançon, and which is nothing more than a salt of iron with excess of oxyd. I then believed that these two substances were homogeneous, and that both were magnesia, which was only an oxyd of iron carried to its *maximum* of oxydation. Even the name of this earth encouraged my illusion, which was also confirmed by the opinions of chemists who have preceded me, respecting the transmutation of metals into earths. I deferred this research to another time, but I made as I went on some experiments on magnesia, and perceived that by treating the solutions of this earth with sulphureted hydrogen, it afforded precipitates similar to the green oxyd of iron.

Although my subsequent researches on iron apprised me that none of these substances were magnesia, yet the colour produced by sulphureted hydrogen in this earth was a fact for which I must afterwards account, and which, on reconsideration, caused me to suppose that the sulphureted hydrogen might possibly have a mode of acting different from those which are known. I was eager to make this experiment, not only on magnesia, but on lime and alumine; and I saw in fact that the soluble salts of these three earths, treated with sulphureted hydrogen,

drogen, gave precipitates perfectly similar to the green oxyd of iron *. These precipitates, exposed to the air, resume their white colour in a little time, if not agitated; but motion considerably hastens this transition; and it is a farther assimilation of these precipitates, and those yielded by the red salts of iron, treated also with sulphureted hydrogen.

These green and earthy precipitates are not hydrosulphurets, as might be supposed, but *hydrures* that retain probably a little acid; and the proof of it is, that they are decomposed by oxygenated muriatic acid, without leaving any traces of sulphur; and that redissolved by the acids they preserve their green colour, and other usual properties; which could not happen if they were hydro-sulphurets, which would have been immediately decomposed by the acids.

By these elucidations the colour of the green oxyd of iron, and that which it receives from the muriatic acid, are accounted for. No green oxyd is ever formed but when hydrogen is set free, and consequently a part of this hydrogen remains engaged in the oxyd, and gives to it the green colour, and the property of being less soluble in water, or more crystallisable. This property of rendering a salt more crystallisable by a principle so little dense as hydrogen, appears at first sight very extraordinary; but it is confirmed by the super-oxygenated muriate of potash, the oxygen of which renders it two or three times less soluble than the simple muriate.

* It requires a certain degree of experience to succeed in this experiment; but I have not repeated it enough to be enabled to give certain directions. I left some sulphurated hydrogen for an hour in contact with sulphate of magnesia before it precipitated. Sometimes the precipitate becomes green even in the act of precipitation; at other times it is not green until some moments afterwards.

The

The oxygenated muriatic acid acts then upon a green salt of iron as it acts upon sulphureted hydrogen, phosphoreted hydrogen, &c. It deprives the oxyd, of the hydrogen with which it is combined, as it likewise does the sulphur and the phosphorus: which at the same time proves that the hydrogen is in the oxyd of iron, in a state of expansion different from that in which it exists when it is uncombined, since in this state it does not combine with the oxygenated muriatic acid at the temperature of the atmosphere.

The hydrogen is also perceptible, from the disagreeable odour that exhales from a concentrated solution of iron when a fixed * alkali is poured into it, and the glass is a little shaken. It cannot be alledged, that this odour is owing to some globules of hydrogen that have remained engaged mechanically in the solution, since the same phenomenon takes place when these solutions have been previously boiled. If these solutions be diluted with six or eight times their bulk of water at 50 or 60°, and if, whilst the alkali is pouring in, it be stirred with a glass rod, the odour is very powerful, and it continues as long as any atoms of green oxyd remain in the precipitate; so that even when the precipitate is not perceptible, it may be easily discovered by this method if the solution be green or red.

When a little green sulphate, very much concentrated, is precipitated in a bottle, like that which forms a white precipitate, if it be afterwards corked up and the bottle shaken, we may observe that the gas augments, and if the stopper be not well adjusted it will fly out, notwithstanding the temperature be always the same. If we afterwards examine the air of the bottle we shall find that

* Because the odour of ammonia disguises that of the hydrogen.

it

it extinguishes candles, or that it detonates. It is known that the hydrogen possesses this property according as it is pure or combined with other principles, and it is very likely that it has a little iron in solution, as there is also sometimes zinc and arsenic.

In order to be further assured of the presence of hydrogen, and of its influence on the salts of iron, I put into a tubulated retort (to which was adapted a small recipient and a bent tube, one end of which was immersed in water) a portion of green sulphate of iron quite fresh, which I had previously boiled for half an hour to remove all the hydrogen that it mechanically retained. I afterwards precipitated the solution with caustic soda, very much diluted with boiling water. As soon as the mixture arrived at ebullition, it disengaged a gas with the smell of hydrogen, which also detonated at the approach of a candle. Even the water of the pneumato-chemical apparatus acquired the odour and savour of the hydrogen disengaged from the solutions of iron.

With the intention of disengaging all the hydrogen, or of making all the oxyd red, I continued the distillation, and the mass was scarcely dry, when the retort burst, and I found in it more than 300 grains of red oxyd, and a little green oxyd that occupied the bottom of the retort. The pressure of the red oxyd, and that of the sulphate of soda that covered the green oxyd, had prevented the disengagement of the hydrogen from the latter.

I shall farther add, in support of my opinion, two facts which, although less direct than the above, will yet have much weight. If, when oxygenated muriatic acid is poured upon a green solution, the oxygen of the latter combines with the oxyd of iron, there should be a great disengagement of caloric, considering the state of expansion of the oxygen in the oxygenated muriatic acid, and

and the fixed nature of the red oxyd, of which the greatest fire of our furnaces cannot volatilise a particle. Now, I am assured by several experiments that the elevation of temperature is scarcely sensible. This feeble disengagement of caloric agrees with the combination of the hydrogen, in the hydrure of iron, and of the oxygen in the oxygenated muriatic acid, because these gases, in these two combinations, are almost as much dilated as when they formed water.

Lastly, if the action of the sulphureted hydrogen upon a red solution of iron be only to bring the latter to the same degree of oxygenation as the ordinary green solutions, its properties ought to be the same; but, on the contrary, we see that the green solutions made by sulphureted hydrogen, when exposed to the air, change rapidly to the red; when heated for a quarter of an hour, they become entirely red, which is not the case with the ordinary salts when they are fresh. They are no longer crystallizable, and their precipitates change with much more rapidity than those of ordinary solutions.

I dissolved 6 grains of iron in muriatic acid, cold; and at the same time, in a separate vessel, 6 other grains of red oxyd, which I had previously saturated with sulphureted hydrogen. At the end of four hours I precipitated these two solutions by an alkali; and I perceived that the precipitates of the green solution, by sulphureted hydrogen, changed to the red with the greatest rapidity. By decanting the floating liquor, and pouring water upon the oxyd from some height, it changed all at once to the red; whereas the precipitates of the other solution resisted this test. The green oxyd, by sulphureted hydrogen, re-dissolved in muriatic acid, precipitates red; or at least this effect takes place at the end of two solutions. The ordinary green oxyds of iron, when they are fresh, preserve

preserve their colour even after five or six dissolutions in the acids, which undoubtedly tends to prove that, in the ordinary green solutions of iron, the hydrogen combines with the iron in the nascent state in very dense gas; and it forms a combination more solid than that of the red oxyd with hydrogen, furnished by sulphureted hydrogen.

If the green oxyds of iron are hydrures, as I think they are, it is very easy to account for the alteration in the green salts of iron exposed to the air. It is not surprising that hydrogen, combined with the oxyd of iron, volatilizes spontaneously at a temperature above 10 degrees. Almost all combinations, into which hydrogen enters, are decomposed in the same manner, particularly when they are dissolved in water, such as sulphureted, phosphoreted, and carbonated hydrogen. All the vegetable acids are likewise spontaneously decomposed when they are dissolved in water; alcohol also suffers this decomposition when diluted with water. The atmospheric air has no more influence on these phenomena than on those of fermentation and putrefaction. All these operations require open vessels, because they disengage different kinds of gas, which, if impeded by any pressure whatever, arrest the progress of the operation.

I regard the experiments related in this memoir only as the rough draught of a more extended and deeply considered work; but as different circumstances have occasioned me to defer this work for a year, and as it is very doubtful that I shall be able to attend to it for some time to come, I am desirous of announcing these facts for the use of chemists.

Inferences proceeding from this Memoir.

1. All oxyds of iron soluble in acids are red; and although their proportion of oxygen varies from 0,15 to beyond

yond 0,50, they are not distinguishable by any of the means hitherto employed in chemistry.

2. The white oxyd of iron is a salt with excess of oxyd.

3. The green oxyd is not a particular oxyd, but an hydrure, or the combination of the red oxyd with hydrogen.

4. The atmospheric air has no influence on solutions of iron, at least at the usual temperature of the atmosphere.

5. The saturation of oxygen in the oxyds of iron does not destroy their magnetism, as it has been hitherto pretended. All oxyd of iron is magnetic, or is capable of becoming so, without losing an atom of oxygen.

Note.—It has been long observed that the magnetism is weakened or disappears entirely in the oxyds of iron. At different periods this phenomenon has been accounted for according to the light in which the metallic calxes were viewed. Before the pneumatic theory was promulgated, the magnetism was attributed to phlogiston. After the labours of Lavoisier had taught that the formation of the metallic calxes was owing to the combination of oxygen with the metals, it was naturally concluded that oxygen affected the magnetism; and as, on the other hand, facts appeared to prove that there was no magnetism in oxyds very much charged with oxygen, it was established as a principle, that oxyds at the *maximum*, or red oxyd, were not magnetic. This principle, which does not agree with the fact that I have related, has embarrassed several philosophers in the interpretation of some phenomena. The celebrated Baron de Humboldt, who discovered the magnetic polarity in the serpentine stone, could not account for this property in a mineral, which by analysis contained only oxyd super-oxydated, or at the *maximum*. M. Guyton observes on this occasion, that the word *super-oxydated*, which the Baron uses, is inaccurate, because the two properties of being super-oxydated and magnetic are *incompatible*; and that the magnetic properties of the serpentine stone of Saxe, and other minerals which do not give the green oxyd by analysis, should lead us to suppose there were intermediate oxydations of iron. M. Haüy, to whom we owe some very perspicuous elucidations of magnetism, was also misled by the prevailing opinion of other chemists; and in seeking to account for the magnetism acquired by some red oxyds of iron when strongly heated, says, that it supports the idea that heat *reduces some particles of oxyd, at the same time that it seconds the magnetic action of the globe*, &c.

I myself at first subscribed to authorities so respectable, and because, as Bacon says, *oportet ediscentem credere*, and especially as at the commencement of the researches, I had tried several red oxyds obtained from different solutions of iron, as well as several aperitive safrons of Mars, which gave not the slightest sign of magnetism; but as by the sequel I perceived that oxyds very much charged with oxygen, such as those that contain 0,50 and 56, preserved their magnetism, whilst the others which had scarcely 20 (those obtained from green solutions, of which I shall speak at the conclusion of this memoir) were not attractable, I concluded there was some other cause which acted together with the oxygen, or perhaps exclusively, in destroying the magnetism. In reflecting on the circumstances that attend the formation of all these different oxyds, I suspected that in these phenomena, as in most of those to which the oxyds of iron yield,

yield, influence has been ascribed to the oxygen, and effects attributed to it, which do not belong to it. If the loss of the magnetism in some red oxyds of iron be not occasioned by their extreme divisibility, it has at least a much more obvious influence than the oxygen.

When the magnetic oxyd of which I have spoken is precipitated by concentrated alkalies, and without diluting the solution with much water, the precipitate is brown, more or less dark; it is not changed by drying in the air, and it is very evidently magnetic. If on the contrary, the solution and the alkalies be diluted with water that has been boiled for a long time, in order to remove all suspicion of super-oxydation, the precipitate is red, like all those that are denominated at the *maximum*; and if it be dried in the air, or by a gentle heat like the preceding, it gives no signs of magnetism. Now we cannot attribute this difference of colour and of magnetism to a different proportion of oxygen, since by making this experiment on two equal parts of oxyd, we see that the weight of the red oxyd is the same as that of the magnetic. The difference of magnetism, therefore, like that of colour, is owing to the difference of approximation or density in the molecules of the two precipitates.

Indeed, when the solution is concentrated, the molecules of oxyd touch, or at least they are much nearer to each other than when the solution is diluted with water; and this difference of approximation is owing to the bulk of the two solutions, since the distribution of the oxyd is in both cases the same. Let us suppose this difference of approximation to be as one to ten, or, what amounts to the same, the thickness of the columns of liquid, that separate the molecules, to be one-tenth of a line in the concentrated solution, whilst it will be the thickness of an entire line in that which is diluted with water; what will be the consequence if a drop of alkali touches any point whatever of the concentrated solution? The alkali will occasion the precipitation of a certain number of molecules of oxyd, which at first will be one-tenth of a line apart, as when they were combined with the acids; but their weight, assisted by the pressure of the atmosphere and by that of the solution, is capable of overpowering the resistance which the small quantity of liquid that separates them opposes to their approximation. Hence it is that this precipitate is blackish, preserves its magnetism, and at the end of some minutes is not soluble in muriatic acid in the cold.

In the solution much diluted with water, although the alkali determines the fall of an equal number of molecules, and although their weight and the pressure acts in the same manner, as the resistance that the liquid opposes to them is ten times greater, the approximation cannot be so complete.

Besides, when iron filings, extremely small, are calcined, and divided in the course of the operation, until they have taken up 15^{c} of oxygen, a very fine red powder is obtained, which is much less magnetic than the oxyds of 30 and 40 obtained by the ordinary process *, although they contain only the few hundredths of oxygen indicated.

In short, the red precipitates of solutions of iron, and most of the aperitive safrons of Mars, after being well dried give no signs of magnetism; but, if they be submitted to a brisk fire for some time, their bulk diminishes, their colour is deeper, and their magnetism decided. Now it cannot be said in this case, that the magnetism is

* That is with the ordinary filings, and without pulverizing them in the course of the operation.

is owing to the loss of oxygen, since the experiments of M. Proust, and latterly those of M. Berthollet, have proved that these oxyds, exposed to the strongest heat of our furnaces, do not lose an atom of their oxygen.

To this same approximation belongs the conversion of red crayons into magnets, as related by M. Haüy, and the magnetic polarity that is discoverable in all the oxyds of iron heated by the blow-pipe, as Lelievre observes. Besides, the weakening of the magnetic property by the division, and even the absolute suspension of its effects, is a consequence of the theory, or rather of the ideas that we entertain of magnetism. Although I am not acquainted with any accurate experiments which prove that the magnetism acts in direct proportion to the size of the mass, yet numberless facts attest that it is subjected to this law. It is well known that a magnetic bar, eight inches long, and one thick, is more powerful than another of half these dimensions.

The two hypotheses which influence the terrestrial magnetism are also subject to this law. It is by virtue of their immense size that the iron mines attract at such prodigious distances. Without this law, we cannot account for this phenomenon. Thus, under equal circumstances, a grain of iron will have a magnetic force one hundred times greater than $\frac{1}{100}$ of a grain, and one thousand times more than $\frac{1}{1000}$, &c.; and the imagination can easily conceive a subdivision by which the magnetic power of a grain of iron may be so reduced, and its sphere of action so much abridged, that the attractive power of each particle is not only incapable of extending through the space that separates it from its adjoining particle, but is also unable to give signs of magnetism when placed in contact with a magnetic needle. An example will elucidate this.

Suppose

Suppose that I present the Northern pole of a needle to a piece of iron filing; the Southern fluid of the latter will be attracted to the extremity nearest to the needle, whilst its Northern fluid will ebb to the opposite extremity. But, as there is a difference sufficiently appreciable between the distance at which the Northern pole of the needle acts upon the two fluids of the bit of iron, the Southern force of which will prevail over the Northern force, and, by virtue of this preponderance, will approach the needle; let us divide this piece of iron successively until the distance between the two poles of one of the portions be so small, that to the eye the two poles appear confounded; then the difference between the attraction and the repulsion will be inappreciable, and the particle will give no signs of magnetism.

It may be said that this developement of magnetism in oxydes strongly heated is rather because the heat weakens the coercive power that is opposed to the magnetism; but, besides that this coercive force is not a fact so well proved as the approximation of these oxyds whenever they become magnetic, a part only of these phenomena can be accounted for by it; for, in the oxyds obtained by precipitation, which can be rendered magnetic at will, no heat is employed.

Finally, whatever may be the cause of this phenomenon, it is certain that the oxyds saturated with oxygen are magnetic, or at least they are capable of becoming so without losing an atom of oxygen; yet I do not pretend to say that a given quantity of iron saturated with oxygen preserves the same magnetic power that it possessed before it was oxygenated. I have made no experiments on this point.

Report

Report made to the National Institute on the Results of M. Clouet's *Experiments on the different States of Iron, and for the Conversion of Iron into Cast-Steel.*

By M. Guyton.

(Concluded from Page 66.)

THE frequent and almost inevitable accidents to which the crucibles are liable, owing to the wind from the bellows, made it desirable to ascertain whether the operation would succeed equally well in reverberating stoves, or any other wind furnace, as announced by M. Clouet.

We at first made use of Macquer's furnace, belonging to one of the laboratories of the Polytechnic school. Although its want of repair did not permit us to hope for all the effect it was constructed to produce, a pyrometer, placed in a separate crucible, indicated that the heat had been raised to 151 degrees: the crucible appeared to be neither pierced nor split; yet the fusion was incomplete, and even a portion of iron remained bare above the vitreous matter, without any possibility of discovering the cause.

We at first resolved to repeat the experiment in a casting-furnace; M. Lecour willingly permitted us to operate in that established in his laboratory: the success surpassed our expectations, considering the small capacity of this furnace. The detailed description of this operation seems to us to be the best method of explaining its object, since it tends to establish the possibility of its execution in the large way, and to form the basis of this new art.

The wind-furnace, which was at our disposal on this occasion, is constructed of bricks; its fire-place is a

square

square space of 25 centimetres each interior side and 45 high, terminated below by a grate composed of square bars, of 27 millimetres, and raised 25 centimetres above the floor of the ash-hole.

The fire-place is surmounted by an iron cover moving upon hinges, and inclined backward about 25 degrees.

The chimney which terminates the furnace is likewise composed of bricks; it commences above the opening of the cover or door; it forms a square, whose interior measures 25 centimetres on each side, which narrows towards the top; so that at its extremity it measures no more than twenty. This pipe rises, inclining against the wall, to thirteen decimetres in height. There it joins a large chimney, raised about 15 metres, in which is inserted a regulator, that plays when the furnace is in action.

We had put before-hand in a Hessian crucible (15 centimetres in height and 8 in diameter), 367 grammes of small drawn iron nails and 245 grammes of a mixture of carbonate of lime and baked clay: this crucible was placed on its support in the middle of the grate.

At one of the angles of the bottom a small crucible of Kaolin was placed, furnished with its cover, and inclosing two of Wedgwood's pyrometric pieces. We foresaw that in this position they would not receive the same degree of heat as the crucible in the center; but it was a method of estimating not to be neglected.

When the fire was first lighted it was kept at a moderate heat, and the fusion was judged complete at the end of an hour; the vitreous part was withdrawn, and the ingot was cast. One part of the matter remained congealed in the crucible, because too much time was spent in taking off the last portions of glass; perhaps also it required heating a quarter of an hour longer; but the piece by by its form and its grain left no doubt of a good fusion, and a perfect conversion.

One of the two pyrometic pieces that were placed at the angle of the furnace indicated 136 degrees, and the other 140; from which we judged that the matter in the large crucible had received about 150 degrees of heat.

Perret says in his memoir addressed to the Society of Arts at Geneva, that cast-steel is judged intractable by many smiths; yet it is possible to work it by attention and address.

M. Clouet's cast-steel requires precautions particularly adapted to its nature, and the specimen proves that it is capable of being forged; in this state, although its grain be not improved by tempering, it will bear a comparison with the English cast-steel. We likewise had a small piece of iron forged, produced by fusion in a wind-furnace; the grain of its fracture, after having been forged, fully confirmed the judgment we had formed from its appearance when cast.

The ingots presented almost always in their fracture little cavities, which it might be supposed would produce defects at the forge; but as they are clean, and free from all foreign matter, they are no impediment whatever to the re-union of all the parts. It is, besides, easy to prevent this accident, by causing it to cool more slowly in the ingot-mould; all which will naturally take place when the operation is performed on larger masses.

We must not omit to mention, that this steel, when forged in bars, is in the state that Kinman describes as one of the characters of cast-steel. Its specific weight is to that of the finest steel not cast, as 7.717 to 7.79.

However convincing these results may be, they would still be unsatisfactory if we could not shew that this steel in the hands of a good workman is capable of making as good instruments as that of the English; and we have the satisfaction of being able to offer this farther proof of the utility of M. Clouet's discovery.

A small bar of iron, produced at the casting-furnace at the Conservatory's dépot of machines, was remitted by M. Mollard to M. Lepetitwalle in the Faubourg Antoine. He made three razors from it, two without any preparation; the third, taken from the same bar, was cleared of the little spots, cracks, or fissures, that are discoverable on the surface and the edge; the latter, he declared, was fabricated with the greatest ease, owing to the good quality of the material, that it would bear a comparison with the finest English steel, and that all the three were excellent.

4. We have hitherto confined ourselves to the examination of processes and products, that have more particularly attracted the attention of government; but we cannot terminate this report, without describing, in a few words, the theoretical truths that result from them.

It is known that iron does not become steel but by taking up about 0.2013 of its weight of carbon; and as it exists there only in the state of carbonic acid, this acid must therefore be decomposed. This is a very important phenomenon, which the observation of M. Clouet adds to the proofs of the doctrine of the French chemists.

But how is this decomposition effected? It evidently results from the eventual or predisposing affinity that a portion of the iron exercises on the oxygen of the acid, at the same time that the remainder of the iron tends to unite with the carbon; and the concurrence of these forces effect a separation, which would not take place by simple affinity only. In this operation also, the vitreous flux is always charged with oxyd of iron; its presence is discoverable by a very deep green colour.

Hence

Hence perhaps it may be inferred, that this indispensible oxydation of a portion of iron occasions a loss in the product, which is of so much the greater importance as none but iron of the best quality should be used in this operation. This consideration induced us to direct our attention to this loss, for the purpose of estimating its probable extent. In the experiment made with a wind-furnace the loss was not quite one-twelfth part; in another experiment, made with the forge of the Mineralogical School, under the inspection of M. Vauquelin, of 428 grammes of iron, only 19 were lost, which is less than a twenty-second part. But this loss is of no consequence, since it will be amply compensated by the increased value of the rest of the material, and since, instead of augmenting, it will rather be diminished in operations on a larger scale; for it is evident, that it is for the most part produced by an accidental scorification, and always more in proportion to the surface than to the mass.

It now only remains for us to point out in this process, in what respect it appears to us to be superior to those until now in use, for the conversion of iron into steel. It is known that the grand difficulty lies in making it combine with the proper dose of carbon—if too little, the steel is soft, and if too great the steel is super-saturated almost to the state of cast-iron, and is equally intractable. Might not the quantity in this case be determined by the concurrence even of the forces of affinity which effect the decomposition of the carbonic acid? the degree of saturation would then be always the same, and the product uniform.

Conclusion.

In consequence of these reflections, and the facts related in this report, we conclude:

That the observations of M. Clouet on the different states of iron diffuse a new light on the method of treating this metal.

That the immediate conversion of soft iron into cast-steel, without having recourse to charcoal, and by the decomposition of carbonic acid, is a discovery as important to the advancement of the theory of chemical affinities, as it is valuable for the augmentation of national industry.

That by the labours of M. Clouet the processes of this new art are already so satisfactorily determined as to leave no doubt of their success in a large undertaking.

That the steel produced by them, when forged, has all the external characters, appearance, and intrinsic qualities of the English cast-steel; that it will serve for the same purposes, and may be introduced into commerce in competition with it without fear of a disadvantageous comparison.

That it is desirable, in order to secure and extend the fruits of this discovery, that government should order fifteen or twenty myriagrammes of this steel to be made, and the value and actual price would be equivalent to the expense.

That by intrusting to M. Clouet the direction of the infant foundries would be to insure their success.

And, lastly, that M. Clouet's liberal and unreserved communication of this discovery entitles him both to the gratitude of his fellow citizens and to a national reward.

Facts relating to the History of Prussiates. By M. Proust.

(Continued from Page 59.)

Black Oxyd an Element of Prussian Blue.

WE have demonstrated that this oxyd, in an invariable proportion, is a principle essential to the constitution of triple prussiate; but a circumstance worthy of attention is, that this same oxyd will follow the prussic acid from one combination to another, without changing its state; that it will pass from prussiate to prussiate, returning from the last to the first, circulating as it were even through mediums the most oxydating, without losing by that means the state of an oxyd at the minimum. This appears to me to be a fact in the history of prussiates hitherto unknown.

If then it be true that, without the concurrence of black oxyd, the prussiate of potash would not be yellow, nor crystallisable, nor capable of yielding a blue with iron, we may with equal confidence affirm that Prussian blue cannot be formed without the intervention of this oxyd; and, indeed, whenever Prussian blue is made with a solution of red oxyd and triple prussiate of potash, the black oxyd from this salt passes, together with its acid, into the new combination; whence it follows, that this oxyd, being an element of prussiate of potash, afterwards becomes an element of the Prussian blue, and even, as we shall presently see, of all other metallic prussiates that are made with this salt.

This black oxyd is so intimately combined with the Prussian blue, and is so well defended by the prussic acid from all ulterior super-oxydation, that it is always found in this blue in the same state as it had been before in the triple prussiate. I can farther say, that if a blue be made

made with this prussiate and the green sulphate, the oxyd of the latter will rise, as is well known, to its maximum, in proportion as the blue colour increases by the action of the air; but will it be the same with the black oxyd that passes, together with the acid, into the Prussian blue? Certainly not; for this oxyd does not lose the property it had, in the prussiate of potash, of remaining at the minimum; that is to say, that if, during the exposure to the air, the base of the green sulphate, and consequently that of the white prussiate, rises from 0,28 to 0,48, the black oxyd, which is inseparable from the prussic acid, will not partake of this super-oxidation, but will remain invariably at 0,28.

Not only the atmosphere, which raises with so much facility the oxydation of the bases of the sulphate, muriate, and white prussiate, loses all its activity when opposed to the black oxyd in question, but neither the application of boiling nitric acid nor oxygenated muriatic acid will raise the oxydation of the latter. These acids may indeed destroy some Prussian blue, and reduce it even to red oxyd; but, so long as any blue remains to destroy, it will retain its black oxyd to the last entirely in its primitive state.

If the red oxyd be treated with prussic acid, not any sort of combination will take place, which agrees with an observation of Scheele's; but if the black oxyd be used, a greenish prussiate will be obtained, which the air converts into a perfect blue. The black oxyd therefore certainly enters into the composition of Prussian blue. If this oxyd were not necessary to it, or if the red oxyd were capable of serving exclusively as a base to Prussian blue, there is no reason why this oxyd treated with prussic acid, or even a solution of this oxyd mixed with simple prussiate of potash, should not produce Prussian blue.

I have

I have remarked above, that the affinity of the prussic acid for this dose of black oxyd, which renders it fit for producing triple prussiate, may be powerful enough to prevent it from being acted upon as all oxyds are when combined with acids in general.

Indeed, it appears to me that this inference may be drawn from the following experiment.

Pour into a bottle, hydrosulphuret of potash upon Prussian blue, and keep the mixture well corked; at the end of a few days, the hydrosulphuret is converted into triple prussiate, and the red oxyd of the Prussian blue changes into black hydrosulphuret; whence we see that although the red oxyd is affected like all others when they are united with acids, and exposed to the action of hydrosulphuret, yet it is not the same with the black oxyd, which, as we have before frequently repeated, passes from the triple prussiate of potash into Prussian blue. This oxyd keeps itself distinct from the red oxyd, and is never susceptible of the changes to which the latter is subject, and which is the base of Prussian blue.

Hydrosulphureted water brings the Prussian blue to the state of white prussiate, as it does the red sulphate to that of green sulphate. This is a fact that I have already published in my former memoir; and the power of this re-agent never passes beyond these limits, but the hydrosulphuret of potash totally changes the red and green sulphates into black hydrosulphureted oxyd. Why does not the action of the hydrosulphuret extend to the black oxyd in question? It must be, that a singular affinity (of which, I believe, there are few examples in chemistry) gives to the prussic acid, which is in so many respects the weakest of acids, the property of protecting this oxyd against the action of the alkaline hydrosulphurets.

All metallic solutions which produce prussiates with triple

triple prussiate of potash, are undoubtedly affected in the same manner as those of iron.

The prussiates that result from them will preserve in its original state the black oxyd which the prussic acid carries with it; but it is now time to relate the principal experiment, which demonstrates that the prussian blue is a triple salt, and that the black oxyd, which has passed from the triple prussiate of potash into the prussian blue, may again be returned from the prussian blue into the potash, without losing for an instant its quality of an oxyd at the *minimum*.

This experiment I can say, by whatsoever means it is done, presents a clear idea of the nature of the triple prussiate of potash.

Take, for example, a Prussian blue that has been fully subjected to the action of the atmosphere or the most oxydizing acids. Apply pure potash to it, and a lessive may be extracted that will yield only triple prussiate; that is to say, a combination, in which we shall find the prussic acid constantly associated with the ordinary dose of black oxyd. If this prussiate be really such as I stated it to be, and if the reader can believe it, he will not object to this new point of theory, which states that prussiates, whether white or blue, are treble combinations, as well as the prussiate of potash used in their formation.

I treated some prussiate of manganese with potash; the result from it was crystallizable triple prussiate of potash, which was yellow, and furnished with all its black oxyd. Therefore, this prussiate of manganese is also a combination trebled by the black oxyd. The prussiate of copper, which is the colour of red lead, is undoubtedly another treble combination; for the simple prussiate of copper is yellow.

Scheele

Scheele assures us that other oxyds have also the property of trebling the simple prussiate of potash; and it appears to me that a course of interesting researches may be undertaken, which will possibly lead to the discovery of some colour as valuable as the Prussian blue; and in short we may farther conclude, from what has been shewn, that there is no such thing as simple prussiate of iron, a species of combination of which other metals are nevertheless susceptible, as we shall soon see.

Distillation of Prussian Blue.

This prussiate when exposed to an elevated temperature is destroyed; the products of the operation confirm the theory that Berthollet has given us respecting the nature of prussic acid. We obtain some acid that has escaped destruction, some carbonate of ammonia, a little free carbonic acid, and gaseous oxyd in abundance; an ounce of the blue of commerce, of a good quality, yields a little more than two pints and a half of this gas, and carbonic acid completes the three pints. The water of the pneumatic tub contains a little prussic acid fixed by ammonia.

It is well known that this prussiate has similar properties with that of simple potash; it will not produce a blue with solutions of red oxyd, yet it will afford it with those of an oxyd at the *minimum*, because it forms at the same time a triple or blueing prussiate.

The residue weighs five drams fifty-two grains, is perfectly black, and very attractable by the magnet. It is a pyrophorus that inflames rapidly. After it has been kept in a bottle badly corked, so long as not to light of itself, if it be moistened with nitric acid at 40 degrees, it burns with much vivacity; and I am inclined to believe that in this combustion the iron burns together with the charcoal.

If the Prussian blue contain no alum, the residue will be composed of charcoal and iron only.

Muriatic acid disengages from it that aromatic hydrogen with the greatest facility which indicates the presence of iron combined with charcoal, as in steel. The remainder is pure charcoal, which is one of the elements of the destroyed acid. The two others, hydrogen and azote, produce ammonia. As for the carbonic acid and gaseous oxyd, it is equally evident that they are the two major and minor oxydations of charcoal, furnished by the oxygen of the two oxyds, which we have discovered in the Prussian blue.

This decomposition is obtained at such a moderate heat, that it appears to me a convenient mode of obtaining gaseous oxyd. There is not the least foundation for supposing that oil is present in it; and it is surprising to see that, in the course of a destruction in which charcoal and hydrogen abound, there should not be a particle of these combustibles so constituted as to be capable of producing oil.

The oily and aromatic character which the hydrogen takes during the dissolution of the residue, also demonstrates that a very elevated temperature is not requisite for the combination of iron with charcoal. The charcoal of blood, which is obtained by a much less heat, likewise contains iron in a carburated state; for with muriatic acid it yields odorant hydrogen.

Distillation of triple Prussiate of Potash.

This salt loses 0,10 of water, and its colour at the same time, for it becomes white. It does not begin to soften until it is at a red heat. Some chemists have fancied that

that they have found in its roasting, or in its fusion, a method of separating the oxyd from it; but the following results will shew that these processes lead to nothing useful.

When this salt enters into fusion, a little prussic acid escapes, which is taken up by the ammonia that forms at the same time. This is succeeded by a cloudy vapour, which condenses in flowers in the neck of the retort, but is not produced when the fusion is completed. This sublimate on examination is found to have the alkaline and bitter savour of simple prussiate.

Alcohol dissolves a part of it, and that which is separated is triple prussiate unaltered; that is to say, that this produces Prussian blue, with solutions of red oxyd, which the other does not.

If a lighted candle be applied to the mouth of the retort, the prussic acid only burns; and the carbonic acid that proceeds from its combustion forms, with the ammonia, crystals of carbonate, which condense in the neck a few lines below the flame. We will now proceed to the examination of the melted prussiate.

The mass resembles melted sea-salt; it is ash-coloured, and strongly attracts moisture.

It has no longer the mild taste of triple prussiate, but an alkaline savour perfumed with the bitterness of noyau, supplies its place. This savour indicates at once that there is simple prussiate of potash contained in this residue. A few drops of acid disengage a gas that does not appertain to this prussiate, and which shews that the carbonate of potash is also present in it.

Lastly, this mass, when dissolved, deposits a black powder, which is micaceous and very brilliant. It is collected by filtering, and is a mixture of charcoal, pure iron, and a little sulphuret of iron. This latter is an accidental product; its sulphur proceeds from the decomposition of sulphate of potash, from which it is difficult to purify the triple prussiate. This powder is attractable by the magnet. A weak acid disengages first some sulphureted hydrogen, then the aromatic hydrogen, and lastly nothing but charcoal powder remains.

Examination of the Solution of the Residue.

Mixed in a moderate quantity with alcohol at 25 degrees, it immediately forms a brilliant pearly snow, which is collected by the filter. When dissolved and crystallized, it affords yellowish crystals, which are sweet, and with muriatic acid furnishes prussic acid and white prussiate. This is the prussiate purified from oxyd that M. Richter has proposed.

The alcoholic solution, distilled almost to dryness, is afterwards covered with alcohol at 30 degrees, which then dissolves one portion, and the other remains at the bottom. This, on examination, is found to be carbonate of potash, with a residue of triple prussiate. The new solution distilled affords simple prussiate, which is discoverable by its savour, and has the property of not producing a blue with solutions of red oxyd. These are the products of the fusion of triple prussiate of potash.

CONSEQUENCES.

The triple prussiate cannot sustain an elevated temperature, without being simplified in its composition. It is freed from the black oxyd, and is converted into simple prussiate; but it may also be reduced to something more simple, as we shall see farther on: then it leaves in its place potash, and the usual remains of the prussic acid, which are ammonia and charcoal. A part of the latter serves

serves to disoxydize the black oxyd, to reduce it to iron, and form carbonic acid.

During these changes, a part of the triple and simple prussiates gradually disappear, in proportion, no doubt, to the carbonate. But it must be understood that, at a continued high temperature, in vessels capable of sustaining it, these prussiates would in the end be reduced to the two binary combinations, ammonia and carbonic acid, and to potash, iron, and some remains of charcoal, that the oxygen of the iron and of the moisture could not acidify.

Simple Prussiate of Potash.

This is obtained by saturating, according to Scheele's method, some potash with prussic gas, disengaged from prussiates of potash or of mercury; but it is more expeditious to keep alcohol upon a concentrated lessive of animal charcoal. It is shaken from time to time; and the progress of the solution is discoverable by the alkaline and bitter taste of the alcohol. The lessives of the charcoal from blood or leather are rarely exempt from a little hydrosulphuret, because the sulphate that contaminates the prussiates forms sulphur, which passes into the alcoholic solution; but the charcoal also contributes to it, for I have prepared lessives with charcoal of blood and very pure carbonate of potash; and I have nevertheless found hydrosulphuret, although in a less quantity. It must not be forgotten that sulphur already exists in the ammoniacal products of blood. It appears even that it has the property, like phosphorus, of fixing in the charcoal, but not in the iron that it contains; for the aromatic hydrogen, we before mentioned, leaves no reason for supposing the presence of sulphur by the smell.

The

The simple prussiate is easily known by its two-fold alkaline and bitter savour, and by the aroma, with which it strongly perfumes the mouth. It precipitates the solution of copper in yellow, and will not produce a blue with that of the red oxyd, but it precipitates them in an ocreous yellow, as it would a pure alkali *. In short, it affords a blue with an ordinary solution of sulphate of iron, because it constitutes at first triple prussiate, and afterwards gives prussiate of iron white or blue. If the prussiate be black, it is because the alkaline hydrosulphuret introduces into it some hydrosulphureted oxyd; but it is freed from it by some drops of acid, and only the prussiate of iron remains. The simple prussiate does not keep well, unless in a closed vessel. Scheele has shewn that carbonic acid is sufficient for separating the potash, so weak are its affinities; when the black oxyd is not united with it, though concentrated, it will not crystallize, but forms into a mass, in which, however, some saline leaves are distinguishable.

This prussiate is the proof-liquor proposed by Scheele. Its utility in analysis must be very limited, since all solutions in which iron is at the *maximum* (and this is mostly the case) are not, as he has himself declared, at all affected by this re-active. To employ it usefully, a portion of the oxyd of the solutions must be brought back to the *minimum*; and this cannot always be done easily, nor without the risk of augmenting the difficulties of the operation.

* In a Memoire on the Stone of Sigena, I have stated this union as possible; but it is an error. I was deceived by a sulphate of iron that I had superoxydized by nitric acid, and which retained notwithstanding a remainder of black oxyd. Scheele, therefore, whom I contradicted on this point, was better informed than myself.

Its

Its Decomposition.

The heat of the ebullition causes the aqueous solution of this prussiate to abandon a part of its acid; which sufficiently demonstrates that this combination is neither solid nor to be compared with any of those that form the oxygen acids. It froths continually, and has even something soapy in its composition. A lighted candle applied to the mouth of the retort burns this portion of the acid; but the loss ends not there: the acid which this salt retains most strongly, by means of the potash that begins to predominate, is gradually destroyed by the heat, which converts it into ammonia and carbonic acid. At any period of the ebullition, carbonate of ammonia mixed with a little prussic acid is always found in it; and at last, when the water begins to fail, this carbonate condenses in needles within the neck of the retort.

If the water be renewed in order to continue the ebullition, these same products are found in the water of the recipient. But after four or five successive distillations, performed in the same manner, they are no longer perceptible, although the saline residue still evidently contains prussic acid.

It is then treated with alcohol; one part is dissolved, and the other is not in the least affected. Prussiate of potash is in fact present in the alcoholic liquor, but the salt that resists its action is nothing but carbonate of potash.

The two following experiments were made in order to place beyond a doubt the destruction of simple prussiate by the heat of ebullition only.

This prussiate does not render turbid the muriate of lime; but that which has been subjected to a long ebullition, precipitates calcareous carbonate in abundance. There

There is then a transformation of prussiate into carbonate of potash.

Two measures of prussiate, the one altered by long ebullition, and the other entire, were employed to precipitate some ordinary sulphate of iron. They both yielded some blue; but, after the *(l'avivage)* addition of a little acid, that of the first measure was three times less in bulk than the second.

If some simple prussiate dried be heated to redness, it produces carbonate of ammonia, fouled by an oily vapour, which has the character of that of hartshorn. The saline mass dissolved leaves some charcoal, and also carbonate of potash mixed with a little of the prussiate not decomposed.

Consequences.

All these results undoubtedly authorise the conclusion, that simple prussiate of potash is, as Scheele has already discovered, a fragile combination, the principles of which easily separate, like all others that are complex. We see, indeed, that a part of the acid separates from the potash by the single force of dilatation, while the other, subjected for a longer time to the re-action of caloric, is destroyed and changed into ammonia and carbonic acid. We will now procéed to the application.

It is a fact that the triple prussiate of potash undergoes no alteration whatever from reiterated ebullition. The leys that are employed in the fabrication of prussian blue contain, as we shall see presently, triple prussiate and simple prussiate, but there is not any ammoniacal salt. Indeed, the great excess of carbonate which they also hold would expel it; and in fact the ammonia evaporates during the ebullition. Whence comes this ammonia then, if it is not from the decomposition of the simple prussiate?

It

It may then be concluded that the boiling of the lessives, or their concentration, exposes them to waste by the destruction of this same prussiate, which ought to be preserved; and as the carbonate of potash is also one of the principal results of this destruction, it adds to that which is already present.

Curaudeau is well acquainted with the waste that boiling the lessives occasions, and he very completely prevents the effects, by adding to them a little sulphate of iron. This is according to a principle of Scheele's, who has stated that simple prussiate changes into triple prussiate as soon as it is combined with a portion of black oxyd, and is defended by that from decomposition.

As to the products from the destruction of prussiate by melting or ebullition, they certainly contain nothing extraordinary, since it is sufficient to be acquainted with the nature of prussic acid to foresee them; but it is not thus with the carbonic acid that appears during one of these destructions. For whence comes the oxygen, which, during the ebullition of the aqueous prussiate, acidulates the charcoal of the prussic acid? Either this oxygen will be, like hydrogen, azote, and charcoal, one of the results of the destroyed prussic acid, or we must suppose that there is a decomposition of water. It is not yet time, I think, to decide between these two opinions; but, whilst waiting for new discoveries, I shall observe that, if we reflect on the circumstances that accompany the production of the prussic acid, we shall more willingly adopt the opinion that Berthollet holds than any other hypothesis possible. He says, "It appears difficult to me to suppose the existence of oxygen in a substance that contains elements which are disposed to form particular

cular combinations with it, such as hydrogen and carbon, and which will sustain a sufficient degree of heat without being decomposed." Indeed, to admit that this acid is an oxygenated product, we must suppose that such acid is capable of contending for the oxygen with the charcoal that envelopes it in all parts; and we must at least place it at the head, I will not say of acids, but of oxyds that are known to be the most difficult to reduce.

TO BE CONCLUDED IN OUR NEXT.

Intelligence relating to Arts, Manufactures, &c.

(Authentic Communications for this Department of our Work will be thankfully received.)

Process of Distillation.

THE following is, we believe, a more complete account of the process of distillation than has ever been before published, and we have therefore been induced to insert it. It is extracted from the Appendix of the Fifth Report of the Commissioners of Inquiry into the Fees, Gratuities, Perquisites, and Emoluments, received in the Public Offices in Ireland, and is the deposition of James Forbes, Esq. of Dublin, who was concerned for many years in a large distillery. Printed by order of the House of Commons.

"The corn is first ground, then mashed with water, and the worts, after being cooled, are set for fermentation, to promote which a quantity of barm is added to them, and they become wash; the wash is then passed through

through the still, and makes singlings, and these being again passed through the still, produce spirits; the latter part of this running being weak, is called *feints*; when singlings are put into the still a small quantity of soap is added, to prevent the still from running foul; a desert-spoonful of vitriol, well mixed with oil, is put into a puncheon of spirits, to make them shew a bead when reduced with water: this is only done with spirits intended for home consumption, and no vitriol is used in any other part of the process. In this distillery the former practice was to use about one-fourth part of malt, and the remainder a mixture of ground oats, and barley, and oatmeal; latterly the custom has been to use only as much as would prevent the kieve (mash-vat) from setting. He had found that malt alone produced a greater quantity of spirits than the mixture of malt and raw corn of the same quality with that of which the malt had been made. He generally put from 50 to 54 gallons of water to every barrel of corn of twelve stone (14lb. to the stone). Each brewing was divided into three mashings, nearly equal: the produce of the two first was put into the fermenting backs, and the produce of the last, which was small worts, was put into the copper for the purpose of being heated, and used as water to the next day's brewing, when as much water was added as would make, with the small worts of that brewing, 54 gallons to each barrel of corn. The kieves were so tabulated that he always knew the quantity of worts which would come off at each mashing. Their strength he ascertained by Saunder's saccharometer, and at the above proportions he obtained from a mixture of the two first worts, an increase of gravity from 20 pounds to 22 pounds *per* barrel, of 36 gallons, above water-proof, at a temperature of about 88.

The small worts gained at the same temperature about six pounds. The grain, after the last worts were off, retained nearly the same bulk as when put into the kieve; the whole of the grain was put in at the first mashing; he never knew any grain to be added to the second mashing. The worts of the first and second mashings were run through the mash-kieve into the under-back, in which state they were usually found to correspond with the computation made in the ma '. kieve and under back, in the latter of which a correct guage might be taken of them. He usually commenced brewing at six o'clock in the morning: the first worts were run off into the under-backs, and required from an hour to an hour and a half to be forced up into the cooler; the second worts came off at the end of two hours from the discharge of the first, and required about the same time to pass into the coolers. The small worts were generally run off late at night, and being then, or early on the following morning, put into the copper to be used for the next brewing, were seldom shewn on the coolers. He thinks that any decrease of the worts by evaporation whilst on the coolers must have been very inconsiderable; and that a correct guage of the worts might be taken in the coolers as well as in the underbacks. The quantity of wash in the backs was found to be nearly correspondent with that of the strong waters which had been on the kieve and in the cooler. The fermentation of the worts was produced by means of yeast, and was in general so contrived as to be apparently kept up for the full time allowed by law (six days): he has, however, usually had his wash ready for the still in twenty-four hours from the time in which it was set. Backs are renewed in two ways; either by additions made to them from other backs in the distillery,

each

each supplying a certain portion of wash to the back which is next before it in the order of fermentation, while the newest and least-fermented wash is replenished by worts, or when the fermentation is down by an intire substitution of worts. He has ordinarily in course of work charged a 500 gallon still with wash, and run it off in from twenty to twenty-three minutes: he has seen a 1000 gallon still charged and worked off in twenty-eight or thirty minutes. He understands that it is now the practice of some distillers to heat the wash nearly to the state of boiling before the still is charged with it, by which means he believes the process to be accelerated by three or four minutes. He has seen a 1000 gallon still charged with singlings, and worked off in from forty to fifty minutes, and thinks a 500 gallon still requires nearly an equal time. Feints from pot-ale (the name given to completely fermented wash) usually are run off in from six to seven minutes; making allowance for every delay, about six charges of spirits may be run off from a still of 500 gallons content, each charge estimated at 150 gallons. The feints were always put back into the pot-ale receiver; 20 gallons of feints is the usual quantity run from a 500 gallon still charged with singlings; he thinks there is more spirit extracted from feints than from pot-ale; there was no delay between one charge of pot-ale and another, or between one of singlings and another; the still could be cleansed in less than a minute: it very rarely occurred that the ordinary accidents which happened to the still delayed the work to any considerable degree. The still is never charged with wash beyond about seven-eighths of the still, nor with singlings beyond about four-fifths, exclusive of the head. The estimated produce (according to which the duty may be charged)

charged) is one gallon of singlings from three gallons of wash, and one gallon of spirits from three gallons of singlings, but it is very frequently somewhat more. Previous to the regulation (of Excise) which took place in June 1806, from a still of 540 gallons, which is charged with 2075 gallons of spirits weekly, he has frequently drawn 5300 gallons in one week, and thinks 5000 gallons to be a fair average. He usually made spirits about 14 *per cent.* above proof, by Saunders' hydrometer. Spirits exported by him from 12 to 14 *per cent.* above proof, by Saunders and Hyatt's hydrometer, were charged in London at from 24 to 26 gallons *per cent.* Before he sent them to the Custom-House for exportation he either reduced them with water, or drew them at that strength from the still. To every six gallons of strong spirits one gallon of water was added in the distillery, which reduced them to the strength usual for exportation. The reduced spirits are permitted to the king's warehouses, and the distiller given a credit for a decrease of stock equal to the quantity so permitted; by these means he has one gallon of private spirits to dispose of for every gallon of water mixed with the spirits exported; besides this, the distiller draws back the allowance given in lieu of the malt duty on every gallon of water added: when he warehoused spirits with the intention of afterwards using them for home consumption, he left them at their full strength.

List

List of Patents for Inventions, &c.

(Continued from Page 80.)

JOSEPH BOWYER, of Kidderminster, in the county of Worcester, Carpet-manufacturer; for a method of working or manufacturing carpeting for carpets and carpet-rugs not heretofore used. Dated May 29, 1807.

JOHN BROWN, of the parish of Saint Andrew Hubbard, in the city of London, Stationer; for certain improvements in the construction of a press for printing books and other articles, part of which may be applied to presses now in common use. Dated June 2, 1807.

JOHN BYWATER, of the town and county of the town of Nottingham; for certain improvements in the construction of windlasses for weighing the anchors of ships and navigable vessels, and various other purposes. Dated June 6, 1807.

ALLAN POLLOCK, of Paisley, North Britain, at present residing in London, Merchant; for a stove of a new construction, and various improvements applicable to stoves, grates, and fire-places. Dated June 11, 1807.

HENRY MAUDSLAY, of Margaret-street, Cavendish-square, in the county of Middlesex, Engineer; for improvements in the construction of steam-engines. Dated June 13, 1807.

FRANCIS PLOWDEN, of Essex-street, Strand, in the county of Middlesex, Esq.; for a safe and sure method of preserving, for an extraordinary length of time, at sea and on land, butchers meat, animal and other comestible substances, in a sweet, palatable, and nutritious state, without acid, salt, or drying; the preservation of which apthartic viands he conceives will be of great public utility. Dated June 13, 1807.

JOHN

John Syeds, of Rotherhithe Wall, in the county of Surrey, Compass-maker; for certain improvements in the construction of a machine for making rope or cordage, either shroud or cable laid, and in the mode of manufacturing the same. Dated June 16, 1807.

Robert Barlow, of Spring Gardens, in the county of Middlesex, Chemist and Medical Electrician; for certain oriental, aromatic, chemical compositions or compounds, to be made and moulded into various forms, shapes, and ornamental devices, as amulets in butterflies, birds, shells, and animals, and to be worn as an ornamental part of dress by ladies and gentlemen, as rings, broaches, lockets, pins, combs, bandaus, and other ornaments; which oriental, aromatic, chemical composition he denominates "Ebenbosamic and Ebengavui-Bosamic Composition or Compounds, or Aromatic variegated artificial Marbles and Stones, opaque and transparent." Dated June 16, 1807.

William Atkins, of the city of Norwich, Shawl-manufacturer; for certain improvements in the construction of a loom for weaving borders or stripes, or different colours, on shawls or any goods made of cotton, silk, linen, or worsted, or any other mixture of the same. Dated June 16, 1807.

John Palmer, of Enon Cottage, Shrewsbury, in the county of Salop; for a method of constructing and erecting Bridges. Dated June 26, 1807.

THE
REPERTORY
OF
ARTS, MANUFACTURES,
AND
AGRICULTURE.

No. LXIII. SECOND SERIES. August 1807.

Specification of the Patent granted to John Prosser, *of Back Hill, Hatton Garden, in the Parish of St. Andrew Holborn, in the County of Middlesex, Smith; for various Improvements upon Smoke or Air Jacks.*

Dated October 30, 1806.

With a Plate.

To all to whom these presents shall come, &c. Now know ye, that in compliance with the said proviso, I the said John Prosser do hereby declare that my said invention, or new invented improvements upon smoke or air jacks, is and are described in the annexed drawings and descriptions thereof, and that they are as follows; that is to say: The first improvement consists in making the box, case or body of the single smoke or air jack to extend to the whole length from or near the centre of the inside of the chimney to the outside or breast thereof, and inclosing the spindle, and terminating at or near the chain wheel, as represented by Fig. 1, (Plate VII.) The second improvement consists in raising the said spindle and chain wheel, in a slanting direction, above the centre of the worm; by which the oil flows above the top carriage of the worm, without the assistance of pipes or tubes, the box, case or body being one entire piece, (except the top, which is screwed or fastened on to remove at pleasure,) continued from or near the centre of the flue to the outside of the breast of the chimney, by which the oil put in the box, case, or body near the chain wheel runs round, and incloses the whole work, as contained in Fig. 1. The third improvement consists in making the chain wheel of brass or iron instead of wood, and of placing in the groove or space, in which the chain or chains runs or run, tags and holes, thereby effectually preventing the chain or chains from slipping.

Fig. 2 represents the two patterns or moulds from which the improved chain wheel is cast; four of which screwed together upon the spindle, with a nut at the end of the spindle, forms a wheel for two chains.

Fig. 3 is a representation of the contents or machinery as intended for inclosure in Fig. 1. *b* the worm on which the fly *a* acts; which fly may be made in the usual way, with four, five, or six fans, and the worm may be of a single or double thread. *c* the top carriage, in which the worm runs. *d* the bottom carriage and steel step. *e* the plate in which *c* and *d* are fixed. *f* the steel step in which the pivot of the spindle of the worm wheel runs. *g* a screw which fastens the plate *e* to the box, case, or body. *h* a steady pin at the bottom of plate *e*. *i* the worm wheel, *k k* two friction wheels, working in *l*, a small frame, which frame drops into the improved box, case, or body at *m*. *n*, the chain wheel.

Fig. 4, the improved box, case or body, applied to a jack, which works both vertically and horizontally: this box or body may include the whole work except the chain wheel *n*, and the small wheel with its spindle

and

and universal joint *b*. Both the foregoing boxes, cases or bodies, may be applied to the single or double jacks in use by making them the size of the wheel, and omitting the old frame and other superfluous parts, and working the small wheel *o* in the upper part of the bevil gear wheels, the tops of which are seen at *p*.

Fig. 5 represents the improved box, case, or body in a different form and way, which I call the compound and skeleton air jack. I call it compound, because it contains various wheels, pinions, or cranks, connected with the first worm wheel, or the axle thereof, and continued any length, as the situation of the chimney, flue, or place in which it is intended to be fixed, may require. I call it skeleton, because the body may be made nearly as small as two inches wide, by from four to eight or twelve inches deep. I call it an air jack, because, like the others, the air is more the first moving power than the smoke. The fly in Fig. 5 is as at *a*, Fig. 1, and may be made to any size according to the flue. *b* in Fig. 5 is the worm. *c* the improved skeleton box. The advantages of this form of the box are great, and are as follows: Suppose the jack is fixed in a very small flue, or in the funnel of a ship's stove; then, in the usual way, the body of the old jack almost fills up the flue or funnel crossing it, being from nine to twelve inches wide in the box, and thereby preventing the fly from being easily taken up and down, and greatly checking the draft; whereas in this it is the reverse; the box, case or body, being made as narrow as two inches, a trifle more or less, and continued on from or near the centre of the flue, through the breast of the chimney to the outside in any direction, either on the right or left side, or in the centre of the fire-place, as the situation of the chimney may require, and of any depth from four to twelve inches, according as the diameter of the wheels may require; and of any length, according to the optional number of wheels. The advantages will farther appear in a double jack, which comes out in the centre of the breast of the chimney, and extends to the right and left hand; as in the old way three bevil gear wheels are required, but in this way one wheel only is fixed in the middle of the spindle, as represented in Fig. 7, which runs to the right and left, and working in and with those in the narrow box, and will answer the end of the three bevil gear wheels, placed in the old way; and to each end of which may be added a chain wheel, as at Fig. 4.

Fig. 6 is a representation of the contents of Fig. 5. *d* the worm wheel on its short axis *e*. *f*, another wheel, with the teeth cut the contrary way to the last, and so on alternately to any length or number of wheels which the situation or the depth of the chimney may require. On the axis of the last wheel *g*, on the outside of the breast of the chimney, I place my chain wheel or wheels *h*, as shewn in Fig. 5, on the axle, as shewn in the wheel *g*, Fig. 6, which must be elevated above the line of the axis of the other wheels, in order to admit the oil to rise and cover the top carriage of the worm. *i* the said top carriage of the worm. *k* the lower carriage with the steel step. *l* the frame in which the whole wheels run; which frame drops in at the top of the box or body *c*, Fig. 5. *m* a notch on each side of the box or body C, to admit the axis of the last wheel *g*. When a pinion is required on the axis or side of the first worm wheel *d*, for the increase of power, the teeth of the following wheels may be cut straight. All the boxes, cases or bodies, except Fig. 1, above described, are shewn with their tops uncovered; but each of them are supplied with plate covers, and screwed down or fastened to the boxes, cases or bodies, by means of screws, screwed into the edge of the boxes, cases or bodies, or other like fastenings; and each cover has a small

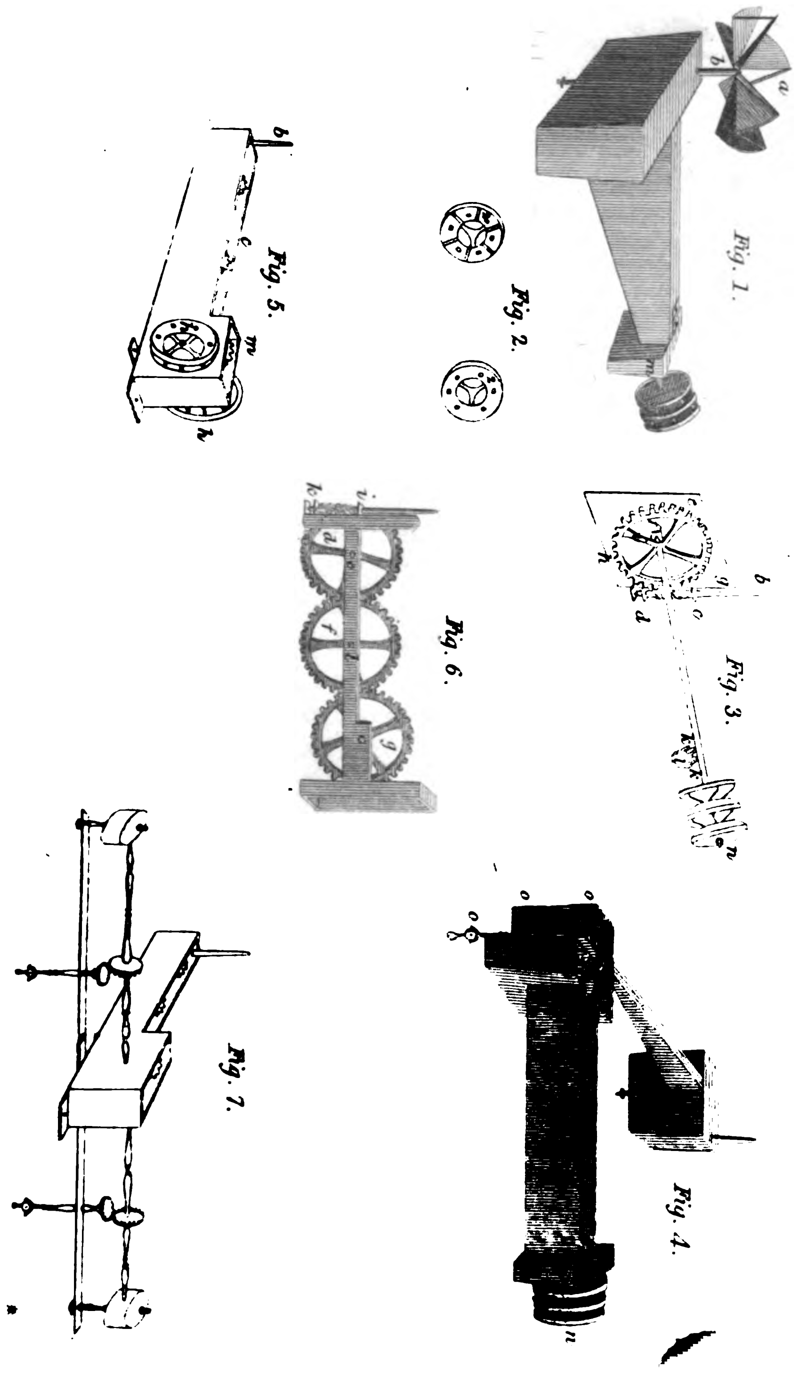


Fig. 1.
Fig. 2.
Fig. 3.
Fig. 4.
Fig. 5.
Fig. 6.
Fig. 7.

a small hinge at or near the chain wheels on the outside of the breast of the chimney, by which means oil, or any substitute for oil, may be introduced, as occasion may require, without ascending the chimney. The boxes, cases, bodies or covers, are made of cast iron, or any other metal, being first made in wood, wider at the top than the bottom, in order to give ease to the founder in moulding. Where and when cast iron ones cannot be procured, then make them of sheet-iron, or copper, or other proper metal.

In witness whereof, &c.

Specification of the Patent granted to CHARLES RANDOM DE BERENGER, *of Hart-street, Bloomsbury, in the County of Middlesex, Artist; for a certain Animal Substance, and Method of preparing and manufacturing the same, whereby the said Substance becomes applicable as a Substitute for Horse and other Hair, now used for the stuffing of Cushions, Mattresses, Carriages, Sofas, Chairs, &c. and all other Purposes for which Flocks, Wool, or Hair are now generally applied.* Dated July 24, 1806.

TO all to whom these presents shall come, &c. Now KNOW YE, that in compliance with the said proviso, I the said Charles Random de Berenger do hereby declare that the said invention, and the manner in which the same is to be performed, is described in manner following; that is to say: The said article or substitute for horse hair is manufactured of the hair or coat of hogs (not of the bristles or mane of the hog, but of the hair of its body in general); long hair of large hogs is the best for the purpose, but even that of pigs may be made use of. After killing the hog, the hair is to be scraped off as at present it is; then washed and cleansed, and thrown into lime water,

water, where it may remain from one to two days. Though the immerging in lime water is not absolutely necessary, it is nevertheless desirable, as thereby every fleshy substance is destroyed, and putrefaction completely prevented. It is then washed in cold water, and twisted into a cord of about the thickness of a goose quill, which cord is forced into a tin, glass, or other tube while it is twisted; the tube to be about three quarters of an inch in diameter, and from fifteen to thirty or more inches in length, though the length is immaterial. This cord will readily coil itself round in the inside, and a stick should occasionally be introduced to force it quite tight. When full, these tubes must be corked up close at both ends; and when a sufficient number of tubes are filled, they are to be placed in a copper of boiling water, where they should continue for two hours, the water boiling the while. The hair is then taken out of the tubes, and left to cool in solid pieces: these are afterwards unpicked, when the hair will be quite curly. It is then loosely thrown into large earthen pans with fine dry sand at the bottom, and a layer of dry sand is sifted on every layer of hair, till the pans are filled; they are then tied over with brown paper, and put into a hot oven, where they may so remain for three or four hours. (The heat must not be sufficient to burn the brown paper, but nearly so). After the sand is quite cold it is passed through a sieve, and the hair will be found fit for use, having obtained a good curl and fine elastic power, being also perfectly clean and incapable of engendering any vermin.

N. B. A small wheel, or other machine commonly used for twisting, may also be used for twisting the hair together, to put it into tubes; either in this case, or when twisted with the fingers, the cords so twisted need not be long. The hair should be damp to be twisted.

In witness whereof, &c.

Specification

Specification of the Patent granted to ANTHONY FRANCIS BERTE, *of the Parish of St. Dunstan in the West, in the City of London, Merchant; for a Machine for casting or founding Types, Letters, and Ornaments, usually made use of in Printing.* Dated April 29, 1806.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Francis Berte do hereby declare, that my said invention is described in manner following; that is to say: I do construct a vessel of iron, or other fit material for containing type metal in the fused state, or for bringing it into fusion, and keeping it at the proper heat for casting; and I do make in the side or sides of the said vessel one or more apertures, out of which the fluid type metal is suffered to flow at the time of casting. The operation of casting is performed by applying a mould for casting letters or types, either singly or more than one, at the same time, or other articles for Printers use, unto one of the said apertures, which at that instant, by means of a lock or valve, or any other well known similar contrivance, is opened; in consequence of which the metal suddenly flows into the mould, and applies itself to the matrix or matrixes with a force which is greater or less, according to the height of the level surface of the type metal in the vessel first before-mentioned, or according to the magnitude of such additional pressure as may be applied in the manner hereinafter to be described. And I do farther declare, that though the said aperture or apertures may be made on any side of the vessel, that is to say, at top or bottom, or elsewhere, yet I do give the preference to a surface or face which shall be nearly horizontal, so that the fluid metal shall

spout

spout upwards into the mould; and I do prefer, as the most simple and easy method, that each aperture shall be kept closed by a plate of metal lying upon the said horizontal surface, and well fitted thereto: and that I do make and fashion the lower part of my mould flat and true, in order that the same may be applied in like manner, and slided along upon the said horizontal surface; and that I do slide the said mould by pushing the same against the said flat plate until the plate shall become displaced, and the aperture of the mould shall become directly opposite to the aperture in the vessel, and shall accordingly receive its charge of metal; after which, the mould being again drawn back, the plate of metal, by means of a weight or spring, or other well-known agent suitable to the purpose, is made to follow the mould and close the aperture, by resuming its first situation; and, in order that the said motions and effects may be performed and produced without any particular skill or attention in the workman, I do make and apply guides, sliders, stops, or pins, for confining, directing, and limiting the said motions, as will be sufficiently obvious and intelligible to artists employed in works of this nature. And moreover, in order that the said fluid metal may rise with sufficient force into the mould, I do make my vessel of such a figure as that the quantity of type metal intended to be contained therein at any one time shall have its upper surface sufficiently high above the level of the aperture or apertures before-mentioned; and that I do, in preference, form my vessel of the figure of a box or closed receptacle, having a pipe or tube rising out of the same, so that the pressure afforded by the statical action of the metal in the said pipe or tube shall produce the desired effect at the aperture or place of casting; or otherwise I produce, or increase the said pressure, by the statical action

of

of water, or any other fluid which may be used, by the well-known means to compress a body of air against the surface of the type metal for the purpose's aforesaid: and the said machines, consisting of vessels so fitted up together with the moulds and other parts respectively as before described, may be used by one or more workmen to cast different letters and sorts at the same time from the same mass of metal; but in case different metallic mixtures should be required to be used, or in case local circumstances should render it needful that the workmen should be considerably distant from each other, recourse must be had to a number of distinct and separate machines of my said invention.

In witness whereof, &c.

Specification of the Patent granted to RICHARD WILLOOX, *of the Parish of St. Mary Lambeth, in the County of Surrey, Machinist; for Improvements in Steam-Engines.* Dated May 21, 1806.

With a Plate.

TO all to whom these presents shall come, &c. Now KNOW YE, that, in compliance with the said proviso, I the said Richard Willcox do hereby declare that my farther improvements in the steam-engine consist in the following novel and appropriate combination of parts, *viz.*

First. My improvements are on the rotary steam engine, and consist, exclusively, in certain parts generally known by the appellation of gates, pallets, valves or cocks, or any more appropriate name by which they may hereafter be denominated; which said gates, pallets, valves or cocks, are, by their particular and novel construction, capable or susceptible of confining and detaining steam, or other elastic or dense fluids between the said gates, &c. The said gates,

&c. hereafter to be described, work or move between the inside of a fixed cylinder, and the outside of an inner cylinder, there being an interstice left for that purpose; which said interstice is securely covered with lids or covers, and the said pallets fixed, the one to the outer stationary cylinder, and the other to the inner or revolving cylinder, whilst a passage is formed on each side of the gate in the stationary cylinder, one of which passages communicates with the boiler, and the other to the condenser; by which means the steam, or other fluids, are brought to act or operate between the said gates, which are opened and shut from the external part of the engine, by gear similar to that used in the present steam engines; by which means the inner or revolving cylinder is forced round in the circle it prescribes, by the elasticity of steam or other fluids pressing against the pallet fixed to the revolving cylinder, which said pallets, &c. during the time of their passing each other, either double up, turn on their edges, or slide backwards and forwards, or upwards and downwards, and, in other cases, as in Figs. 10, 11, and 12, (Plate VIII.) turn on their own axes; as will be more particularly described hereafter: whereby the whole of the original powers exerted, such as steam at any temperature that engines are now wrought by, or water, or other dense fluids, produce their whole effect without any re-action or diminution of power; friction alone excepted, which in this engine is very trifling.

Secondly. In every instance where I use a cock or pallet, or portion of a circle which turns similar to a cock, and which admits of a fixed pallet on the revolving cylinder, as in Figs. 10, 11, and 12, I cut a longitudinal or oblique groove or rabbit down the part of the cock, &c. which comes into actual contact with the revolving cylinder, and fit into or against the said rabbit or groove a piece of metal, which I generally harden and pack secure

cure

ture with bolts against the rabbit, where it is applied against the edge or side of the cock, and place a spring or elastic packing behind (or on any more convenient part) the said metallic piece, whereby it is kept close in contact with the revolving cylinder; and in the other cases, when the said metallic piece is packed in a groove, the same precautions as to packing are to be strictly observed; and when one part of the said metallic piece is worn or ground off by the constant friction of the revolving cylinder, I then pack the said metallic piece out further till it is worn out, when a similar piece is put in its stead at a very trifling expense and loss of time, by which means the cock, &c. will remain tight for many years. Furthermore I do hereby declare, that, in cases where the water abounds with, or is impregnated with, minerals which corrode iron or steel, I use or employ, as a substitute for the said piece of metal introduced into or against the cock as aforesaid, compositions of metals, such as pewter and tin, or bell metal, or any other composition of hard metals now known, and not liable to corrode; or, in other cases, hard woods may be substituted, or paper prepared with oils, such as is used for the purpose of preparing paper tea trays, &c.; or, in any other cases, in small engines, I make my cocks of steel, and harden it afterwards; or of iron, which must be case-hardened.

Thirdly. As no packing will work well, or last long, without a frequent supply of liquid grease, or other animal fat (more particularly metallic bodies); therefore, in order to effect so valuable a purpose in this my rotary engine, I form for that purpose a communication from the external part of the engine to the parts which require to be lubricated, by drilling a hole through the spindle of the cock or pallet down into the body of the said cock or pallet, and from thence horizontally to the parts of the cock or pallet in immediate contact with the cylinder; and by placing a funnel with a regulating cock upon the top of the said spindle, between the spindle and funnel, the parts may be lubricated at pleasure, without stopping the engine; for, by opening the said cock, the tallow, &c. is admitted through the said spindle to the extreme part of the pallet, cock, &c. Here it may not be unnecessary to remark, to prevent infringements, that, although I have described the grease as descending through the spindle and cock, nevertheless it may occasionally be made to ascend by drilling a hole through the bottom of the cock, and so forming a communication by a pipe to a cistern or reservoir of fluid suet or grease, placed at some convenient place above the level of the part of the engine requiring to be lubricated.

Lastly. To diminish the size or dimensions of the said rotary engine, or occasionally to increase its power, after it has been built, I add two or more sets of pallets, gates, &c. so as to cause the steam, or other fluids by which the engine is wrought, to act in two or more places at the same time; thus augmenting its power in a two or three-fold degree, according to the number of the pallets, cocks, &c. that are added.

References to the Drawings.

(Plate VIII.)

Fig. 1 the vertical section of the said improved rotary steam-engine as attached to the common condenser and air-pump, for the purpose of shewing one of the most simple and compact arrangements, where the steam is condensed. A, the outside case or cylinder fixed to the framing of the condensing cistern, or any other more suitable and convenient framing that the engineer may find most appropriate or suitable to the locality of the premises where the engine is to be erected. B B, the inside

side or revolving cylinder attached to and connected with the vertical shaft, which is the first mover, and which gives a rotative power to any description of machinery requiring the same by or through the medium of a spur wheel fixed to the said shaft, or when a vertical motion is required; or with a bevil gear wheel, where an horizontal motion is wanted. C C, moveable pallets, gates, or valves, for regulating the action or operation of the steam or other fluids in the said engine; one of the said pallets, &c. is attached to the fixed cylinder A, and the other to the moving or revolving cylinder B, as is more distinctly seen in Fig. 2, and the references annexed. D, the steam valve for the admission or ingress of steam or other fluids between the said pallets. E, the exhausting valve for the egress of steam. The gear required for opening and shutting the said valves D and E, and for opening and shutting the said pallets or gates C C, is so nearly similar to that of common engines, that it would be useless to describe it more than that the said valves D and E require to be opened and closed at the same time, whereas, in general, they are opened and shut alternately by the plug tree, or other simple and well-known means. F, the top of the cylinder, composed of a ring of metal, for pressing the packing round the moveable cylinder, which said lid or ring is screwed down with screws, as is usual in securing the lids or tops of cylinders. G G, two rings of metal pressed by screws, from a lever secured to the top of the cylinder F, for compressing the packing, and securing the joint of the cylinders A B. H H, a circular channel into which the revolving cylinder B works, for the purpose of preventing the ingress of air or other fluids into or by the said interstice or channel, and which is packed with hemp and grease, and pressed in such manner with a ring as thereby to render the engine

gine more efficient, by keeping it perfectly tight. I, the common condenser, and necessary pump, which is wrought by studds or stops projecting from the horizontal shaft, or any other simple and effectual way the engineer may think proper, as is more distinctly seen in Fig. 3, which is the end view of the shafts, and the side view of the piston rods; the operation of which is so obvious, as not to require elucidation. Fig. 2 exhibits the birds eye view of Fig. 1, with the top of the cylinder and compressing rings removed, to shew the operation or apparatus for opening and closing the pallets, gates, &c. and also part of the flanches removed to shew the situation of the valves. The letters of reference in this case, Fig. 2, are placed upon similar or the same parts of the engine as in Fig. 1, which it would be superfluous to recapitulate. C C, the pallets, &c. formed of two or more pieces of metal; one part of the said pallet is permanently secured to each cylinder A and B, whilst the other part or parts turn on a joint or hinge; which said joint or hinge is made steam-tight or secured, together with the whole of the edges coming into contact with the cylinders, with a hemp cloth stuffed, wadded, or folded together, or by other similar materials, capable of stopping the passage of steam, and which must be screwed or otherwise fastened on the front of the said pallet; and by the pressure of the steam it is pressed or brought in contact with the said pallet and cylinders, and thus it effectually prevents the escape of steam, or other fluids by or with which the engine is wrought. K K, two racks and pinions communicating by a straight and parallel bar, working through a stuffing box in the sides of each cylinder, whereby the said valves are opened and shut, whilst passing each other, from the external part of the engine by a piece projecting from the upper or lower part of the fixed

fixed cylinder, which may be placed at the option of the engineer; which said piece in its passage comes into contact with the gear connected with the said pallets, and thereby with any of the well-known simple methods or gear used for opening and shutting of valves in the present steam engines. The gates, &c. of the engine are opened and shut as occasion requires. L, Fig. 2, exhibits a second gate, &c. which in this case slides backward against a straight parallel surface during the time the pallet in the revolving cylinder is passing when the said gate is sliding by the gear against the revolving cylinder, as in the drawing. The said gates may be opened and closed in a variety of ways, such as a spindle ground into the bottom of the fixed cylinder, and connected by a link to the gate internally, or a crank or compound lever may be applied instead of the rack and pinion externally. Neither of those plans or methods form any part of my Patent, as being well understood by the engineers; but I rest my claim upon the use and application of the gates and pallets or cocks, as applied to the steam-engine in the manner specified. Fig. 4 exhibits the vertical section of a different plan for producing the same or similar effects as in Fig. 1 and 2 previously explained, by causing the pallets, slides, &c. to be lifted from below the bottom of the cylinder; in this case, I always prefer making the cylinder shallow and wide, in order that the gates and slides may have but as little space as possible to slide or move through, whilst in Fig. 1, I prefer the keeping the cylinder deep and narrow, in order that the gates, valves, &c. may be quickly opened and shut.

Fig. 4, A, the outside stationary cylinder. B the inner cylinder. C, the top of the cylinder and rings, as in Figs. 1 and 2, already explained. D, plate of metal, as represented by the dotted lines, made very straight, smooth,

smooth, and parallel, as it respects its thickness. E, a small shaft or axle, working through a stuffing box on each end, and connected at the centre to the extremity of the said plate inside a box, or a receptacle fixed on the outside of the cylinder A, allowing room sufficient for the said plate to drop clear off the bottom of the cylinder, whilst an accurate incision is made in the bottom and side of the cylinder sufficient to admit the said plate D to slide freely up and down, which is effected by a rack and pinion, or lever, or any other simple contrivance attached or connected to the extremity of the shaft E; by which means the steam is caused to act on the same or a similar principle as in Fig. 1 previously explained. F, Fig. 4, presents a second way of producing the same effect, namely, that of raising a plate of metal through an incision made in the bottom of the cylinder A, from a box fixed underneath the cylinder, through the medium of a parallel bar working through a stuffing box, whereby the said plate D is raised or depressed, as the working of the engine requires. Fig. 6, is the side view of the apparatus necessary for raising and depressing the said plate D, by the working of the engine. H, a lever or arm, fixed to the revolving cylinder. I, the connecting rods with a weight at the lower extremity, equal to raise the said plate D; thus, as soon as the lever H comes in contact with the lower connecting rod or lever I, the weight on the extremity is thereby lifted, and the plate D is depressed, and thereby the fixed pallet on the moving cylinder is allowed to pass; but, as soon as the lever H has passed the lever I, the weight on the end of the said lever I raises the plate D into the cylinder that fills up the place when the steam is admitted between the plate D, and the pallet secured to the revolving cylinder; and so on *vice versâ*.

Fig. 5

Fig. 5 is the bird's eye view of Fig. 4, with the same general letters of reference to their respective parts, as in Fig. 4. K, steam passage. L, passage leading or communicating with the condenser, when the steam is required to be condensed. Here it may be necessary to remark, to prevent infringements, that, although I have shewn the plate D as rising upwards, as being the most convenient way; nevertheless, the boxes necessary to receive the plates may be placed above the cylinder, and the plates be made to rise in them, or the plates may be raised in an oblique instead of perpendicular direction.

Fig. 7 is the vertical section of my farther-improved rotary engine. A, the outside fixed cylinder. B, the inner or revolving cylinder. C, compressing ring, similar to Fig. 1. D D, two or more pallets, working through a deep stuffing-box, and by a lever or levers, racks, wheels, &c. are from the external part of the engine turned alternately flat or edgewise in one side of the said Fig. 7, they are fixed to the lower part of the stationary cylinder, and are those seen flatwise, &c. the passage stopped; in the other side, the said pallets D are fixed to the revolving cylinder, and are seen on their edges, with the passages open. E, steam passage. F, passage to the condenser. Fig. 9 presents a view of the pallets, and part of the cylinder and stuffing-boxes, on a large scale.

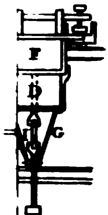
Fig. 8 is the bird's eye view of Fig. 7, with the same letters of reference, as corresponding in similar parts in Fig 7, previously explained in that figure. The cylinder top or lid is removed, and two sets of valves are shewn; the first D D are shut, and ready for the action of the steam, the other said pallets are shewn on their edges, preparatory to their passing each other; during which time the steam valve is to be shut, which is performed by gear as in the common steam-engine, and which will be varied at the option of the engineer.

Fig. 10 is the bird's eye view of my rotary engine as wrought with a cock or portion of a circle, whereby a similar effect is produced as in Fig. 1, by or with a portion of circles: in these figures 10, 11, 12, the lids of the cylinders are removed, and a part of the flanches where the circles or irregular cocks are used is broken off, to render the working parts clear and conspicuous. In these figures, the stationary parts are shadowed light, and the moveable parts dark *. A, the outer or fixed cylinder. B, inner or revolving cylinder. C C, the pallet, cock, or portion of a circle, fitted accurately into the circle it prescribes; with a spindle working through the top of the cylinder, as in Fig. 7. D, the groove as is shadowed red, into or against which the part coming into contact with the revolving cylinder is secured with a piece of hardened metal, in order that the constant friction of the revolving cylinder shall not injure the pallet or cock. E the passage to the boiler, F, the passage to the condenser. G, the pallet secured to the working cylinder. In this figure two portions of circles and cocks are introduced, for the purpose of shewing clearly their situations in different places, the same as in Figs. 11 and 12.

Fig. 11 is the bird's eye view of an engine in most respects similar to Fig. 10. A', the fixed cylinder. B, the inner or revolving cylinder. C C, two pallets or portions of circles turning on the axis secured to the revolving cylinder, into which they turn as passing the fixed or stationary plate D, which is fixed on its edge, and occasionally pressed into contact with the revolving cylinder,

* The shading and colouring afterwards mentioned, have been necessarily omitted in the plate.

by



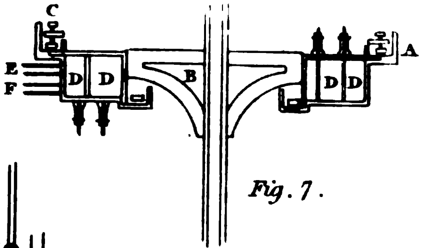


Fig. 7.

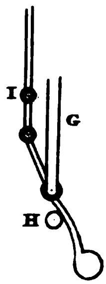


Fig. 6.

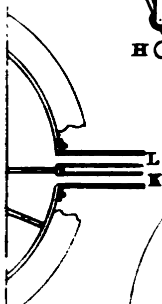
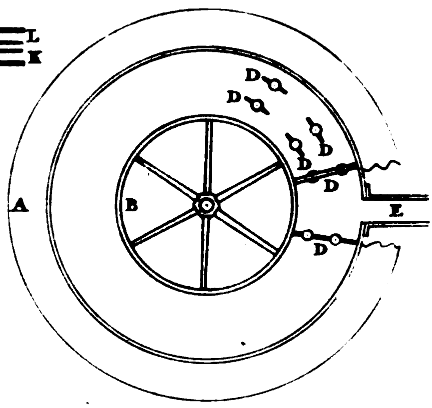


Fig. 8.



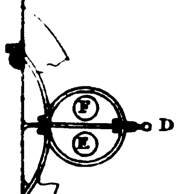
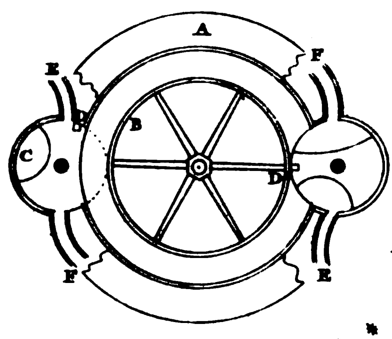


Fig. 12.



by an adjusting screw from the external part of the engine. E, these at for the steam valve; F, the seat for the exhausting valve, which are wrought as in Fig. 1, previously explained.

Fig. 12 exhibits the bird's eye view of my said rotary engine, as wrought by a cock or cocks, which regulate the steam instead of valves, and also act as the principal cock or pallet in the said engine. A, the outer fixed cylinder. B, the inner revolving cylinder, with a fixed pallet. C C, the cocks, which are wrought from the external part of the engine, by a spindle passing through the top as in Fig. 7, previously described. D, a piece of hard metal, introduced into the said cock, to resist the friction of the revolving cylinder, as explained in Fig. 10. E, steam passage. F, passage to the condenser.

Lastly, in cases where my said engine is employed to raise or give motion to any fluid introduced therein, the effects produced will be similar to those for a lifting and forcing pump. And it is furthermore applicable to extinguishing engines, forge furnace bellows, and all such other engines as operate by giving motion to fluids.

And I do hereby farther declare, that although I have drawn and described the cylinders parallel, and situated or fixed in a vertical direction; nevertheless they may, when required, be placed in a horizontal or inclined direction, and the cylinders may have the form of frustrums of cones or other figures described by rotation, instead of being parallels; and the pallets, as in Figs. 1 and 7, may be opened by striking against each other, instead of being opened by gear externally. Likewise, with regard to the fitting, they must be very accurate, and the materials properly proportionate, which, in both cases, must depend upon the judgment of the engineer.

In witness whereof, &c.

An Account of some New Apples, which, with many others that have been long cultivated, were exhibited before the Horticultural Society, the 2d day of December last.

By Mr. ARTHUR BIGGS, *F. H. S.*

From the TRANSACTIONS of the HORTICULTURAL SOCIETY of LONDON.

OF all the different fruits that our island affords, none can be brought to a higher degree of perfection with so little care and trouble, especially in its Southern counties, as the Apple. For a proof of this, I hope it will not be deemed presumptuous in me to refer to the catalogue below, every variety of which I had the honour of exhibiting to the Horticultural Society, at our meeting in December last. Having been flattered by the wishes of many gentlemen then present, to give some account of such as are new, and by what culture they have been produced in such perfection, I cannot but attempt it, though very inadequate to the task, for almost every hour of my life has been employed in following the instructions of others, and when I have deviated from them, with a view to improvement, I have seldom been able to write down the result of my experiments with any satisfaction to myself.

Besides the sorts of apples lately exhibited, the garden of Isaac Swainson, Esq. my indulgent master, contains a number of others, which are less valuable. When I mention that I am cutting these away as the better trees advance, and thinning the branches of the latter also as they require it, I perhaps tell all that is to be told upon the subject; for I have found nothing of more consequence to the health of the Apple Tree than plenty of light and air. The instructions of the late Mr. Philip Miller on on this head are so pointed, and I see so many Apple Trees smothered either by their own branches or those of other trees, that I cannot do better than quote his words. After directing the standard trees to be planted at the distance of 40 feet every way, and the dwarfs at that of 20 feet, he says, "I am aware how many enemies I shall raise by retrenching the great demand which must of necessity be made in the several nurseries of England, if this practice be adopted; but as I deliver my sentiments freely on every article, aiming at nothing more than the information of my readers, so I hope there will be found none of my profession of such mercenary tempers as to condemn me for telling truth, though it may not always agree with their interests."

I feel no fear in referring to this great gardener's work, because all the principal nurserymen who now supply the public in the vicinity of London are men of too much liberality to recommend a less distance than the above; and in the present opulent state of this country, the original price of the trees is comparatively so trifling, that if any one plants double the number which ought to remain, he will be repaid more than a hundred fold in the few years that the alternate trees are suffered to stand. This is a practice, therefore, which I have not scrupled to recommend: but, after all, whether a gentleman plants many or few trees, his future success and gratification depend principally upon the judgment of his gardener, in choosing such trees in the nursery as have been grafted from *bearing branches;* and if I thought myself authorised to give any hints to our nurserymen, it would be relative to the selection of their grafts and buds, not only in the Apple Tree, but every sort of Fruit Tree, about which they are in general too careless.

I must

I must now observe, that the Apple Tree will grow readily by cuttings, and that trees raised in this way, from healthy one year old branches, with blossom buds upon them, will continue to go on bearing the very finest possible fruit, in a small compass, for many years. Such trees are also peculiarly proper for forcing, by way of curiosity or luxury, and I believe that they are less liable to canker than when raised by grafting, though I am unable to assign any reason for it. I have more than once experienced this in the *Golden Pippin*, cuttings of which have remained seven years in perfect health, when grafts taken not only from the same tree, but from the very branch, part of which was divided into cuttings, cankered in two or three years. Accident, which brings to light so many useful things, first taught me this practice; some cuttings that I had stuck into the ground for marks of annual flowers having all made roots. The soil was loamy, and the summer proved so wet and cold, that many bunches of Grapes in a large greenhouse, which I could not prevail upon the gentleman I then served to be at the expense of thinning with scissars, rotted when green.

The soil at Twickenham is light, and inclined to sand rather than loam, in which the Apple Tree will ripen its fruit earlier and more completely than in a stiffer soil, but it will not last so long. Young seedling plants will also produce their blossoms and fruits in a shorter period in such soil. Our trees being originally placed too near each other, I have transplanted several into other quarters with very great success, even after they had attained a considerable magnitude. In doing this, I was careful to preserve every root possible both great and small, to have the ground where they were to be planted ready open to receive them, so that their roots were only exposed to the

the air a few minutes, disposing their fibres as horizontally as possible, and not too deep. The months of September and October should be preferred for transplanting any large tree, watering it well if showers do not fall the same day: if the leaves are not pulled off, it will make fresh roots immediately, or at all events be more disposed to push them forth in spring. I constantly tread the ground exceeding firmly with my feet, in separate layers of about an inch, so as to render staking unnecessary, a practice which if performed so as to have any real effect is very expensive, but which too frequently does more mischief than good.

Of the varieties of the Apple cultivated in Mr. Swainson's garden, which ripen early, I can especially recommend,

The Summer Pippin—Devonshire Quarrington—Summer Traveller—Bland Rose—Summer Pearmain—Red Colville—Marigold—Kirk's Incomparable—Evan's Valuable—Nonsuch.

Of the autumn and winter varieties, perhaps all those which follow are valuable, especially such as are marked with a star, and those marked with a cross are new. Specimens of one of the smaller as well as larger of each, formed the assortment lately exhibited.

* Norfolk Storer—* Norfolk Beaufin—Norfolk Paradise—Holland Pippin—Embroidered Pippin—Striped Holland Pippin.

* Lemon Pippin: as this variety is beginning to canker in many gardens, there is no doubt that it is old, and has been introduced from the Continent, probably Normandy: for a gentleman who was at Rouen, during the last short peace, saw it there in abundance.

* Ribston Pippin—New Town Pippin—* Golden Pippin—Marmail Pippin—French Pippin—Kirton Pippin—Wyken

W\ken Pippin—Fern's Pippin—London Pippin—* Kentish Pippin—New Town late Pippin—Mathematic Pippin—† William's Pippin—Whitmore's Pippin—New York Pippin—Raspberry Pippin—* Cat's Head Apple—* King of Pippins—Nonpareil Codling—Cowring's Queening—* Flower of Kent—Selleswood's Reinette—* Holland Berry—Golden Mundi—Margill—Nutmeg Apple—Royal Russet—Golden Russet—Pile's Russet—Clifton Crab—* Minchin Crab—French Crab—Herefordshire Pearmain—Loan's Pearmain—Holt's Pearmain—Kentish Reinette—Lady's Thigh—Pigeon's Egg—Tolworth Court—Spice Apple—Quince Apple—Hall Door—* Transparent Pippin—* Golden Reinette—Golden Royal—† Bigg's Nonsuch—† Flat Green—† False Beaufin—Summer Breeding—Cœur Pendu—† Minier's Dumpling—† Padley's Pippin—† Oval Apple—† Green Pyramid.

To give a complete history of each of the New Apples above mentioned is out of my power: they have all been raised by other gardeners, from whom we may rather expect it: in the mean while, however, the following descriptions will perhaps suffice to make those which appear to me the best, more known.

William's Pippin.

Size, from 2 inches to 2½ inches long. Colour, pale yellow, with a little red on the sunny side, and here and there a spot. Shape, somewhat conical, scarcely longer than broad, deeply umbilicated at the stalk, which is short, hollow at the top; the leaflets of the calyx, though black and dry, still remaining more perfect than in many. Flesh, pale yellow, soft, excellent to eat ripe from the tree, baking and roasting well, till Christmas.

Padley's Pippin.

Size, from 2 to 3 inches in length. Colour, rich yel-

low,

low, generally very finely laced all over with a pale rough starry bark, if I may use the term. Shape, oval, about the stalk flat, or often a little prominent on one side, not much depressed about the calyx, which is more obliterated than in many others, perhaps from that circumstance. Flesh, firm and juicy, of a rich perfumed and poignant flavour, in high perfection all December and January. I am inclined to think this the very best of our new Apples.

Bigg's Nonsuch.

Size, from 2 to 3 inches in length. Colour, deep yellow, striped and variegated with red on the sunny side. Shape, and general appearance, somewhat like the Nonsuch, but broader at the base, moderately depressed about the foot-stalk, very hollow at the top, where the leaves of the calyx remain long and rolled back. Flesh, pale yellow, soft, and excellent to eat ripe from the tree; roasts and bakes well till Christmas.

Minier's Dumpling.

Size, from 3 to 3 inches and a half in breadth, but not so long. Colour, deep green, and very dark red next to the sun; which, together with its spherical shape, more contracted at the top, and swelled into a few imperfect angles, give it some appearance of the Norfolk Storer, but there are darker green lines on the north side which distinguish it from all the apples I know. It is depressed about the stalk, which is long, and stout enough for so large an Apple. The calyx is nearly obliterated by the time the fruit is ripe, which is not till Christmas, or after. It is most valuable for boiling or baking till April, and even to eat at the end of the season; its flesh firm, high flavoured and juicy.

Account of the Improvement of a Tract of barren Ground covered with Heath, in an elevated Situation in the County of Peebles. By Mr. James Allan.

From the Prize Essays and Transactions of the Highland Society of Scotland.

THE improvements on the farm of Kailzie were begun in 1796, while the land remained in its natural state, covered with heath, and not exceeding two shillings and sixpence *per acre*, on an average value. The number of Scottish acres contained in the ground, which consisted of two plots or divisions, the Tor-hill, and the Law-park, was sixty-one. According to the measurement of Mr. Oman, Land Surveyor, the medium elevation of the Tor-hill, from the water-level to the top, is four hundred and twenty-two feet. The ascent in a right line continues at an elevation of twenty-five degrees, to the extent of two hundred and sixty-four feet, from which it continues to the distance of one thousand and eighty-two feet, at an elevation of seventeen degrees. The quantity of ground reduced to a state of culture during the first year, was fifteen acres, during the second, twenty-five, and during the third year, twenty-one. The ground was ploughed at intervals of leisure, during the summer months, and suffered to remain in that condition till after the harvest; when it was manured with lime, in the proportion of twenty bolls of shells to the Scottish acre. The boll of lime contains six Winchester bushels. From the situation of the ground, it was ploughed with a single furrow, in an oblique direction, from right to left. Small's plough, drawn by two horses, was employed; but in the most elevated parts, where the soil was light and shallow, the small Scottish plough appeared preferable. Shell lime costs 1s. 2d. per boll, at the lime-works; but as these

these are sixteen miles distant, the expense of carriage may be estimated at 1s. 11d. per boll. Lime was preferred to dung as a manure, from the superior facility with which, on account of its inferior weight, it could be carried to so great a height, and spread over the ground. It was brought in carts to the most accessible part of the ground, and dragged up the ascent by doubling the number of horses, or yoking the horses of two carts to one. It was then brought to the steepest parts of the ploughed ground in a sledge without poles, moved by drag-ropes, and termed *a slipe*. The lime was laid upon the ground during the winter, and in the spring the land was ploughed a second time, from left to right, and then sown with oats. After being ploughed from right to left, as at first, a second crop of oats was raised upon it. The next crop was of pease, raised after ploughing in a straight direction down the hill; and in 1801, the same piece of ground was sown with rough barley, or big, and grass seeds, in order to convert it into pasture. In the oat crops, Mr. Allan sowed at the rate of one boll to the acre, and reaped at an average seven bolls. In the pease crop, he sowed three firlots and two pecks on the acre, and reaped at an average eight bolls. The average expence of manure and labour may be estimated from between three pounds fifteen shillings to four pounds the Scottish acre. By a similar process, Mr. Allan intends to convert the whole piece of ground into pasture. After two crops of oat, divisions of between thirteen and fifteen acres may be sown with turnips, broad-cast, and eaten on the ground by sheep; by which the process of conversion may perhaps be accelerated. The average value of the land in this state of improvement, is estimated at the rate of between fifteen and twenty shillings per acre.

The land (sixty-one acres) which Mr. Allan thus first brought into culture, has ever since remained in grass, and maintained its estimated value.

Mr. Allan has continued to prosecute the same plan of improvement on the ground adjoining to the parks already mentioned, which although they appeared equally discouraging, from the ruggedness of the surface, and their being covered with strong heath, promise a more ample remuneration to his industry, from the circumstance of the declivity being less abrupt, and the soil, on being cleared of stones, proving considerably deeper. He has already broken up a greater extent of this kind of land than what is contained in the Tor-hill and Law-parks, and with that spirit which characterises all his improvements, he has by way of experiment sown an acre with wheat, which now (end of June 1806) promise equally well with most of the wheat on the lower grounds in that neighbourhood.

An Essay on the Influence of Frost, and other Varieties of bad Weather, on the ripening of Corn.

By the late Benjamin Bell, *Esq.*

(Concluded from Page 118.)

THE oats sown in the field in which these pots were placed being early ripe, it became necessary to remove the pots, while the plants in all of them were still green; and as in this state the experiment could not have been longer continued but with much trouble, it was not carried on; but although it might have proved satisfactory to have seen the difference in the quality, as well as the quantity of corn from the different seeds the experi-

experiment was carried sufficiently far to shew that it must have been very considerable.

That this, however, might be seen more clearly, the following experiments were made on a larger scale.

Experiment IV.

In October, 1783, a field of twelve acres was sown with nine bolls of wheat, of which about two bolls, or an English quarter, was the best that could be got in London, of crop 1783. Five bolls of the same year's crop was the produce of East Lothian, and equally good in appearance with the English wheat. One boll was the best wheat of the London market of crop 1782; but not having arrived in time to be sown in that year, it was carefully kept, and as it had not been exposed to frost, it appeared to be nearly equal in quality with that of crop 1783. And one boll was the produce of wheat near Edinburgh, in 1782.

Although this last parcel of seed was exposed to much cold and rain during the latter period of its growth, it was nearly as well filled as the seed of the same year that was brought from England, but it had not the healthy aspect of the English and East Lothian seed, although it was the best that could be procured in Mid Lothian, of that season.

The whole field was well fallowed, and equally manured with dung, and the four parcels of seed that I have mentioned, were all sown in the beginning of October, after each of them had been well washed in strong brine, and thereafter dried with new slaked lime.

The English seed of 1783 was sown on one side of the field, and half a boll of the Mid Lothian wheat of crop 1782 on three ridges next to it. To this succeeded the English wheat of the same crop; thereafter the East Lothian

Lothian wheat, and next to it the other half boll of Mid Lothian wheat of 1782.

The field being all in good condition, the wheat over the whole appeared early above the surface, and the shoots were every where strong, excepting on those ridges that were sown with the wheat of Mid-Lothian crop 1782, on which the plants were weak, and not so numerous. Neither did they tiller or spread like the others; so that during the winter and spring months, the wheat on those ridges had a weak appearance; and in harvest the difference was such, that the straw was thin and short; the ears also were short and small, and the corn not so large or heavy as in the other parts of the field.

It was also found, on being threshed and measured, that the produce of these two bolls was only eleven bolls, or five and a half for one; while over the rest of the field it was fully fifteen for every boll of the seed. The difference in value was also such, that the produce of the Mid-Lothian wheat did not sell for so much by five shillings per boll.

The rest of the crop appeared in every part of it so equal, both before being cut and afterwards, that it was not judged necessary to ascertain the difference by measurement. The whole of it was good, the quantity of straw considerable, and the corn full and heavy. Even the produce of the English wheat of 1782 was good, and in no respect inferior to the new wheat of 1783.

Experiment V.

In March 1784, a field of six acres, newly ploughed up from grass, was sown with eight bolls of oats, of which six bolls were of the best white kind that we usually receive from the county of Angus, which ripened fully in in autumn 1781. The other two bolls were of the same kind of corn, and the best that could be procured of crop 1782, but like all the oats in Scotland of that year's growth, they were much exposed to frost, both before they were reaped, and thereafter, while they continued on the field.

That the experiment might be quite fair, it was meant that both kinds of seed should be sown in equal quantities; but on inquiry, it appeared that a much larger proportion of the seed of 1782 was sown on the same quantity of ground, than of the other; from the person by whom they were sown thinking it necessary, in consequence of its being worse: But notwithstanding this, the produce of crop 1782 was poor from its first appearance, the ground was at no period of the season half covered with plants, and only seven bolls and a half of inferior corn were reaped from it; whereas, on the rest of the field the crop was remarkably strong during the whole season, and on being threshed sixty bolls of good oats, and about five bolls of weak corn, were reaped from it, being at the rate of eleven bolls for every boll of seed, and three times the quantity of what was obtained from each of the bolls that had been exposed to frost.

From these experiments, and others which it is not necessary to enumerate, from the results being nearly the same, the following conclusions may be formed.

1. That barley and oats may be exposed to much variety of bad weather, in every period of their growth, without being destroyed, and that they even continue to acquire additional weight, although frequently exposed to severe degrees of cold, and occasionally even to frost

2. Hence, that in late harvests, unripe corns should not be too hastily cut, from an apprehension of their being killed with frost.

3. In

3. In order to judge of the effect of frost, and other varieties of bad weather, on corns, and of the progress which they continue to make, they should be frequently examined with much care and attention, so that none of them may be cut till their farther increase appears to be at an end.

4. In 1782, as well as other bad seasons, it appeared that corns do not suffer so much from frost, whether before they are cut, or after it, when they are dry, as they do from rain and wet snow. They will bear a great deal of frost, and yet continue to fill; and even when cut, they are not so much hurt with it if they are dry, but they are soon destroyed entirely, when exposed to much cold rain, or wet snow. This proceeds from their being apt to vegetate when they are wet, which not only renders barley totally unfit for malt, but exhausts the strength of every kind of corn which vegetates under such circumstances.

This destructive occurrence is most frequent in close moist weather. In this state of the atmosphere, even corns that are not cut, and while still in full vigour of growth, sometimes vegetate, especially if they are lodged; although in some wet seasons it happens even with those that never were laid.

5. But although it appears from these experiments that corns acquire additional weight even in considerable degrees of cold, it is also evident, that exposure to frost renders them very unfit for seed; while every seed of good corn will vegetate and thrive if placed at a proper depth in a good soil, a great proportion of seeds that have been exposed to frost never appear above the surface, and the plants of those that actually vegetate are so weak, that the crop is not only small in quantity, but the corn of inferior quality.

6. Although from these and other experiments, to which

which I allude, it appears that, in using well ripened corn for seed, the crop which it yields depends in a considerable degree on the weight of it, yet this does not happen in any evident degree with corn that has suffered with frost; for the plants arising from corn that has been exposed to much frost, are always weak, and the produce small, even although the seed is of the ordinary weight.

7. Frost appears to be still more hurtful to pulse or leguminous plants, such as beans, pease, and tares, than to wheat, oats, and barley. In every part of their progress this appears to be the case; for while wheat, oats, and even barley, are frequently exposed to frost in the months of March, April, and May, and not unfrequently to slight degrees of it in autumn, without being injured in their growth, this does not happen with any of the varieties of pulse, which are commonly much hurt by it, particularly pease and tares, in every stage of their progress.

All the grasses usually sown in Britain are likewise much injured by frost, and none of them more than the red, or broad-leaved clover; which should not therefore be sown while the frosts in spring continue.

8. Although corns are not much hurt by exposure to moderate degrees of frost in spring, it is sufficiently evident, from what has been said, that in autumn it renders them so unfit for seed, that none which have been ever exposed to it should be made use of. If well dried, and properly kept, they may be used for food; but after every season in which much frost has prevailed in harvest no corn should be sown that has grown in high districts; all that is necessary for seed should be got from better climates, either from the South of England, France, or other countries where the crops have not been hurt by frost.

9. Even as a measure of economy in the first instance, this ought to be done; for in using seed that has been injured by frost, nearly twice the quantity is commonly sown that the ground requires of good seed, and yet the difference in price seldom amounts to a sixth part. Both in the quantity and quality of the crops which they produce, the difference is also such, that they bear no comparison; for the corn is not only inferior in quality when the seed has been hurt with frost, but the crop seldom extends to a third part of the produce of good seed.

10. When good corn cannot therefore be procured without difficulty in high districts, as is commonly the case after bad seasons, it would be much for the national interest to have it furnished by public assistance, and given on reasonable terms to those who require it. Perhaps no means that can be proposed would more speedily remove the calamities of famine arising from this cause, than a sufficiency of good corn being imported by government, for supplying all the high grounds in the kingdom with seed, after every year in which the crops in these districts have been hurt with frost; for as it cannot be done by farmers, they are otherwise under the necessity of sowing their own unripe corn, by which the effects of a single bad crop are increased and kept up for several years, which might be easily and speedily done away.

11. While, accordingly, corn that has been hurt with frost snows, or rain, ought never to be used for seed, it luckily happens, that it is easily distinguished from good corn. The latter is plump and full, of a peculiar healthy colour well known to farmers and dealers in corn, and is commonly free from chaff; whereas the former is shrivelled, for even the best of it is never entirely full, and it appears as if it were bleached, and it does not easily part with the chaff.

12. But

12. But when these appearances are not sufficiently evident, and when we wish to judge of it by experiment, it appears that we should easily be deceived, were we to trust only to the existence of the vegetating principle in seed. It is the more necessary to be aware of this, from its being the chief test that seedsmen recommend; for, if a due proportion of seed vegetates on being sown in a hot-bed, they believe and assert, that it is perfectly good: whereas from these experiments it appears, that seed may possess the full power of vegetating, and yet be totally unfit to produce a good crop. From the whole of these experiments this was very clearly the case.

13. The cause of this very probably is, that seeds and roots not only require a good soil to render the plants which they produce healthy, strong, and numerous; but it seems also to be necessary that they contain a certain quantity of pabulum, or nutrimental matter for their support. This, there is reason to imagine, will prove chiefly useful when they first begin to germinate, a period at which both the tender radicles and stems of plants may be supposed to be less fit to search for nourishment in the surrounding elements than they afterwards become; and it is well known in the rearing of vegetables, as well as animals, that no future attention will render them strong, if they are kept weak from a deficiency of food, or any other cause, when they are young.

14. I believe accordingly, and the opinion has been confirmed by several trials that I have made for illustrating this point, that the practice of washing wheat seed in brine, and other saline impregnations, proves useful only by washing off those seeds that are light and weak; and not by any virtue which any of these articles communicate to the seed.

When light seed is made use of, the crops more readily suffer with blight and other diseases; and it appears that many diseases of plants, especially such as give rise to the generation of insects, are particularly apt to spread and communicate the contagion to plants that are weak; which, like animals in a state of debility, do not so readily resist contagion, nor the formation of those vermin by which they are most apt to be destroyed, as those that are sound and vigorous.

15. This, accordingly, should be considered as a powerful motive for using only the best corn for seed, a maxim that cannot be too strongly inculcated; for as the opinion which I have mentioned prevails with many, of all seeds that vegetate being nearly equally fit for the production of crops, they frequently make use of the weak part of their corn for seed, and convert all the best of it into flour or meal; and thus, for a temporary advantage, continue to perpetuate the production of crops that are both small in quantity, and of very inferior quality.

16. For the prevention of these hurtful consequences, none but the best seed of every kind should be sown; with this view, farmers should not only procure seed that has been well ripened, but such as has been well kept, and never injured by frosts, snows, or rains. It would also be much for their interest, to wash the whole of their seed corn in strong brine; not only their wheat, but their barley and oats, as well as their beans, pease, and tares; for nothing renders corn so fit for seed, as this operation; when properly done, it not only carries off all the light seeds, but also the seeds of a great many weeds which cannot in any other way be so completely separated from it.

17. The influence that I have mentioned above, of sufficient nourishment being given to plants, by the roots from

from which they spring being large, is well exemplified in the culture of potatoes. Hitherto, in planting potatoes, every root has been cut in several pieces; and from finding that all the germinating points, or *eyes*, as they are termed, will vegetate and produce roots, some have been led to assert, that even the smallest of these eyes answer equally well with entire roots. But this is so far from being the case, that from the result of many experiments, conducted with much accuracy, it appears, that crops of potatoes prove, *cæteris paribus*, abundant, or otherwise, nearly in proportion to the size of the sets; insomuch, that ground planted with entire potatoes generally yields fully a third more than if sets only of the ordinary size are made use of. Large crops of potatoes may sometimes be got even from the smallest sets; but in every fair experiment that I have known of the two methods of planting, the crop has been uniformly best where roots of a middling size have been planted entire.

18. As nothing, therefore, is saved by using small sets of potatoes but a few bushels per acre at the time of planting, while the difference in produce runs from one hundred to one hundred and fifty bushels, the practice of planting them in this manner should every where be discouraged; and precisely for the same reason that heavy, well-filled corn, when otherwise in good condition, should in all circumstances be preferred to that which is light.

19. From these experiments, as well as others, it appears, that the preference commonly given to new corn for seed is not well founded.

By Experiments IV. and V. the produce of old corn was, both in quantity and quality, equal to that of the best corn newly reaped. This also is the case with all the

grass

grass seeds that we commonly sow. One of the best crops of hay that I recollect to have seen, was obtained from a mixture of red, white, and yellow clover, rib-grass, and hay-grass, which by accident had been neglected and kept for six years. An acre, or thereby, was sown with this mixture, while the rest of the field was sown with seeds of the preceding year, and the crop was equally good over the whole.

20. Hence, in dry warm seasons, when all our grass seeds are commonly good, every farmer who has it in his power should purchase a large quantity of those that he usually sows, to make use of when they are scarce and bad, which always happens after cold or wet seasons.

It is on this principle, of the seeds of plants retaining their power of vegetating for a long time, that we account for the sudden appearance of many of the grasses, and other plants, where they had not grown for a long period before. After the great fire in London in 1666, broom and clover appeared on the site of almost every house in the space of a few months, although the whole had been occupied with streets for several centuries. We daily perceive in Scotland, that white clover appears almost as soon as the heath is destroyed, with which lands had been occupied before; and I think it probable, that that corn, pulse, and grass seeds, if they have been sound and good at first, and properly kept, will be found quite fit for seed, even when a good many years old.

Facts

Facts relating to the History of Prussiates. By M. PROUST.

(Concluded from Page 154.)

Precipitations by the simple Prussiate.

THIS prussiate, with metallic solutions, gives results very different from those of triple prussiate. Scheele has already discovered some of them, and the following are what I have myself remarked.

Silver, with the triple prussiate, is precipitated white, which however soon turns blue, on account of the white prussiate of iron, which mixes with that of the silver: and with simple prussiate a white curd is produced that does not change.

Gold, with triple prussiate, affords no precipitate.

—— with simple prussiate, produces a white precipitate that becomes of a fine yellow.

If the mixture be heated, this precipitate does not fulminate, for it is a true prussiate of gold. When heated in a retort, it yields water, empyreumatic oil in abundance, carbonaceous gas that burns with a blue flame; and the residuum is gold mixed with powdered charcoal. I find no mention of ammonia in my notes, and I cannot be certain that it was not forgotten.

Molybdic acid, with the two prussiates; no effect.

Oxyd of Tungsten, the same.

Titanium, with triple prussiate; Prussian blue, proceeding from the iron, which this oxyd always retains.

———— with simple prussiate; yellow oxyd of iron such as this yields with solutions of red oxyd. I have not yet been able to obtain titanium exempt from iron.

Uranium, with triple prussiate, is precipitated of a blood red.

———— with simple prussiate; a yellow white.

Cobalt,

Cobalt, with triple prussiate; precipitates a herbaceous green.

—— with simple prussiate; a clear cinnamon.

Nickel, with triple prussiate; precipitates of a greenish white.

—— with simple prussiate; of a yellowish white.

Manganese, with triple prussiate; of a peach bloom colour.

—— with simple prussiate; a dirty yellow.

Copper, with triple prussiate; a fine crimson.

—— with simple prussiate; yellow.

Muriate of copper, or muriate with the oxyd at the *minimum*, dissolved in muriatic acid; is precipitated by the triple prussiate, of a white with a tinge of crimson. We see that if this muriate were perfectly free from oxyd at the *maximum*, the precipitate would be white; but its solution like that of iron, on account of the air, is with difficulty kept at the *minimum* of oxydation.

The same muriate, with simple prussiate, is precipitated in a curd, perfectly white. A few drops of potash free it from the prussic acid, and turn it yellow, which is the colour of the oxyd of copper at the *minimum*.

Platina, with both prussiates; no effect, but I noted it for re-examination.

Prussiate of Mercury.

It is known that this prussiate is obtained by treating the red oxyd of mercury with Prussian blue. This salt easily crystallises in tetraedral prisms; it is always opaque; it may, as we shall see farther on, retain potash, if any was contained in the Prussian blue. It likewise retains oxyd of iron, as may be seen by the following experiment. Heat a few grains of it with muriatic acid in a small matras, and white prussiate will be precipitated.

To

To free it from the iron, its solution must be several times boiled upon red oxyd, and at each repetition it will deposit oxyd of iron. This depuration is sufficient.

The prussiate of mercury is altered, by treating it with the red oxyd, and appears to surcharge itself with it; for it no longer crystallises in prisms, but in small groups of very fine needle-like crystals; their solutions also require a greater degree of concentration: fresh solutions do not cause them to resume their former shape.

This salt, when heated in a retort, is easily and entirely decomposed, if the heat be not too rapidly applied. It is sufficient to heat a few grains of it in a tube, three or four lines in diameter, that is closed at one end. If during this operation the open end be presented to the flame, the prussic gas mixed with the gaseous oxyd takes fire; its flame is red and blue, terminated by a yellowish areola. 100 grains of distilled prismatic prussiate have yielded at one time 72 grains of mercury, and at another 72½.

The residuum, which is from 8 to 9 grains, is a mixture of charcoal and carbonate of potash, which is not surprising, for the alkali will not decompose the prussiate of mercury. It proceeds, no doubt, from the Prussian blue, which is that used in commerce.

The products that are separated by this distillation, are ammonia, oil in some quantity, besides a mixture of carbonic gas and carbonaceous oxyd.

It does not appear that the prussiate has a base of oxyd at the *minimum;* for the prussic acid applied to mild mercury, and to the nitrate at the *minimum*, disengages a portion of mercury, and produces prussiate with a base of red oxyd, the same as would be obtained by treating this acid directly with the red oxyd.

The red oxyd also decomposes the simple prussiate; the

the potash is separated likewise; and as it has no effect on the prussiate of mercury, this latter crystallises in the midst of it. It also completely decomposes the triple prussiate, but this requires long boiling. The black oxyd, which is an element of this salt, changes to red oxyd; and is deposited in the form of an ochre. A portion of mercury furnishes the oxygen required to produce this effect, and hence it is that mercury is found in its natural state with the ochre that precipitates: but without the superoxydation of iron, which we know diminishes the affinities of this metal, the oxyd of mercury would probably fail to decompose a combination so solid as triple prussiate.

Aqueous sulphuric acid has no effect upon prussiate of mercury, even when heated, and without the slightest smell of prussic gas.

Potash saturates the sulphuric acid, like solvent of prussiate; but affords no precipitate.

The concentrated acid destroys the prussic, yields some sulphureous acid, and by that means prevents the possibility of comparison.

The nitric acid does not succeed better, even with ebullition; yet at the commencement a little nitrous gas may be perceived, but it is without doubt occasioned by the black oxyd contained in the prismatic prussiate: the prussiate crystallises in the middle of the acid, which the alkalies saturate, and form no precipitate.

But it is not thus with the muriatic acid; with this, there is a separation of prussic gas, a complete decomposition, and the prussiate is entirely changed into corrosive sublimate. Alcohol also entirely dissolves the saline residuum of this operation; nothing but sublimate is found in it. It is known that alcohol will not dissolve the prussiate of mercury.

Potash,

Potash, with the help of heat, abundantly dissolves the prussiate of mercury. This salt crystallises in it as it cools; alcohol separates it, whence it may be obtained entire.

Muriate of tin at the *minimum*, and hydrosulphuretted water, instantly decompose this prussiate, and set free the prussic acid.

We have seen that muriatic acid acts effectually on this prussiate. It seems natural to expect that the sal ammoniac, which possesses a principle capable of uniting with it, would effect a change in the prussiate of mercury, yet this does not happen. If a solution of mercurial prussiate and muriate of ammonia be heated, nothing new appears; alcohol separates them entirely, potash and lime water cause no precipitate, not an atom of corrosive sublimate is to be seen; and the green sulphate suffers no change, although it would certainly form prussiate of iron with that of the ammonia, if it encountered it in the liquor.

Prussic Gas.

Twenty drams of triple prussiate, heated in a retort with a sufficient quantity of weak sulphuric acid, charged four ounces of alcohol of about twenty-four grains. I kept the alcohol in a jar upon a bath of mercury; and the gas dissolved in it rapidly, but it would have taken much more. The water of the intermediate recipient was also surcharged; its odour was very sharp and penetrating, almost to suffocation, and it had a very strong savour of kernels. This water does not disturb the clearness of barytes. The gas always has a tendency to separate, and continually raises the stopper; if immersed in a small matras in warm water, it separates rapidly, and burns at the mouth. Brought near to a flame, a vapour may be perceived, which is no doubt a part of the charcoal that has escaped, as in the combustion of volatile oils.

The prussic acid dissolved in water, and well corked, decomposes of itself; it turns yellow in about four or five months. By degrees it loses its odour, becomes turbid, and deposits a coffee-coloured sediment, which, when heated, has all the characters of charcoal.

It yields by distillation a little water, some prussic acid and ammonia; the charcoal is azotised, and takes up one of the principles that the acid abandons by its destruction, for I heated it with carbonate of potash, and obtained a ley fit for making Prussian blue.

But while the charcoal is separated by retaining a portion of azot, the greatest part of the latter, together with the hydrogen, forms into ammonia: it is also found in the yellow liquor, with the remains of the acid that has escaped destruction.

The prussic gas dissolved in water does not render turbid the solution of green sulphate, but when it has passed through the above changes, being assisted by the newly formed ammonia, it renders it turbid, and produces a blue colour.

Lastly, this liquor distilled yields prussiate of ammonia, and deposits only a few atoms of carbonaceous matter It was of some consequence to know whether the ammonia contained carbonic acid, but I forgot to notice it. I shall however re-examine it.

The prussic alcohol keeps perfectly well; and we may with some reason conclude, that if alcohol is better adapted for dissolving and preserving it than water, the prussic gas, considering also its aromatic and inflammable qualities, approaches perhaps more to the nature of pro-

ducts

-ducts of an oily combustible, and of a complex nature, than to saline substances.

It is to be concluded from these facts, first, that there is but one prussiate of mercury, and that its base is at the *maximum*; secondly, that all that elevation of affinities which the prussic acid acquires from the black oxyd, when it acts in conjunction with potash or with red oxyd of iron, and on which Berthollet so justly insists, is not necessary to it when opposed to the oxyds of gold, silver, copper, cobalt, nickel, uranium, mercury, &c. Indeed, we see, that with respect to the latter, this acid, of which the affinities are so weak as scarcely to merit its title, does not require black oxyd to enable it to furnish with mercury a saline combination, very soluble and crystallisable, and in short possessing all the characters by which the most perfect compositions are distinguishable. We may add to these extraordinary qualities, that it has also more affinity for mercury than for the alkalies, that it does not yield its oxyd either to nitric or sulphuric acid, though their power is so superior; and lastly, of giving way only to the muriatic acid, which is known in so many respects to be inferior to the sulphuric and nitric acids.

Lixivium of Animal Charcoal.

Equal parts of charcoal of blood and carbonate of potash, heated to redness in a covered crucible, have always produced the richest ley.

As I imagined that the carbonic acid might impede the saturation of the potash, I added lime to the mixture, but the ley was not improved by it.

I kept at a red heat for half an hour a mixture of 144 grains of charcoal, and as much carbonate. When the

ley-

ley was made, 104 grains of charcoal remained, 40 were destroyed.

This 104 grains treated with 144 of carbonate, was reduced to 62, the loss 42.

The ley yielded from these two experiments was saturated with a solution of the sulphate of iron of commerce; the blue of the first, after the acid washing, was double the bulk of the second.

To know the influence of the temperature, I tried three different mixtures in equal parts. The first was kept at a red heat for half an hour, the second an hour, and the third an hour and a quarter. The first ley gave but little blue, the two last a considerable quantity, and in nearly equal proportions. These results prove, either that the simple prussiate, which predominates in the leys, is preserved in the midst of the alkalino-carbonaceous mass, or that it is reproduced as fast as it is destroyed.

The charcoal of blood, when pulverized, becomes moist in the air; by lixiviation it yields common salt and carbonate of soda, containing a little prussic acid.

The charcoal of blood, heated a second time, yields less blue than at the first; the third time still less; and the fourth, none at all. This charcoal exhausted and heated to redness, is incinerated with much facility, and without exhaling the odour of ammonia, like those that are burnt immediately after the distillation. It seems that in proportion as it loses the azote, it becomes more combustible, and approaches nearer to the nature of vegetable charcoals; it is not however inflammable by nitric acid.

The azote being susceptible of forming concrete combinations, and capable of resisting an elevated temperature, what would be the influence of animal charcoal in the formation of steel?

The

The workmen who temper it in cases make use of sheep's feet; has their charcoal any advantages superior to that of wood?

Equal parts of washed charcoal of blood and of caustic potash afford, by distillation, simple prussiate of ammonia, much gas which smells of the prussic acid, and burns with a red flame.

Equal parts of the same charcoal and oxyd of manganese yield carbonate and prussiate of ammonia.

The desire of making ammonia with profit, led me to the following experiment: I distilled a mixture of charcoal of blood, six drams; clay, and sea salt, of each two drams; but the product in sal ammoniac was less than I expected.

All azotized vegetable charcoal is proper for making Prussian blue. Accordingly the charcoal of gluten of wheat, chick peas, indigo, and pit-coal, afforded colouring leys, sometimes mixed with hydro-sulphuret; that of sugar and sugar of milk give not the slightest trace of blue.

The charcoal of chesnut and heath, which the smiths prefer to the others, because it is extinguished as soon as the bellows cease blowing, do not owe this property to the azote, for their leys contain nothing of the prussic acid.

A ley obtained from cream of tartar heated to a red heat, contains no traces of blue; two parts of cream of tartar and one of sal ammoniac are the same; but one part of sal ammoniac with four of cream of tartar produce a ley containing simple prussiate. It gives blue, with the green sulphate of commerce; cream of tartar and nitrate of soda, none.

This result proves that it is only on account of the azote that animal charcoal is preferable to the vegetable, and consequently that if an azotised combination should hereafter

after be discovered more capable of supporting a strong heat than the ammoniacal salts, it is probable that a prussic acid may be made in a manner less laborious than by using the animal charcoals.

Examination of the Leys.

By distillation they uniformly yield prussic acid and ammonia, the cause of which has been given above.

They contain a great quantity of carbonate of potash,

Simple prussiate of potash,
Triple prussiate of potash,
Sulphate of potash,
Phosphate of lime,
Sulphur.

They deposit phosphate of lime as they evaporate, but I do not know how they sustain it.

If we saturate a portion of ley with sulphate of iron, and examine the blue that proceeds from the acid washings, we shall find that it contains phosphate of iron. It was this phosphate that led Westcrumb to believe that the acid of Prussian blue was phosphoric.

Alcohol, applied to the concentrated leys, frees them from the simple prussiate; but it appears to me to be difficult to exhaust them by this method. The triple prussiate remains in the ley together with the carbonate.

Of these two prussiates, one only is capable of affording Prussian blue with solutions of red oxyd, and this is the triple prussiate, because it is furnished with black oxyd. The other has not this property for want of the black oxyd, but it obtains it, and forms triple prussiate, as soon as the leys are mixed with the sulphate of iron of commerce: and consequently if we make use of sulphate completely red, we shall have infinitely less Prussian blue, because, for want of black oxyd, it cannot be-

come

come triple prussiate, and produce a blue with this sulphate. This is proved by two experiments.

I divided some ley into two equal parts; one I precipitated with red sulphate, and the other with the green sulphate of commerce. The excess of oxyd being separated by acid washing; the bulk of blue contained in the second was to that in the first as four to one.

The first ley, when filtered, strongly exhaled the odour of kernels. I saturated it with potash, to fix the free prussic acid: I then essayed it with red sulphate, and it yielded no blue; but with green sulphate, a considerable quantity. We may conclude then, that without the concurrence of black oxyd, a carbonaceous ley cannot be made to produce, with a solution of red oxyd, all the blue that it is capable of affording; accordingly, if we attempt to use a sulphate in which the oxyd is completely red, we shall lose all the simple prussiate contained in the ley. I once recommended this method myself, but I had not then observed that, although the green sulphate produces a pale prussiate, the atmospheric oxygen soon remedies this defect, and it likewise possesses the essential property of furnishing to the simple prussiate the portion of black oxyd that it requires to render it triple, and afterwards produces the blue colour, with the red solutions. Two other experiments tend to support this demonstration.

The leys are usually precipitated with a solution of four parts of alum and one of sulphate of commerce.

I divided one of these solutions into two parts; one was super-oxydated with oxygenated muriatic acid, the other not. I afterwards saturated them with a carbonaceous ley. The ordinary solution furnished an abundance of blue, but the other yielded only a pale precipitate, which was nothing more than a little blue confounded with a considerable quantity of alumine. This experiment fundamentally agrees with the preceding. It has only the advantage of shewing, that alum is only a passive ingredient in the formation of Prussian blue.

The fabricated leys are not so productive as that from an alkali boiled upon Prussian blue; this latter will always furnish abundance of blue, because it is tripled in the course of the operation; but the other leys are not; they are incapable of producing it but in proportion to the triple prussiate they contain; and, in order to increase or elevate to the same degree their simple prussiate, it is indispensible to use either a sulphate strictly green, or at least a sulphate containing as much as is usually found in that of commerce.

These particulars likewise evince, that if the leys contain only a portion of trisulated prussiate, it is either because the charcoal of blood has not enough of iron to raise the simple prussiate which forms during the calcination to the triple; or rather, that a part of this latter becomes reduced to simple prussiate, by the loss of its oxyd, as we have seen is the case when heated by itself. I am inclined to adopt the latter of these opinions, because the charcoal of these lessives affords ashes that contain much iron; therefore in the calcination of alkalino-carbonaceous mixtures, we cannot presume that iron does not exist in prussiate; and it is surprizing that the tripled prussiate that really exists in the leys is capable of defending its oxyd against the charcoal which continually tends to reduce it. In short, all this part of the process is very obscure; we neither know when the prussic acid is formed, nor whether it is destroyed, and then re-produced, nor even the degree of heat proper for obtaining the greatest possible quantity of either of the prussiates, which is an object with the makers of Prussian blue.

The

The existence of triple prussiate in the leys is immediately demonstrated by the following experiments.

Some ley saturated with aqueous sulphuric acid disengages, first, carbonic acid, and then the prussic acid of the free prussiate. It must be afterwards heated, and the triple prussiate and white prussiate of iron appear. Further, the leys concentrated and left at rest deposit octaedral crystals of triple prussiate.

The prussic ley has two savours, very distinct, one of potash, and the other of kernels; it is from the latter that we judge instantly of its quality. If the flavour is weak to the taste, either the mixture has not been sufficiently heated, or the charcoal has been employed too sparingly. I believe also, that the calcination of mixtures in the open air, does not contribute to the augmentation of the prussiates, and that perhaps it would be more advantageous and less toublesome, to heat them in covered crucibles, placed in a reverberating furnace, since it is not necessary to stir them.

When these leys are concentrated in order to diminish their bulk, or for keeping, the simple prussiate should, as Curaudeau has shewn, be preserved from destruction; this is immediately obtained by pouring green sulphate upon it in small portions, which completely dissolves it; the ley reddens at first, then becomes yellow; an excess of sulphate causes no alteration in it, beoauc the potash that predominates reduces it to an oxyd, which deposits without being changed to prussiate; for, to accomplish this change, it must be accompanied by an acid; the oxyd we are speaking of being at the *minimum* only, has no effect on the triple prussiate. The following experiment clearly shews the advantages of this method.

I divided some ley into two equal parts, one prepared or trisulated by green sulphate, and the other not: I af-

 terwards

terwards distilled them; the first contained no ammonia, and the second yielded it as usual. It is then indispensible to prepare the leys before they are concentrated. Lastly, neither the red oxyd, nor its sulphate, will dissolve in simple prussiate, and give to it the quality of the triple, as Scheele had found to be the case. This oxyd, although calculated to form the base of Prussian blue, is incapable of decomposing the triple prussiate, for it must necessarily be dissolved by an acid.

Recapitulation.

The prussic acid is composed of charcoal, azote, and hydrogen, in proportions, with which we are yet unacquainted. Only from the great quantity of charcoal that remains after its destruction, we may conjecture that this radical ingredient predominates; there is no indication whatever of oxygen, and indeed, when we consider the known affinities of its three elements, together with the circumstances of its formation, we cannot expect to find it.

The prussic acid itself has very few acid qualities; for it has not the sour savour; it does not redden turnsol; it is less soluble in water, the proper solvent of acids, than in alcohol, in which it is even spontaneously decomposed, without the help of the external air. It forms with the alkalies such imperfect combinations, as still to exhibit some of the qualities of the component parts; and carbonic acid, which is the weakest of all acids, will decompose it. In short, its combustibility, its savour, its aromatic odour, its production in the midst of volatile oils and kernels, and its preservation in alcohol, comprise an assemblage of properties, that give it much more of the nature of oily and inflammable productions than of saline substances.

However,

However, the prussic acid, notwithstanding its weak saline power, still attacks the *maximum* oxyd of mercury with much effect; it furnishes, with this oxyd, a saline combination so decided in its attributes, that it must be admitted that it acts, in certain circumstances, as a very powerful acid. Indeed, the prussiate of mercury possesses every quality necessary to establish it as a perfect metallic salt; it may be thought surprizing that it will not unite to the oxyd at the *minimum*; but by one of those effects of affinities, of which there are other examples, it is raised to an oxyd at the *maximum*, by reducing one part of the metal, so as to form prussiate of mercury with the other.

The prussic acid has no effect on the red oxyd of iron, but it readily combines with the black oxyd, and produces white prussiate. It is true, that this prussiate is not perfectly white, owing to the difficulty of preparing with the green sulphate, a precipitate at the zero of superoxydation; it is always greenish, but as it becomes, in dyeing, a perfect Prussian blue, there is no doubt but that the prussic acid, with the green sulphate, perfectly free from red, would yield a prussiate as white as that obtained by the most easy means.

Prussian blue is not a simple combination, as it has been supposed; and the following observation proves it.

We know, for instance, that red oxyd forms the base of this blue; but if this oxyd alone is sufficient to make Prussian blue, why do not the prussic acid and the red oxyd produce it? or the solutions of this oxyd and the simple alkaline prussiates? The fact is, that Prussian blue requires another element, which the following examples completely shew. By applying potash to Prussian blue, we obtain a yellow crystallisable salt, which has always a constant portion of black oxyd.

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We employ the yellow prussiate, to re-produce Prussian blue, and this oxyd passes with the prussic acid into the new combination, The black oxyd then is an element as necessary to the formation of crystallisable prussiate as of Prussian blue, and of all the metallic prussiates that are prepared with the triple prussiate of potash.

There are some metals capable of forming both triple and simple prussiates, such as copper, silver, manganese, cobalt, nickel, uranium, &c.; there are others that afford only the simple prussiate, such as gold, mercury, &c.; and lastly, there are some that will produce neither. But with the exception of Prussian blue and prussiate of mercury, all the others are little known and merit examination. The black oxyd united to the prussic acid, will pass from one combination to another without alteration. The base of this combination may even be raised from the *minimum* to the *maximum* without the black oxyd by that means undergoing any change. The combination of the acid with this oxyd is preserved by an affinity so powerful, that the alkaline hydrosulphurets cannot separate them; or in other words, cannot unite with the oxyd in either the triple prussiate of potash or in Prussian blue.

The prussic acid, united with that portion of black oxyd which enables it to form triple prussiates, either alkaline or metallic, is a peculiar combination of which the existence cannot be doubted, but of which we have no other instance except in these prussiates.

The triple prussiate of potash cannot sustain a red heat, without losing its black oxyd, and being consequently reduced to the state of simple prussiate.

The simple prussiate may be also decomposed, but at a much lower temperature; its acid is destroyed, and reduced to ammonia and carbonic acid; it is the destruction

of

of this salt by the heat of ebullition, that injures the leys for preparing the Prussian blue.

The simple prussiate takes the character of the triple prussiate, as soon as it is exposed to combination, either with black oxyd, or a salt with a base of black oxyd, and acquires, besides the advantage of crystallising, that of being no longer decomposable by the heat of ebullition.

This prussiate, which was the test liquor so much sought by chemists, affords no Prussian blue with solutions of red oxyd, but does yield it if they contain a portion of black oxyd, because its acid attaches immediately to that portion of the black oxyd, which is necessary as an intermedium between the acid and the red oxyd.

The triple prussiate of iron, or Prussian blue, when strongly heated, is reduced to the following ingredients: ammonia, the two gases carbonic and gaseous oxyd, iron in the state of steel, and charcoal.

The prussiate of mercury when decomposed affords the same products, but with the addition of a certain portion of oil.

The carbonaceous leys contain but little triple and much simple prussiate. They must not be concentrated until the second has been previously converted into triple by an addition of black oxyd or green sulphate.

To obtain from these leys all the Prussian blue they are capable of producing, it is indispensably necessary that a sulphate should be used, that contains at least a portion of green oxyd, or the simple prussiate they contain will not furnish blue with a sulphate having a base completely red.

Lastly, if this memoir is compared with Scheele's work on this subject, it will be found that all the facts herein stated were well known to him, but it appeared to me, that they required much more developement; and that is what I proposed to accomplish in this work.

Description

Description of an improved Instrument for ascertaining the Strength of Gunpowder.

From Sonnini's Journal.

With a Plate.

THE common powder-prover with a toothed wheel; although the worst that is made, is in universal use, because it is the cheapest and easiest to obtain. Its evident defects are:

1. That the friction of the spring; blunts and rounds the extremities of the teeth of the wheel.

2. The spring, which is necessarily strong, and always bent, loses in time its elasticity and force.

3. The wheel being too confined in its movements, its friction is irregular, and varies also according to the state of oxydation or cleanliness of the instrument.

Whence it results, that the prover most used is in fact the most imperfect; and with the view of correcting its defects, and at the same time preserving its qualities, it has been improved in the following manner.

A, (Plate IX.) is a wooden stock, covered with a plate of metal which sustains the apparatus.

B, a small metal mortar, for receiving the powder intended for proof. This mortar has a priming pan affixed to it.

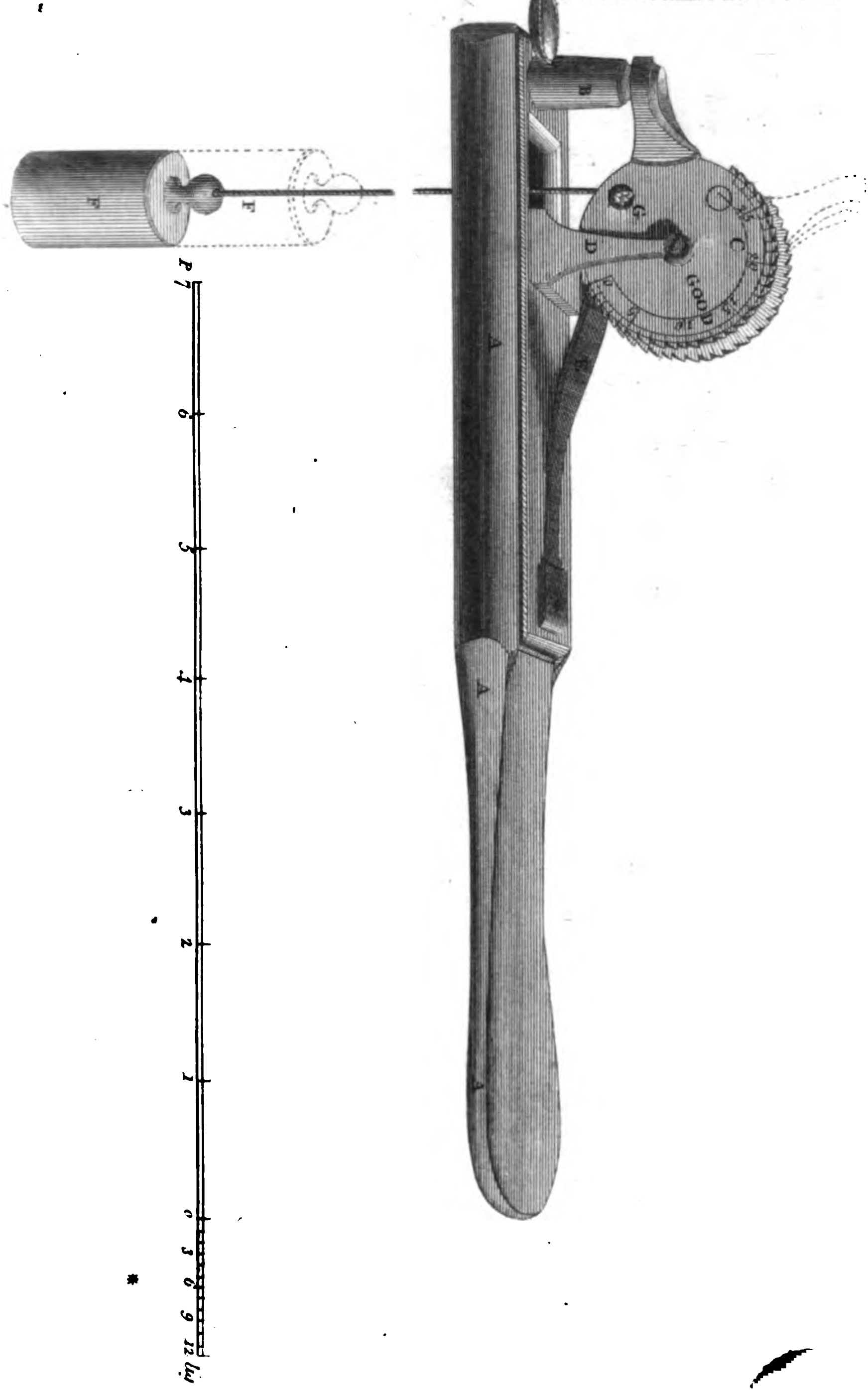
C, a brass wheel grooved like a pulley, and furnished with 30 ratchet teeth, cut upon its circumference. This wheel, or rather pulley, carries a projector which exactly covers the mouth of the mortar B.

D, a support in which the wheel plays freely, as it turns on its axis.

E, a spring that acts as a clapper.

F,

Pl. IX. Vol. XI. Second Series



F, a weight suspended by a string that is fastened to the body of the wheel by the eye G. The string passes through the stock by an opening made sufficiently wide to prevent its touching.

Directions for using it.

1. Fill the mortar with powder, and pass the end of your finger over the mouth, that none may remain between the projector and the mortar.

2. When the fire is applied to the priming, the prover must be held horizontally in the left hand. A rod of red hot iron is preferable to lighted charcoal.

Its Effects.

The powder, as it explodes, occupies a greater space, turns the wheel, by raising the weight which opposes its motion; and we may judge of this motion by the end of the spring E, which points out the number of degrees that the weight has been raised.

When it points to the degree marked GOOD, it indicates that the powder which has been proved is good; and when it is above this degree, the powder is proportionably better.

It is to be observed, that the same powder, with the same prover, does not always produce the same effect; it is therefore necessary, in order to be certain of its quality, to repeat the experiment several times, and to take the mean term.

Memoir on Wooden Matches for Artillery, as Substitutes for Rope-Match or Port-Fires. Read to the National Institute April 1806, *by* C. L. Cadet.

From the Annales de Chimie.

DURING several centuries, the *military match* or *rope match* only was used for firing cannon, mortars, howitzers and other pieces of artillery. This match, as is well known, is a cord of supple hemp, and of a middling size, has been boiled for two days in a lessive of saltpetre, ashes, quick-lime and horse-dung. This cord, when dried, burns slowly to the end, in the manner of touchwood, and communicates its fire like red-hot coal. For use it is twisted round a stick called a *port-match*, and an end is left projecting beyond it, which is about four inches and a half in length. (This length will burn an hour.)

This match has several inconveniences: it requires continual inspection, since it must be unrolled from the port-match every hour, and sometimes oftener. A tolerably heavy rain extinguishes it; by night, it gives no light to the gunner; the end that extends beyond the port-match is sometimes unsteady, and the artillery man is in consequence slow in firing his piece. These different defects have induced commanders to confine the use of the rope-match to the artillery of garrisons, and to employ in the field *artificial port-fires*, reserving however the hemp-match to serve as a fire-holder.

These artificial port-fires are cartridges of pasteboard, filled with a mixture of sulphur and saltpetre, and a very little powder. This composition, of which saltpetre forms the greater part, burns and melts with very great activity, giving a vivid and brilliant flame, which rapidly fires

fires the priming. In this respect they are infinitely preferable to the rope-match; since they light the gunner, their fire is more vivid, and they are more easily directed. Yet these advantages are counterbalanced by dangers and defects. The inflamed saltpetre in these port-fires is never entirely consumed; a part runs out of the cartridge. When the materials are unequally pulverized, the port-fire is apt to *spit*, that is, to throw out pieces of inflamed saltpetre to the distance of three or four feet; which may occasion very serious accidents, especially at sea. During the experiments that I made at Vincennes with the Director of the Artillery, a port-fire at some distance shot out a spark that burnt my hair and both my coats. In ships the gunners are obliged to stand in the middle of a tub full of water.

Such were the only means employed for communicating the fire to pieces of artillery, when one of my correspondents at Madrid, wrote to me that Messrs. Borde and Proust had proposed to the Spanish government to use instead of rope-matches wooden rods impregnated with nitrate of copper. He added that these wooden rods burnt like touch-wood, giving a burning coal of a conical form; that the trials made with them had succeeded, but that the government had not adopted them. I acquainted his Excellency the Minister at War with this new method; and he invited me to make the experiments necessary for ascertaining the utility of this process, and he desired M. Lespagnol, a captain in the artillery, to assist in my researches.

My first idea was, that all kinds of wood were not equally proper for this purpose; and that the difference of their porosity would cause a difference in their combustibility. Before I tried the metallic nitrates, I em-

 ployed

ployed ordinary saltpetre, and I boiled, in a strong solution of this salt, several kinds of wood, which became differently saturated with it. This experiment was unsuccessful, and the common cane, or *rotang* of Linnæus, was the only wood that burnt rapidly; but its coal had no substance, and the slightest shock broke it, and extinguished the fire. I then employed a joiner to make some wooden rods of a square form, and half a metre in length. The woods he used were oak, elm, ash, elder, birch, poplar, lime or linden and fir. I formed two assortments of these woods; and one I boiled in a solution of nitrate of copper, the other in a solution of nitrate of lead. In each of these parcels, the oak, elm, ash and elder, were not saturated, and afterwards burnt in the usual manner; the others furnished me with very good military matches: but, before I enter into the detail of their properties, I must say, that I think the nitrate of copper should be rejected; because it is too dear, it quickly corrodes the boilers, and its vapour is noxious. I therefore employed only nitrate of lead, and after several trials I found that it perfectly answered the desired purpose.

The wood that succeeded best was that of the lime, the birch and the poplar: to compare their properties, I weighed some rods both before and after boiling; I ascertained the increase in their weight, the duration of their combustion, and I calculated how much one pound (500 grammes) of nitrate of lead would saturate of each. The following table establishes these proportions:

Name

Name of the Wood.	Weight in Grains before Experiment.	Weight in Grains after Experiment.	Increase of Weight in Grains.	Or,	The Pound of Nitrate of Lead will saturate in Metres.	Duration of the Combustion.
	The Metre.	The Metre.				
Birch - - -	888	1416	528	7 drs. 24 grs.	17 1/3	3 hours.
Poplar - -	516	936	420	5 1/2 24	21 33/35	2 hours.
Lime - - -	888	1728	840	11 1/2 12	10 34/35	3 hours.

From

From this comparative experiment it follows, that the lime is the most proper for making matches for artillery; and with this wood I made the experiments required by the Minister, in the presence of M. Lespagnol.

In some circumstances the gunner requires light while firing his pieces. Rods that are simply impregnated with nitrate of lead, produce a coal sufficient to communicate the fire, but which furnishes no light. I imagined that by soaking them in oil of turpentine, they might produce flame without injuring the action of the nitrate; my hopes were realised; and the rods, thus prepared, furnished at pleasure both light and fire. In this improvement I found two other advantages: one, that of rendering the rods impervious to water; the other, of facilitating the reduction of the lead, a part of which I feared was carried off with the smoke, and might be prejudicial to the health of the artillery-men who must breathe it.

The theory of the process that I employ is simple and it is easy to explain why metallic nitrates succeed better than nitrate of potash. However dry the wood employed may be, it always retains a little of its water of vegetation or of composition, which prevents its speedy combustion. By boiling the rods in a solution of lead or copper, this liquid, which owing to its specific gravity rises to a temperature of 150 and 160 degrees, dilates, softens and penetrates the fibres of the wood, and expels the water of vegetation, which is replaced by that of crystallisation.

The nitrate then comes in direct contact with the carbon of the wood; whence proceeds the rapidity of the combustion. The nitrate of potash did not succeed so well, because, retaining much water of crystallisation, its solution does not acquire so high a temperature; and, supposing that it could penetrate the wood as intimately, it carries into it too much water for the combustion to be

progressive

progressive and continued. We find the proof of this reasoning in the composition of the two salts. The nitrate of lead contains a base of 75,0 ; and nitrate of potash contains but 49,0.

The rapid combustion of the rods is likewise owing to the facility with which the salts of lead are reduced, when they are in contact with the burning charcoal. If a hempen rope be boiled in a solution of acetate of lead (extract of Saturn), this rope, when dried, may be used as a military match. It burns slowly like touch-wood, and affords a very bright coal. The oxyd of lead, as it is reduced, yields its oxygen to the carbon, and accelerates the combustion.

By comparing the specific gravity of different kinds of wood with their different saturation by salts, we find that the lighter a wood is, the more saline matter it absorbs into its pores, or in the interstices of its fibres. From this I think we may conclude, that it contains less carbon than heavier wood of equal bulk, and that its combustion will disengage less caloric, since the caloric emitted is in the ratio of the quantity of oxygen combined with the combustible. We might, I should think, by the absorption of the salts, class the different kinds of wood, according to their combustibility, so as to know which are most advantageous to burn for domestic purposes, whether we desire a rapid combustion or a stronger and more continued heat.

These researches will be the subject of a particular work that I propose to publish on our forest-trees.

The wooden matches, compared to the port fires, have the following advantages:

The port-fire lasts only three or four minutes. The wooden match (a metre in length) lasts three hours.

The port-fire is liable to break in the boxes. The wooden match is firm and easily carried about.

The

The port-fire emits dangerous sparks. The wooden match concentrates its fire about itself.

The port-fire costs from six to nine pence. The wooden match costs only three or four pence.

This last consideration is very important, since, according to the calculation made in the War-office, what now costs the state twenty thousand francs will only cost fifteen hundred.

As it was necessary to ascertain whether the new matches would resist rain, I caused several to burn during long showers, and they remained on fire until they were totally consumed, their combustion being only slightly impeded.

The fabrication of these matches requiring some care and precaution, I shall terminate this memoir with a particular description of the process, by the desire of the Minister at War, for the instruction of the artificers employed in the arsenals.

Mode of preparing the combustible Wooden Matches for Artillery.

Form of the Matches, and choice of the Wood.

These artillery-matches are parallelipidons, half a metre long by 6 lines, or 13,531 millimetres, thick. The wood most proper for this purpose is that of the lime-tree and birch; but for want of these the poplar and fir will do. All white and soft wood will serve for this purpose; but the preceding are to be preferred.

The form of the match, at the first view, seems immaterial; yet experience has proved that the round matches do not give so good a fire as the square ones. The angles, in burning, keep the charcoal in the centre, in a vivid incandescence, and the match always terminates in an inflamed cone two inches long.

Drying

Drying of the Wooden Matches.

Before the matches are saturated with nitrate of lead, the wood should be perfectly dry. In order to obtain them sufficiently dry, it is necessary that they should be made with wood that has been at least a year in store, and they should be exposed to the heat of a stove at a temperature of thirty degrees (we suppose of Reaumur). If a stove cannot be had, a baker's oven may be employed, and the matches may be put into it after the bread has been drawn out.

Furnaces and Boilers.

For the fabrication of these matches there should be two furnaces and two boilers. They should be made in the form of a narrow fish-kettle, three quarters of a metre in length; their size must be in proportion to the quantity of matches that are to be made at one time. The furnaces must be so constructed that the heat shall act equally on every part of the bottom of the boiler. The first boiler should be of copper strongly tinned, furnished with a plate of the same metal, for the purpose of pressing down the matches, and keeping them immersed in the boiling solution. The second boiler may be either of copper or cast iron; it should be placed upon a sand bath, and have no direct communication with the fire in the furnace; lastly, it should have a cover to fit exactly, and handles to raise it easily when necessary.

Preparation of the Nitrate of Lead.

In order to make this salt, some nitric acid must be saturated with red oxyd of lead or litharge; but as it is necessary that the salt should be neutral, and have no excess of acid nor of base, there are some precautions to be taken in this operation. If the acid be too much co [illegible] con- [illegible]. If [illegible] little oxyd [illegible], the salt becomes [illegible] and soon destroys the boilers. To obtain [illegible], a pound of litharge (500 grammes) must be put into a vessel of glass or earthen-ware, and thirteen ounces (416 grammes) of nitric acid at 40 degrees with four ounces (128 grammes) of water must be poured on it. It must be heated until all the oxyd is dissolved, filtered, and the liquor evaporated to dryness. From these proportions twenty ounces (640 grammes) of nitrate of lead should be obtained.

Bath of Nitrate of Lead.

The nitrate of lead is very soluble in water, but the least quantity of liquid possible should be put to it; for the bath when fully charged, acquires a more elevated temperature than boiling water, and thus easily insinuates itself into the pores of the dilated wood. To a pound of nitrate, therefore, only a quart (a *litre*) of water should be put, or thereabouts; but as the different kinds of wood do not equally saturate themselves with the salt, the proportions should be studied. It is known from experiment, that to absorb a pound of nitrate of lead requires 10 metres $\frac{4}{5}$ of lime, 17$\frac{1}{3}$ of birch, and 21$\frac{3}{5}$ of poplar. The lime therefore when saturated is the most combustible. The ebullition should be continued for six hours, that the saturation of the wood may be complete, and warm water added to it, when the bath is low, and suffers the salt to precipitate.

Second Drying of the Matches.

When the matches are taken out of the boiler, they should be put into a stove, and made perfectly dry, to fit them for the following bath.

Turpentine

Turpentine Bath.

Put into the second boiler a sufficient quantity of oil of turpentine to cover the matches about the depth of an inch (2,8000 centimetres) heat it very slowly till it boils, but as soon as the bath grows white and rises, it must be covered, and quickly lifted up, lest it should take fire. This ebullition is to be repeated two or three times; and the whole operation will last about half an hour. The bath is then to be left to cool, the matches taken out, wiped and dried in the stove; they are then fit for use.

The Institute at its sitting on the 5th of May, from the report of Messrs. Carnot, Deyeux and Guyton de Morveau, approved of this memoir.

Facts towards the History of the Gallic Acid.

By BOUILLON LAGRANGE.

From the ANNALES DE CHIMIE.

I HAVE had the honour of presenting, for the judgment of the class, the result of my experiments on tannin: I now submit to it some facts relating to the gallic acid, which I had announced as forming the second part of my memoir.

Of all the vegetable acids, the gallic may be considered as the most interesting; consequently it has been an object of enquiry with several chemists. Macquer, Monnet, Lewis, Cartheuser, and Gioanetti, have described the manner in which the substances called *astringents* act upon solutions of iron. The academicians at Dijon were the first who discovered the presence of an acid in these substances; and in 1772 they shewed that the distilled products of nut-galls blackened the solution of sulphate of iron, and that its infusion reddened the tincture of turnsol; yet

 these

these facts were only a general proof of the acid nature of the principle contained in nut-galls, for they afforded no means of extracting this acid, and obtaining it separate; it is to Scheele that we are indebted for this discovery. His process was published in 1780. M. Deyeux some years afterwards, in 1793, discovered that this acid might be obtained by sublimation. Messrs. Berthollet and Proust have since added much by their researches to our knowledge of the properties of this acid; so that it may be considered as better known than any other produced from vegetables.

Several foreign chemists have also given, within these few years, processes for extracting and purifying this acid; but none of them, except M. Richter's, are equal to Scheele's. Among the number of experiments that have been made on this subject, there is one which I have neither seen quoted nor refuted in the memoirs published on the gallic acid.

We find in a letter from M. G. Charles Bartholdi to M. Berthollet, in the year 1792, some facts that were calculated to fix the attention of chemists.

M. Bartholdi first points out a process for obtaining pure gallic acid; he afterwards treats this acid with metallic oxyds; he declares that he has shewn that all bodies which yield oxygen to the gallic acid render it brown; that in these operations the acid itself, as it carbonises, forms, by a slight combustion, colouring particles.

For this purpose he boiled some red oxyd of mercury for half an hour in a solution of gallic acid, which acquired a blackish colour. He found in the residue some fluid mercury, mixed with a carbonaceous powder; he afterwards saturated the liquor with the carbonates of potash and soda. These salts yielded no blue precipitate with the sulphate of iron.

He

He obtained a similar result with the oxyd of manganese.

Other experiments persuaded M. Bartholdi that bodies which abstract the oxygen from the gallic acid give it a lighter colour. He says he has rendered a solution of gallic acid as colourless as distilled water, by boiling it for some time with very pure and well-powdered charcoal, of which he took double the weight of the acid; it remained clear as long as it was defended from the influence of the atmosphere, and precipitated iron black.

M. Bartholdi presumes that we may thus accomplish the destruction of its astringent property.

I shall not, at present, make any observations on this, as it is necessary that we should be acquainted with the following experiments, to be enabled to judge.

Extraction of the Gallic Acid.

There exists several processes for extracting this acid from nut-galls.

Scheele's Process.

Pour six parts of cold water upon one of nut-galls, pounded and passed through a coarse sieve. Leave it in a glass vessel for four days to macerate, and stir it frequently; afterwards filter it, and expose the liquor to the open air in the same vessel, simply covered with blotting paper: at the end of a month this infusion is covered with a thick mouldy pellicle; no precipitate is formed, and it has no longer its astringent taste, but is acid. Leave the liquor at rest for five weeks longer, and at the end of that time a precipitate is formed two fingers in thickness, above which is a mucous pellicle. Filter the infusion, expose it again to the air, and after some months the greatest part of the liquor is evaporated; collect all the precipitates, and pour cold water on them; leave this mixture

mixture to settle, and decant it; add as much warm water as is necessary to dissolve it; filter it, and evaporate it at a mild heat, and yellow crystals are produced.

Bartholdi's Process.

Evaporate the alcoholic tincture of nut-galls, dissolve it afterwards in distilled water, and add sulphuric acid to the solution, until the mixture has acquired a decided acid taste; the extractive matter falls down in a few hours; and the supernatant fluid, being freed from the sulphuric acid by barytes, yields, according to this author, pure gallic acid.

The above process does not afford this result.

It is generally very difficult to ascertain when all the acid is separated by the barytes, since it combines also with the gallic acid. After the evaporation of the liquor a bitter matter remains that retains a considerable quantity of tannin, and is incapable of crystallisation.

M. Deyeux's Process.

This chemist has discovered, that by slowly and carefully heating pounded nut-galls in a glass retort, a tolerable quantity of brilliant and silvery lamellated crystals sublimed.

M. Richter's Process.

Infuse some nut-galls, reduced to a fine powder, in cold water, being careful to shake the mixture often. After a short time strain the whole through a linen cloth, mix the residues once again with water, and submit it to pressure; collect the liquors, evaporate them by a very gentle heat, and a very brittle blackish brown substance is obtained. This substance, reduced to a very fine powder, and digested with very pure alcohol, produces a pale straw colour. The second infusion has scarcely any colour;

colour; it leaves a brown residue, which is composed of tannin almost perfectly pure. Mix these two alcoholic liquors, and distil them in a small retort till only one eighth remains; the liquor becomes nearly solid as it cools; pour water on it, heat it slightly, and a clear and faintly-coloured solution is afforded.

If we evaporate this solution, we obtain very small and very white prismatic crystals; the mother-water also furnishes more, but they are generally slightly coloured; however, by being washed in water they become perfectly white. We obtain, by this process, half an ounce of crystals from a pound of galls: these crystals are exceedingly light.

The processes of Scheele, Messrs. Richter, and Deyeux, have afforded the most advantageous results; but they differ as to the purity of the acid. The first, as Berthollet has observed, retains much tannin; the second is perfectly white; and the third also contains tannin.

By M. Richter's process the acid, after it has been purified, is straw-coloured, I have tried, without success, to bring it to the state of purity that he mentions; and I have discovered, that by employing evaporation, desiccation, and subsequent solution in alcohol, a certain quantity of acid is decomposed each time; so that the alcoholic liquor, instead of being more transparent, becomes brown. There is therefore a certain point at which it is necessary to stop, if we wish to preserve the whole of the acid, and its properties.

M. Berthollet has attempted to purify Scheele's acid in various ways; and he succeeded best by treating it with the oxyd of tin recently precipitated from its solution in an acid.

I have repeated this experiment as follows:

After having separated the oxyd of muriate of tin by an alkaline base, I washed it carefully with boiling water, and

and then boiled it for some time in a fresh quantity of water. I afterwards treated it with gallic acid, evaporated it to the consistence of thick honey, and then added to it some distilled water: the liquor, when filtered, was clear, limpid, without taste or smell, and when evaporated to dryness there remained no product.

This variation from the results obtained by M. Berthollet led me to suppose that I had committed some error; I therefore repeated the experiment in the following manner, with the utmost attention.

I dissolved 61 grammes of gallic acid confusedly crystallised, and very brown, in 5 hectogrammes of boiling water. I reserved for comparison a portion of this solution, and the remainder was submitted to ebullition, with 61 grammes of oxyd of tin, well washed and still wet. I evaporated it until only half the liquor was left, and then added enough water to bring it to its original weight; I compared them, and found that this latter had lost much of its colour. The difference in the degree of acidity was hardly sensible; it still precipitated gelatine; the precipitate was yellow and bulky; whilst that from the unpurified liquor was brown, heavy, more plentiful, and even united into a mass. We see that the acid is as yet not decomposed; but I could not, like M. Berthollet, obtain crystals as white and pure as those produced by sublimation.

Being desirous of knowing if a fresh quantity of oxyd of tin would entirely deprive this acid of tannin, I added to the liquor 30 grammes of oxyd of tin, and evaporated it until it was reduced to about 100 grammes: it passed through a filter clear and without colour; it did not precipitate either sulphate of iron or gelatine, and I could not obtain gallic acid from the evaporation.

This

This experiment proves that it is very difficult to deprive the gallic acid entirely of tannin, and by continuing the action of the oxyd of tin the acid is decomposed. It is thus, without doubt, that M. Proust has proceeded, for he has observed in his memoir, printed in the *Annales de Chimie*, *tome* 42, that the oxyd of tin he employed to purify the gallic acid, produced a liquor without either colour or taste, and which had no effect either on solutions of iron or tincture of turnsol.

I do not think that the methods proposed by M. Bartholdi can be employed; yet, as he has neglected to examine the products of his operations, I thought it necessary to repeat his experiments, and to determine the nature of the results that might proceed from them. For this end I poured a solution of gallic acid upon red oxyd of mercury; it became immediately brown, and gradually black; the liquor also acquired a deep brown colour: in this state it was still acid, it gave a blue colour to the solution of sulphate of iron, and precipitated gelatine, but contained no mercury.

I boiled this liquor upon a fresh quantity of oxyd; it then became clear, colourless, and contained neither tannin nor gallic acid.

One part of the oxyd of mercury was reduced; the other was mixed with concrete phosphoric acid; but nothing was sublimed from it by the action of heat.

If we use charcoal previously purified instead of red oxyd of mercury, the solution of gallic acid loses almost entirely its colour and taste: the liquor becomes green, and no longer precipitates gelatine; but it still gives to the solution of sulphate of iron a violet-blue tint. Boiled with a fresh quantity of charcoal, the liquid becomes colourless, and effects no change whatever in the solution of of gelatine and sulphate of iron. When evaporated to dryness, there remains in the capsule a brown matter that precipitates the acetate of lead of a dirty grey, and nitrate of mercury, and muriate of tin, yellow; we may therefore consider it as extractive.

These experiments demonstrate that there exists no process besides sublimation for purifying Scheele's gallic acid; unless the proportions of oxyd of tin, employed by M. Berthollet, and which he has not specified, have great influence on the result. However the method of purifying by sublimation cannot be used, if we wish the gallic acid to retain all its properties. The different characters that these acids exhibit support this assertion.

Comparison of the crystallised and sublimated Gallic Acids.

Scheele's crystallised Acid.

This acid gives to water a light lemon colour, the solution becomes deeper coloured by exposure to the air; it reddens the tincture of turnsol: lime-water turns it blue, and an excess changes it to a peach-blossom colour; if we add a few drops of nitric acid, the liquor becomes rose-coloured. The same phenomena take place with barytes.

This solution assumes a colour more or less green, with carbonate of soda; with that of ammonia the colour is unchanged. It acquires a deep brown with caustic potash; and with ammonia, a reddish brown.

With the green sulphate of iron, the colour is of a violet-blue, which is constant with this sulphate; an excess makes no alteration.

With nitrate of mercury, we obtain a yellow precipitate; it is white with acetate of lead and muriate of tin.

The

The solution of this acid exhibits no phenomenon whatever with oxygenated muriatic acid.

It forms an abundant precipitate with gelatine.

The same experiments have been made on acid obtained by M. Richter's process; the results were the same, with this single difference, that the precipitate with gelatine was trifling.

M. Deyeux's Sublimated Acid.

The solution of this acid by warm water emitted an aromatic odour, and we perceived a light oily pellicle on the surface of the liquid.

When exposed to the air it becomes brown; it slightly reddens the tincture of turnsol; lime water gives it the colour of wine lees, and an excess renders it fawn-coloured; we obtain the latter tint with barytes, and the liquor is immediately covered with an oily pellicle.

Carbonate of ammonia occasions no alteration in the acid liquor; carbonate of soda gives it a fawn colour.

Caustic potash browns it considerably, and the colour is clearer with ammonia.

If we pour into this acid liquor a few drops of a solution of sulphate of iron, we obtain a blue colour, which soon changes to a violet blue; yet very often it produces a deep green in place of the blue, which is undoubtedly owing to some peculiar circumstances. I believe that this phenomenon may be attributed to the oxygenated state of the iron; for, with muriate of iron at the *maximum*, we uniformly obtain a green. This effect is less apparent with other acids; the infusion of gall-nuts, made cold, always retains its fine blue colour.

With nitrate of mercury, the precipitate is blackish; that afforded by acetate of lead is fawn-coloured and verp light.

 The

The sulphates of zinc, copper, and muriate of tin exhibit no phenomena.

The oxygenated muriatic acid gives a brown colour to the solution of gallic acid; an excess discolours the liquor. By comparing the difference in the effects of these acids, they will be easily appreciable.

The sublimated acid is less acid; it becomes decomposed in the air; it has no action on barytes, carbonate of ammonia and muriate of tin. The precipitate obtained from it by nitrate of mercury is blackish instead of being yellow; that of acetate of lead is light and fawn-coloured, instead of being white and plentiful.

Oxygenated muriatic acid gives a brown tinge to a clear and transparent solution of the sublimated acid, whilst it causes no change in the colour of that of the crystallised acid.

In short, this acid does not give an uniform colour with sulphate of iron, neither does it precipitate gelatine.

Although it is easy to demonstrate the characters that distinguish these two acids, we cannot so readily explain whence their difference proceeds. M. Berthollet has discovered that Scheele's acid, when unpurified, contains much tannin; and when purified by oxyd of tin, it no longer precipitates the gelatine.

TO BE CONCLUDED IN OUR NEXT.

On

On the Preparation of pure Barytes. By M. ROBIQUET.

From the ANNALES DE CHIMIE.

IN a note inserted in N° 183 of these Annals, on the decomposition of acetate of barytes by means of soda, M. Darcet mentions, as a process more economical and certain than those hitherto practised for obtaining pure barytes, the decomposition of the barytic salts, and principally the muriate, by a caustic alkali. I do not think that the preference he gives this process to that most generally employed, namely, the decomposition of the nitrate by heat, is well founded. In considering the matter in an economical point of view, it may be observed, that either in one case or the other it is necessary at first to obtain a soluble salt of barytes; that in the first, the liquor employed cannot be so much concentrated as that no barytes shall remain in solution; that with whatever precaution the caustic alkali is prepared by lime, if it be only during the filtration, a portion of it is always carbonated; consequently there is a proportional deficiency in the barytes that should be obtained; besides that, as it is necessary to agitate the liquor during its precipitation, a certain quantity of it is thereby carbonated; that the washing occasions a certain loss; and, in short, that by a new solution in boiling water, it is still more carbonated. It is clear that all these losses put together will be of considerable amount; while, by the decomposition of the nitrate, the whole of the barytes it contains is completely obtained, which is nearly half the weight of the dry salt employed; besides which, this operation is neither so difficult nor so expensive when properly performed. To succeed well, the following precautions should be observed.

Fill a crucible to nearly two thirds with dry and pulverised nitrate; place it, provided with its cover, in an ordinary

ordinary furnace, and at such a gentle heat as shall only cause the salt to melt in its own water of crystallisation; increase the fire progressively and with care, as a considerable swelling of the salt takes place towards the end. When the mass, which will then be of a cherry red, ceases to bubble, cover the crucible with fuel to the depth of one or two inches; put the stone on the furnace with a sheet-iron pipe or chimney in it; after leaving it thus for a quarter of an hour, withdraw the crucible from the fire, break it, and as quick as possible put the barytes into a close-stopped bottle.

I have lately treated by this process seven pounds of nitrate, which I divided and put into three ordinary crucibles, placed in the same furnace, with about fifteen pennyworth of fuel; in two hours the decomposition was complete, and I obtained three pounds six ounces of barytes perfectly pure. But it is necessary to observe that if the barytes is kept too long in the fire after the decomposition of the nitrate, it becomes considerably carbonated, and however small the portion may be, it is totally impossible by any heat that may afterwards be applied to deprive it completely of the carbonic acid. I am therefore of opinion that it is really more economical to extract barytes from the nitrate by lead, than by means of the process proposed by M. Darcet; for even supposing the quantity of barytes obtained by each process to be equal, but which I have shewn is not the case, the price of the potash used in his method would almost double the expense of the other; as to the purity of the product, since the washings must be reduced as much as possible, I do not see that the process of M. Darcet has any advantage in this respect; for it is probable that the barytes thus obtained will retain a little of the salt contained in the liquor from which it has been precipitated; and on the

the contrary, that extracted from the nitrate is extremely pure, if, before decomposing it, the precaution has been taken of giving it a gentle calcination, and of re-dissolving it in water, in order to separate a portion of iron proceed-from the sulphate employed.

List of Patents for Inventions, &c.

(Continued from Page 160.)

JOHN DICKINSON, of the parish of Saint Martin Ludgate, in the city of London, Stationer; for a certain machine or machinery for cutting and placing paper.
Dated June 30, 1807.

WILLIAM BOUND, of Ray-street, in the parish of Saint James Clerkenwell, in the County of Middlesex, Smith and Iron Founder; for a receiver applicable to register and other stoves, by which means the cinders and ashes are with cleanliness and safety constantly retained; while the same forms an easy support to a general fire-screen.
Dated July 4, 1807.

APSLEY PELLATT, of Saint Paul's Church Yard, in the city of London, Glass Manufacturer; for his improved method for admitting light into the internal parts of ships, vessels, buildings and other places.
Dated July 7, 1807.

CHARLES GRÖLL, of Leicester Fields, in the parish of Saint Martin, in the city of Westminster, for his discovery of certain improvements on harps.
Dated July 13, 1807.

JOHN NORTON, of Rolls Buildings, Fetter-lane, in the city of London, Mathematical Instrument-maker; for his improved pump. Dated July 13, 1807.

JAMES

James Bradley, of Maid Lane, Southwark, in the county of Surrey, Iron-founder; for his new kind of iron bar to be used in fire-places, for boilers, furnaces, hot-houses, and any other fire-place where bars are used. Dated July 13, 1807.

Gordon Howden, of Oxford-street, in the County of Middlesex, Saddler; for his girth pommel, which most effectually prevents the saddle from getting forward upon any description of horses, however much nature may, in the shape of the animal, work against it.
Dated July 20, 1807.

Charles Lucas Birch, of Great Queen-street, in the parish of Saint Giles in the Fields, in the county of Middlesex, Coach-maker; for certain improvements in the construction of the roofs and upper quarters of landaus, landaulets, barouche landaus, barouches, barouchets, curricles, and other carriages, the upper parts of which are made to fall down. Dated July 21, 1807.

John Phillips, of East Stonehouse, in the county of Devon, Stone-mason and Sculptor; for his method or methods of constructing and removing offices, counting-houses and other rooms, with desks, drawing boards, and other similar conveniences, which method or methods may also be applied in the constructing and removing bridges, cottages, sentry boxes, and to other purposes or erections of a smaller or larger extent.
Dated July 28, 1807.

Joseph Astley, of Borrowstounness, in that part of the United Kingdom of Great Britain and Ireland called Scotland, Chemist; for certain improvements in the manufacture of sal-ammoniac. Dated July 28, 1807.

THE

REPERTORY

OF

ARTS, MANUFACTURES,

AND

AGRICULTURE.

No. LXIV. SECOND SERIES. Sept. 1807.

Specification of the Patent granted to ANTHONY FRANCIS BERTE, *of the Parish of St. Dunstan in the West, in the City of London, Merchant; for Improvements in casting Printers' Types and Sorts, and other Articles of Metal. Communicated to him by a Foreigner residing abroad.*

Dated April 15, 1807.

TO all to whom these presents shall come, &c. Now KNOW YE, that, in compliance with the said proviso, I the said Anthony Francis Berte do hereby declare, that the said invention is described in manner following: that is to say: I do construct a vessel of iron, or other fit material for containing type-metal in the fused state, or for bringing it into fusion and keeping it at the proper heat for casting; and I do make in the side or sides of the said vessel, one or more apertures, out of which the fluid type-metal is caused or permitted to flow at the time of casting. The operation of casting is performed by applying a mould for casting letters or types, either singly or more than one at the same time, or other articles for Printers' use, unto one of the said apertures, which at that instant, by means of a cock or valve, or any other well known similar contrivance, is opened; in consequence of which the metal suddenly flows, or is driven into the mould, and applies itself to the matrix or matrixes with a force which is greater or less according to the height of the level surface of the type-metal in the vessel first before mentioned, or according to the magnitude of such an additional pressure as may be applied in the manner, or by the means hereinafter to be described.

And I do farther declare, that though the said aperture or apertures, may be made on any side of the vessel, that is to say, at top or bottom, or elsewhere, yet I do give the preference to a surface or face which shall be nearly horizontal, so that the fluid metal shall spout upwards into the mould; and I do prefer, as the most simple and easy method, that each aperture shall be kept closed, when required so to be done, by a plate of metal lying upon the said horizontal surface, and well fitted thereto. And that I do make and fashion the lower part of my mould flat and true, in order that the same may be applied in like manner, and slided along upon the said horizontal surface. And that I do slide the said mould by pushing the same against the said flat plate, until the plate shall become displaced, and the aperture of the mould shall become directly opposite the aperture in the vessel, and shall accordingly receive its charge of metal; after which the mould being again drawn back, the plate of metal by means of a weight, or spring, or other well known agent, suitable to the purpose, is made to follow the mould, and close the aperture by resuming its first situation: and in order that the said motions and effects may be performed and produced without any particular

skill

skill or attention in the workman, I do make and apply such guides, sliders, stops or pins, for confining, directing and limiting the said motions, as will be sufficiently obvious and intelligible as to their construction to artists employed in works of that nature: but that in such other construction of the apparatus herein before described as may not require or admit of the said sliding plate for closing and opening the said aperture, I do apply my mould unto the said aperture, either by sliding the same to its place, as aforesaid, or by any other method of opposition: and moreover, in order that the said fluid metal may rise with sufficient force into the mould, I do in general (except as herein after mentioned) make my vessel of such a figure, as that the quantity of type-metal intended to be contained therein at any one time shall have its upper surface sufficiently high above the level of the aperture or apertures before mentioned. And that I do in preference, for the said purposes herein before mentioned, form my vessel of the figure of a box or closed receptacle, having a pipe or tube rising out of the same, so that the pressure afforded by the statical action of the metal in the said pipe or tube shall produce the desired effect at the aperture or place of casting; or otherwise I produce, or increase the said pressure in such vessel, by the statical action of water, or any other fluids which may be used, (by the well known means to compress a body of air), against the surface of the type-metal, for the purposes aforesaid.

And I do farther declare, that one other of my improvements in casting, as aforesaid, doth consist in making the said vessel in which the metal is to be kept in a melted state ready for use, close on all sides, except at the aperture or place out of which it is intended that the said metal shall flow, and also at another larger aperture, terminating upwards in a tube, pipe, or prismatic cavity, into which I fit a metallic plug or piston, sufficiently well fitted to move up and down with facility therein, without suffering any metal to issue out between the parts in their relative motion. And I do make use of the said plug or piston to produce the extrusion of the melted metal, through the aperture before described, into the mould, when applied thereto; for which purpose I do give a stroke, or apply a suitable pressure to the said plug or piston; or I do permit the said plug or piston to descend by its own weight in the said tube, pipe or prismatic cavity, so as to strike the surface of the melted metal, and impel the same into the mould. And in every case or construction wherein the said plug or piston shall be applied and used, it will not be needful or proper to close the aperture to which the mould is to be applied as aforesaid by a cock, valve, plate or other contrivance; but, instead thereof, I do so regulate the quantity of my metal, or the position of the parts of my apparatus, that the surface of the fused metal shall be accurately, or very nearly, at the upper part or opening of the said aperture beneath the mould: and the said machines, consisting of vessels so fitted up, together with the moulds, and other parts respectively as before described, may be used by one or more workmen to cast letters and sorts, at the same time, from the same mass of metal; but in case different metallic mixtures should be required to be used, or in case local circumstances should render it needful that the workmen should be considerably distant from each other, recourse must then be had to a number of distinct and separate machines of my said invention. And I farther declare that one other of my improvements in casting as aforesaid doth consist in making the body of the mould (in which the letter or

types

types are to be cast) of four adjustable pieces instead of two, as hath heretofore been done; each of which said four pieces hath two external plain faces inclined to each other in the precise angle of a square or right angle, so that all the four convex pieces, when put together with their angular edges in the same line, will fit, and leave no cavity; but, when the several pieces are slided upon each other face to face at right angles to the middle line, or edges upon every one of the touching faces, a square or rectangular cavity will be left, which, instead of being adjustable in one direction only, can be made of any required dimensions so as to admit of changes in the width as well as the thickness of the body of the letter; and when the desired adjustment hath been made, the plates may be fastened together in pairs, and used like the common moulds. And farther I do, when required, make my moulds without nicks or notches, or such parts as shall produce nicks or notches, in the shank of the letter; and I do strike out or expel the cast letter from the mould, by a punch, or proper tool, without opening the mould, as is usually done.

And I do farther declare, that moulds so improved as herein before described may be used along with any other improvements in casting, which are herein before described and specified, as the said improved moulds may be used and applied for casting in the common way.

In witness whereof, &c.

Specification

Specification of the Patent granted to RALPH WEDGWOOD, *of Charles-street, Hampstead Road, in the Parish of St. Pancras, in the County of Middlesex, Gentleman; for an Apparatus for producing Duplicates of Writings.*

Dated October 7, 1806.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Ralph Wedgwood do hereby declare, that the nature of my said invention, and in what manner the same is to be performed, is as follows.

In writing by this mode, I make use of a prepared paper which I call duplicate paper. This is made by thinly smearing over any kind of thin paper with any kind of oil, preferring those kinds of oil which are least liable to oxygenizement, or to be evaporated by heat.

The ink made use of in this mode of writing consists of carbon, or any other colouring substance, and finely levigated in any kind of oil. This ink is to be evenly spread on leaves of thin paper or any other thin substance, after which it should remain for five or six weeks, or any shorter period, betwixt sheets of absorbent or blotting paper, after which it is fit for use; this I call carbonated paper: or any colouring matter of any kind, and in any other medium or vehicle, may be used, provided that medium be such as will admit of the colouring matter being transferred to the duplicate and writing paper. Some colouring substances may likewise be used without any medium or vehicle.

The pens or styles used are made of agate, ground and polished to a smooth round point. These are set in metal sockets, or sockets of any other substance; any hard substance may be substituted for the agate.

To

To write singly in this mode, I lay a leaf of this carbonated paper upon a smooth tablet of metal or any other smooth substance; and over that I lay a leaf of duplicate paper: upon these I write with the style, the pressure used causing a transfer of the carbon to be made upon the under side of the duplicate paper, which being transparent, instantly appears through as if written upon the paper.

To write double, I lay first a leaf of writing paper upon the tablet, second a leaf of carbonated paper upon that, third, upon both, a leaf of duplicate paper, and upon the papers so disposed I write with the style. The effect produced is a double transfer of the carbon from the carbonated paper, that on the lower surface thereof to the letter-paper beneath it, and that from the upper surface thereof to the under surface of the duplicate paper above it: if desired, the tablet may be left out; yet the impression is always much stronger with it. Duplicates may also be formed, by substituting any thin paper for the duplicate paper, and writing thereon with any hard substance which will leave a trace behind it, or by using such papers as admit of a ready absorption of the colouring matter beneath.

To make a further increase of writings from an original one, I use a set of types and a type tablet; and for shortening the hand-writing the types can be reduced to one figure, namely, a point; but more figures may be used if seen convenient. These convey the idea of any letter by the position in which they may be placed in a square or other formed figure, printed or otherwise marked on the writing paper, which square I call the basis of the letters, and the paper character-paper. The precise shape and size thereof is not of importance, but may be varied at pleasure.

The

The types consist of small tubes of metal, or any other material, round or any other shape; and on that end which is to give the form of the letters may be either a round point, or any other simple mark or marks, as may be thought most convenient. The types are of the same thickness from end to end or otherwise, as it is found most convenient.

The type tablet consists of a piece of flat metal or any other material, and of any dimensions, perforated with holes or sockets to fit the types; on the top of the type tablet is engraved, or otherwise marked, squares corresponding with those upon the character-paper on which it is intended to write or print. To prevent the accidental shifting of the types in their sockets, they are rubbed with a little bees-wax softened with oil or any concrete fatty substance. To prevent the types passing through the sockets of the type tablet in the act of writing, there is a plate of metal or any other hard substance of equal size of the type tablet fixed at the bottom of it, so that it will admit of the types being pressed to any given distance through the sockets of the type tablet found most convenient, at which place they are thereby stopped.

In order to fix the types previous to taking off impressions, melted lead or any other substance may be run into the tops of those sockets which are vacated by the depression of the types which have been used for the composition of any work. The lead uniting the whole, this I call a stereo-typed tablet. This stereo-typed tablet may be used the same as any other type in the common mode of printing, and with a common press; observing always, in printing, to place the character paper, so that the squares thereof and those of the type tablet shall perfectly correspond, and meet line for line when pressed upon each other.

Or,

Or, leaves of thin character-paper and carbonated paper may be laid alternately upon each other, and upon this the stereo-typed tablet is pressed in any manner found most convenient; by this means with a single pressure a multiplicity of impressions are formed at once.

To write with the new characters, I take one, two, or even six layers of duplicate paper, on which is stamped or printed the basis of the letters; betwixt every two leaves I lay a leaf of carbonated paper, and over all I lay the type tablet, each square of which must be exactly over the squares or figures in the character-paper so arranged, and when thus laid, with the point of metal or other hard pointed style, I press down each type which I may require to form a word, from which act six copies are produced on the papers underneath; and when the types are fixed as before directed with lead, a stereo-typed tablet is formed, from which other impressions may be printed in any quantity.

After melting out the lead, the types may be all replaced in their respective sockets, by gently pressing on their points a metal or wooden tablet which will cover the whole of them at once. The type tablet is then ready for the composition of a second page of any work to be printed therewith. In witness whereof, &c.

Observations by the Patentee.

This invention combines the advantages of making several fac-similes of writings or drawings at the same time by a single pen or style, which requires no repair, and with ink which is proof against those chemical agents which destroy common ink.

Independent of copying, this machinery saves time, is perfectly simple, and adapted for all climates. It may go in the pocket, and in that form weighs only three ounces.

Specification of the Patent granted to RICHARD LORENTZ, *late of Great Portland-street, in the County of Middlesex, but now of Brook Green, near Hammersmith, in the said County, Esquire; for certain Inventions (communicated to him by Foreigners residing abroad) of different Machines or Instruments, one of which will produce instantaneous Light, and the other instantaneous Fire.*

Dated February 5, 1807.

With a Plate.

TO all to whom these presents shall come, &c. Now KNOW YE, that I the said Richard Lorentz, in compliance with the said proviso, do hereby declare that the nature of my said inventions, and the manner in which the same are to be performed, are particularly described as followeth; that is to say:

In the drawings hereunto annexed (Plate X.), Figs. 1 and 2 represent front and side views of my said machine or instrument for producing instantaneous light; and Fig. 3 exhibits a vertical section or view of the inside of the said machine; and Fig. 4 exhibits the same internal parts seen from above; and Fig. 5 shews the shaded plan of an electrophore, being part of the said machine; and Fig. 6 shews a tube of communication for inflammable air or hydrogen gas, being also part of the same; and in all the said drawings or figures, the dimensions are laid down from one and the same scale (which may nevertheless be varied, if thought fit), and the same parts are every where denoted by the same letters of the alphabet.

And farther, as to Figures 7 and 8, the said Fig. 7 represents my said machine or instrument for producing instantaneous fire; and Fig. 8 is a section thereof, in which the structure of the interior parts is manifest.

The outline A A A E C D F B, Fig. 3, represents a vessel, box or receptacle of tin or other fit metal or materia.

material open at top A B, but having the lower part, amounting to nearly half its capacity, closed by a plate or partition E F, except with regard to a fixed tube or pipe K, communicating from the upper part of the said inclosed space, and with regard to another fixed tube or pipe F D, communicating with lower part of said inclosed space, and used for the purpose of admitting a moveable pipe H I I. In the upper or open compartment of the said vessel, box or receptacle, I place a vessel or bottle G, in which hydrogen is to be developed or produced, and conducted from thence through the tube H I I, which for that purpose is provided with a perforated stopped piece at H, (see Figures 4 and 6,) into the lower compartment at D, Fig. 3, through a side hole in the fixed tube or pipe F D. L represents a cock turned by the handle or axis V, for conveying the hydrogen through a small nozzle or adjutage M, to a candle or other combustible matter at N. T T is the resinous plate of an electrophore, placed in a drawer or cell well secured from humidity or dust which might come from the external air or otherwise ; Q Q is the metallic plate thereof (see also Fig. 5) which can be raised or depressed by a wire at P, while its due positions are regulated and governed by the insulating arm R, moveable on the joint or axis S. At O the upper end of the wire P O is hooked upon or fixed to an insulated knob of metal at the extremity of an arm proceeding from the axis of the cock L, so that, when O is sufficiently raised, the knob is stopped by M, to which it previously gives the electric spark.

The operation or effect of my said machine or instrument may be easily understood from the structure and position of the said parts thereof. I pour water into the upper compartment nearly to fullness, or as required, the cock L being shut, and in these circumstances very little of the water can descend into the lower compartment through F D, because the elasticity of the common air naturally included in the said last-mentioned compartment opposes its introduction. I then take off the adjutage M, and open the cock L, in consequence of which the included air escapes through K, while the water descends through F D, and fills the lower compartment. In the next place I put zinc and diluted muriatic acid, or such other well known and fit materials as will afford hydrogen, into the vessel G, and after a short time I apply the tube H I I in its place, and the hydrogen descends through the said tube, and fills the lower compartment more or less, while a correspondent bulk of water is forced up the interstice of the tube F D into the upper compartment, where, by the action of its gravity, it compresses the hydrogen and gives it a tendency to escape with considerable velocity through K L M, whenever the cock shall or may be opened. In this state, after the electrophore hath been excited, the machine or instrument will be ready for use; and whenever by means of a handle or arm or other communication put on or applied at V the cock is opened, a stream of hydrogen gas rushes forth, and strikes the wick of the candle, but nearly at the same instant the electric spark from O sets fire to the said gas, and converts it into a jet of flame which lights the candle; and the same effect may be repeatedly and for many weeks produced by one charge and excitement of the said machine or instrument, in the manner hereinbefore described.

Fig. 8 shews the construction of my machine or instrument for producing instantaneous fire. *a* represents the cap or head of a staff or stick, having therein a cavity or space for containing the prepared fungus known by the

name

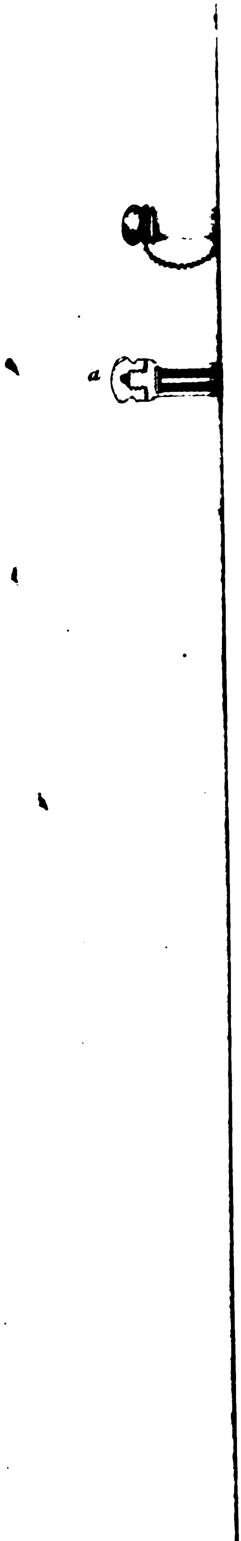


Fig. 4.

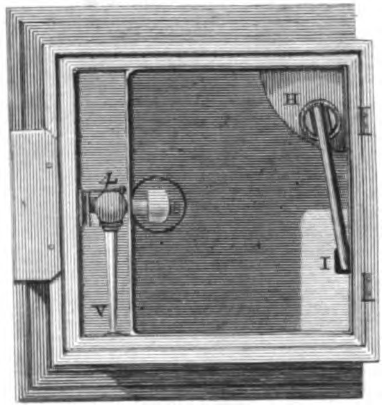
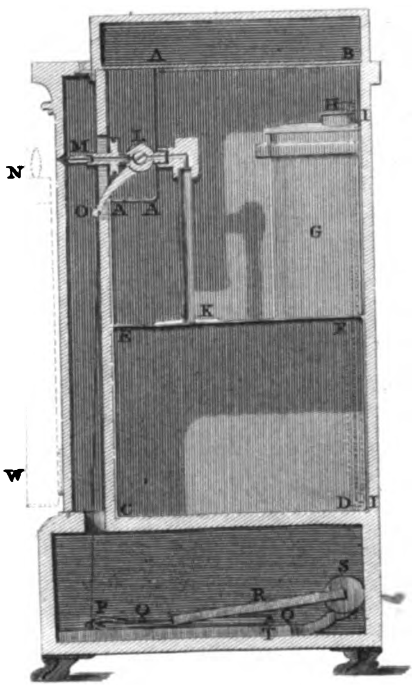


Fig. 3.



name of German tinder, or for containing common tinder of rags or any other very combustible substance. *c* is the outer end of the rod of a syringe, which works by a piston in the upper part of the staff, and by a stroke of about twelve inches forces the common air with great velocity, and in an highly condensed state, through a small aperture against the combustible matter included in the head *a*, which is well screwed on against a shoulder or face, armed with a collar of leathers; *b* is the hole for admitting common air when the piston is drawn quite back. The manner of working consists simply in pressing the end of the rod of the charged syringe strongly against the ground, so as to drive the air suddenly on the tinder; and the cap *a* being without loss of time unscrewed, the tinder is found to be on fire

In witness whereof, &c.

Specification of the Patent granted to James Peache, *of Cuper's Bridge, Lambeth, in the County of Surrey; for a floating hollow Buoy on a new Construction, for supporting Mooring Chains, Cables, Ropes, &c.*

Dated April 8, 1807.

To all to whom these presents shall come, &c. Now know ye, that, in compliance with the said proviso, I the said James Peache do hereby declare that my said invention, and the manner in which the same is to be carried into effect and practice, are described as followeth; that is to say: I construct my said buoy out of pieces of wood longitudinally applied to each other, after the manner of staves; but, instead of making the joints to consist of flat surfaces evenly or squarely applied to or against each other, I do rabbit the same together by making the half thickness of each piece to overlap the other;

other; and I do tar the faces which are to be applied to each other; and upon one of the said faces I do apply a thin covering of beaten hair, such as is used by plasterers, or of wool or flax, or any other fibrous matter; and upon the said hair, wool, flax, or other fibrous matter, I apply or smear in the hot and melted state a coat of a mixture of pitch and tar; and immediately thereafter I do put the said joints together, and secure the same by nails or screws, or pins, or pegs, or bolts, and by hoops suitably enveloping the whole. And, farther, I do put in the heads of my said buoy by rabbiting the same in and with the staves or side pieces thereof; and I do make good the fitting by several steps or successive faces in the joint, between which I apply tar and hair, wool, flax, or other fibrous matter, and pitch in the manner already described; and, for greater security, I do in some cases put in and fix two or more additional heads within the external heads. And, farther, I do, in constructing and making my said buoy, place and fix therein a trunk or tube, or perforated piece, so that the same shall not occasion or allow the water to enter the said buoy without; but that a passage or opening shall nevertheless remain, through which the chain, or rope, or cable used for mooring, shall and may be passed, and remain and continue to be moveable therein, in the same manner as is done with regard to the small and imperfect buoys which are made out of single and solid pieces of wood. And I do make and put together, and fix, the said trunk, tube or perforated piece, by rabbited joints put together and secured as aforesaid, as well with regard to the parts thereof, as with regard to the places at which the said trunk, tube, or perforated piece may be applied to, and connected with, the parts of the said buoy. And, moreover, I do place and fix the said trunk, tube or perforated

rated

rated piece, in any convenient direction, position or situation within the said buoy; and in some cases, wherein the same may be found convenient or useful, I do place and fix as aforesaid two or more such trunks, tubes or perforated pieces within the said buoy, instead of a single one. And, lastly, I do declare that my said buoy may be made, framed and put together, of any convenient and suitable figure; but that, in general, the cylindrical or prismical, or conical pyramidal figures, are to be preferred; and that, when the cross section of the figure is not circular, the number of sides which in practice I do prefer is eight.

In witness whereof, &c.

Specification of the Patent granted to JOHN ROEBUCK, *of Warren-street, in the Parish of St. Pancras, in the County of Middlesex, Civil Engineer, for certain Improvements in a Machine called the* Caledonian Balance.

Dated May 14, 1807.

With an Engraving.

TO all to whom these presents shall come, &c. Now KNOW YE, that in compliance with the said proviso, I the said John Roebuck do hereby declare, that the nature of my said invention, and the manner in which the same is to be carried into effect and practice, are described in the following manner; that is to say: The Caledonian balance or instrument itself, upon and wherein my said improvements are made, doth consist of the following parts, which are represented and connected in the annexed drawing or section, (see Fig. 1, Plate XI.) namely: First, a base or platform M N, upon which a column or pillar C doth stand, and is fixed for the purpose

pose of supporting the fulcrum of an equibrachial beam or balance A B, and upon which said base or platform two other columns or pillars D do stand, and are fixed for the purpose of supporting an horizontal cross axis, having at each of its extremities an arm D E, of the same length as another arm D F, proceeding from the middle of the said cross axis, and connected with A, by a wire or rod, which leaves full liberty of action or play in the said axis at D, and fulcrum at C. And secondly, a triangular piece or moveable platform O P, suspended or supported by three wires, which are hooked into loops or eyes in O P, and do hang freely from the extremity B of the lever or balance A B, and from the two extremities E of the arms which proceed from the ends of the cross axis supported by the columns D. And thirdly, a table or upper platform I K secured, framed, fixed and supported upon, with, into and by the triangular platform O P, by means of columns Q and R, or otherwise. And fourthly, an arm D S proceeding from the middle of the cross axis supported at D, which said arm, being divided, may be depressed or acted upon by a weight G, in the same manner as the arm of the common steel-yard.

And the manner in which the said Caledonian balance doth produce its effect as follows: When any weight L is laid upon the table, the pressure thereof is communicated to the platform O P, which acting upon the points B and E E, tends to depress B, and to suffer A to rise, in such a manner, that the table will (if it be moved at all) rise without any tilt or totter, or side motion, and will constantly remain parallel to its first situation. And at the same time the extremity S of the steel-yard lever will tend to rise, and the motions here mentioned will actually take place, unless a re-action, such as that of the weight

weight G, be applied to prevent it; but the weights G and L will be in equilibrio if their quantities be respectively as the lengths E D and D G. And hence it follows, that a small weight may in this instrument be made to indicate the quantity of a larger; and conversely a large weight will make the quantity of a smaller, if the same be placed or applied upon or unto the said table I K, and lever D S; the reasons of which are too familiar to mechanical men to be requisite to be here given. And I do farther declare, that I have hereinbefore described the said instrument or Caledonian balance, in order that my said improvements may be more clearly understood; and also, that my said improvements are as follows: First, I do place and fix a weight or load H beneath the cross axis near the middle thereof, by means of which I render the tendency to equilibrium in the horizontal position more smart, speedy, and effectual, and I obtain an indication of the precise result more conveniently, readily and accurately, than could otherwise have been had. Secondly, I do in some constructions, and for purposes in which the same may be preferred, reject the arm D S, and apply a spring beneath F, which, by acting downwards, doth by means of a graduation afford an indication of the load upon I K, without requiring any weight, such as G, at all. Or, thirdly, instead of D S and the weight G, I do place my weight H by an arm forming a greater angle with D E than a right angle or ninety degrees, by means of which, upon the principle of the bended lever, the re-action will be greater the lower the table descends; and there will be positions of equilibrium for different weights afforded by the descent of the said table and the rise of H, which I do severally indicate by graduations on a circular arc formed by experiment, or by any other well known and fit method. Or, fourthly,

 instead

instead of D S and the weight G, I do hang a scale at F or G, or elsewhere, and weigh by a set of weights as usual. Or, fifthly, I do reverse the position of the cross axis and arms supported by D, so that D and E shall be farther out towards the letter S than the letter F is; and I do enlarge or continue the moveable platform P O, so as to reach the supporting wires from E; and I do carry the arm D S in the direction beneath the table contrary to that represented in the drawing, by which means the apparatus becomes more compact, and the weighing may be performed by any of the methods hereinbefore specified and described, as being applicable to the apparatus as its first mentioned positions or constructions of the parts thereof.

In witness whereof, &c.

Account of the Second Voyage of the Ship Economy, built on Mr. J. W. Boswell's *Patent Construction.*

Communicated to the Editors by the Patentee.

Gentlemen,

The performance of a ship built on principles so different from the common method as the ship Economy, (which is described in your fourth volume of the second series, page 430,) is in effect the continuation of an experiment on a subject of the Arts, of the greatest importance to a commercial nation; and therefore I hope you will think the account of her second voyage a proper communication for your very useful work, which I have received from her last commander, Captain W. Ross, and enclose to you.

The only objection which has been made to the construction is, that the diagonal braces of the transverse frames

frames interrupt the stowage of long hogsheads or packages; and as they were chiefly put in as substitutes for hanging knees, it must be obvious to any one, that they may be removed without detriment to the strength of the vessel, by placing an adequate number of hanging knees instead of them under the beams.

It would take up too great a portion of your publication to enter on this subject more particularly at present; but, with your permission, I will prepare for an ensuing number, a description of what seems to me the best method of making this alteration in the plan; and also of a method of laying the decks proper for a vessel of war, both within the limits of my specification, inserted in your second volume of the new series, page 81.

I have only to add to the account given of the ship by Captain Ross, that since her return I have minutely inspected the state of her internal framing, and find, notwithstanding the severe weather she has experienced, that no part has in the least given way, and that every joint is as close and firm as when she was first launched. She may be seen in the outward-bound West India dock, or its vicinity in the river, till she sails on her third voyage in October or November next.

I am, Gentlemen,

Your very humble servant,

JOHN WHITLEY BOSWELL.

Letter from Captain Ross *to Mr.* Boswell.

Dear Sir, *London, August* 5, 1807.

I have to inform you of my arrival from Demerara in the ship Economy, built according to your patent. We had several heavy gales while in the Downs, in November and December last, and also several gales on the voyage out and home; and I have pleasure in stating, that the Economy rides extremely easy at anchor, and performs every thing I expected under sail. She is a good sea-boat, and remarkably tight, and when clean, sails equal to coppered ships in general, although only wood-sheathed; and I have never seen cargoes delivered in such good order as both the outward and homeward cargoes were. A great many gentlemen have seen the Economy both here and at Demerara, and all approve of the plan in point of strength, which must be obvious to every one at first sight. I shall therefore only state such advantages of this plan as occur to me in point of stowage and bearing a cargo.

First. A ship built on your plan for the West India trade, of about 350 tons register, with the transverse frames placed at the distance of four lengths of sugar hogsheads, will only lose in stowage the thickness of the diagonal stantions (say eight inches) in every four layers throughout the whole length of the ship; which is less than would be lost by midship-stantions, hanging knees, &c. in a ship built in the common way.

Secondly. The flooring being laid athwartships over the keelson and fore and aft ribs, renders the use of dunnage unnecessary; and in case of the ship springing a leak, or the timbers being choaked, the water will have a free passage to the pumps over the floor-timbers, without any risk of damaging the ground tier.

Thirdly. There being a clear space for four longers in each room, without any interruption from the keelson or midship stantions, a ship may round or fill up with any number of casks, according to the size, which I have experienced to be a great advantage; and the ground tier may be screwed home, without any risk of losing longer, by which means they will the better

sustain

sustain the weight of the two upper tiers, and will be delivered in as good condition as any other part of the cargo.

Fourthly. In case of a ship having to deliver an outward cargo at different ports, this plan affords a great facility in stowing different plantation stores in separate rooms; and from the great strength of the ship fore and aft ways, any room may be cleared without any risk of hurting the ship, which is not the case in ships built in the common way. The great strength I allude to is derived from the fore and aft ribs which run the whole length of the ship, and also the manner of laying the decks with strong pieces, which are placed under the comings of the hatches fore and aft the whole length of the ship, and act like a string to a bow. Upon the whole, I highly approve of the plan, and hope it will meet with the attention which in my opinion it deserves; and I remain, most respectfully,

Dear Sir,

Your most obedient servant,

WILLIAM ROSS.

Improvements in printing Paper-Hangings.

By Mr. JOHN MIDDLETON, *of St. Martin's-lane.*

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

The honorary Silver Medal was voted to Mr. MIDDLETON *for this Communication.*

Method of printing Light Grounds.

Fig. 2, (Plate XI.) A, the printer's table, covered with a soft blanket. B, the woollen-cloth sieve, on which the colour is laid and spread by a boy (called the tere-boy) with

with a hair-brush. This cloth sieve is laid upon a leather sieve impervious to wet, and it floats upon some gum-liquor, in a wooden vessel C.

D, D, two cords, 36 feet long, stretched from the table A to the other end of the room, and kept tight by a weight at E.

F, F, an endless cord, passing round a grooved wheel G, under the table, over a pulley H, in the side of the table, and over another I, at the other end of the room. Its use is to carry the cross-piece K, called the traverse, which is fastened to it.

L, a wheel fixed on the same axis as the wheel G, but on the outside of the boarding of the table; it has three pegs projecting about four inches from its face. This wheel is moved by the printer setting his foot on one of the pegs.

Fig. 3 is the traverse on a larger scale. M, M, are two pieces of wood connected by a hinge at N, and when closed are retained in that position by a ring O, put over the ends of them: it is connected with the endless cord by a staple P on one side, and another staple on the other side, and slides along the cords D, D, by means of two pulleys R, R.

The operation of printing commences by putting one end of the paper to be printed (which is 12 yards long and 23 inches wide) between the divisions of the traverse (Fig. 3), and fastening it there by the ring O. The other part of the paper, except what lies on the printing-table, is wound round the roller S. The workman takes up the printing-block with his right hand, dips the face of it on the woollen cloth in the sieve, which the tere-boy had previously spread with colour, and then places the block upon the paper to be printed, giving it two or three smart strokes with a leaden mall held in his left hand; he then removes

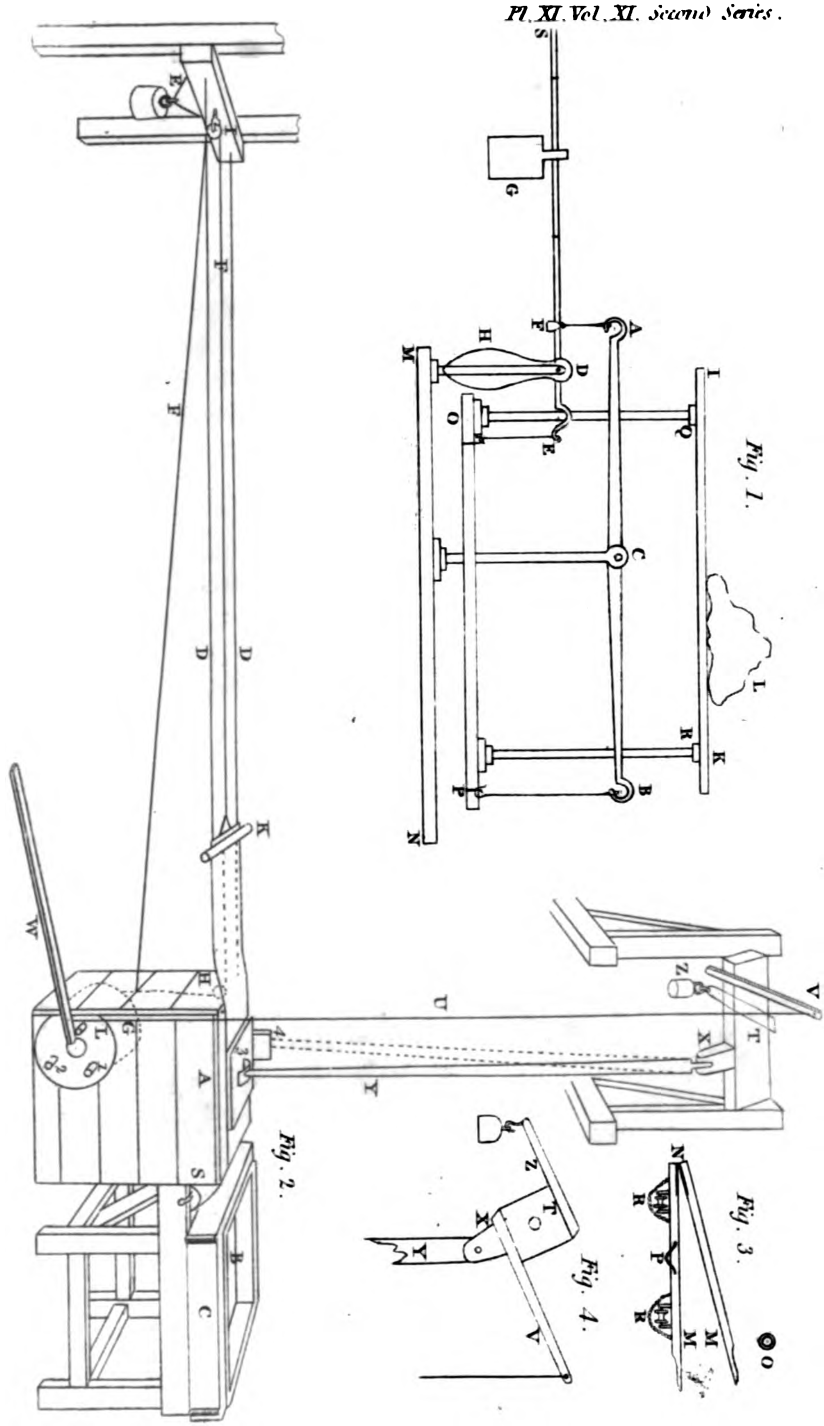


Fig. 1.
Fig. 2.
Fig. 3.
Fig. 4.

removes the block to supply it with more colour from the sieve; and during this operation sets his left foot upon the peg in the wheel; and, as he recovers his upright position to bring the block over the table, his foot presses the peg down into the position 2, which, by means of the wheel G, endless cord F, and traverse K, draws the paper forward on the table just the proper distance to print again. When the whole piece is printed, the tere-boy goes to the end of the room, loosens the paper from the traverse, and hangs it up to dry in folds on loose sticks placed across racks attached to the cieling.

Method of printing Dark Grounds.

The table and sieve for the colour are the same as in printing light grounds. The difference of printing consists in applying the colour from the block upon the table by means of a lever, instead of striking the block with a mall; the pressure of the lever forcing a greater quantity of colour upon the paper, and in a more even manner.

T, the axle of the lever. Y, the arm (15 inches long) to which the power is applied by means of a rope U, fastened to it, which has a treadle W at its end, for the workman to place his foot upon. X, another arm (six inches long), to which is jointed Y, a long pole, whose end is applied to the back of the block 3 when the pressure is given.

Z, an arm on the other side of the axle T, to which a weight is hung to balance the pole Y.

Fig. 4 shews a section of the axle T, with the arms V and Z projecting from it, and the manner in which the arm X is connected by a joint with the pole Y; the excellence of this principle depends upon the very great increase of power which is given by bringing the pole nearer the centre of the joint or axis.

The

The paper being placed upon the table as in printing light grounds, and the workman having placed his block, furnished with colour, upon the paper to be printed, he puts his foot on the treadle W, attached to the cord U, takes the pole from behind the piece of wood 4, and applies its end upon the block U, and pressing down his foot, makes the impression from the block upon the paper. He then lodges the pole behind the piece of wood 4, to be out of the way; he next removes the block to furnish it again with colour, and draws the paper forward for another impression by the foot-wheel L, as described in the former mode.

On the Cultivation of the Crambe Maritima of Linné, *or Sea Kale. By Mr.* John Maher, *F. H. S.*

From the Transactions of the Horticultural Society of London.

If the man who makes two blades of grass grow where only one grew before, is to be esteemed an important benefactor to his country; he who teaches us how to improve a palatable and nutritious vegetable, hitherto often neglected, upon the barren cliffs of our sea-girt isle, has surely no small claims to our gratitude: as such, I must ever regard those of the late Mr. Curtis, from whose pamphlet upon the *Crambe Maritima*, or *Sea Kale*, I first learnt how to grow this early esculent; but as his useful directions are yet in the hands of comparatively few of my brother gardeners, and as the young shoots have been obtained at Edmonton, of a size and delicacy greatly superior to what generally appears at the table, I venture to offer a particular account of the method of cultivating it there to the Horticultural Society: for the botanical

botanical description prefixed, I am indebted to our Secretary.

CRAMBE.

Ordo Naturalis.

Cruciferæ. *Juss. Gen.* p. 242.

Sect. II. Fructus brevis, siliculosus.

Calyx incurvo-patulus. Petala breviter unguiculata, ampla. Filamenta longiora bifurca apice altero antherifero. Torus inter eadem biglandulosus. Stigma sessile. Pericarpium carnosum, subglobosum, monospermum, clausum, deciduum. *Plantæ maritimæ, facie* Brassicarum. *Folia glauca, magna, plus minus, sinuata. Flores albidi, paniculâ densiusculâ ramsiossimâ.*

C. *(maritima)* caule foliisque inermibus: petalis late obcordatis.

C. maritima. *Smith in Engl. Bot.* n. 924, *cum Ic* optimâ. C. maritima. *Curt. Monogr. cum Ic.* bonâ. C. maritima. *Mill. Gard. Dict. ed. à Martyn.* n. 1. C. maritima. *With. Arr. ed.* 4. p. 563. C. maritima. *Bryant Fl. Diæt.* p. 124. C. maritima. *Fl. Dan.* t. 316. C. maritima, *Linn. Sp. Pl. ed.* 2. p. 437. C. maritima. *Mill. Gard. Dict. ed.* 1. p. 1. C. maritima. &c. *Raii Syn.* p. 307.

Brassica maritima. *C. Bauh. Pin.* p. 112.

Brassica marina monospermos. *Park Th.* p. 270.

Brassica marina Anglica. *Ger. emac.* p. 315. f. 15.

Brassica marina sylvestris. *Ger. Herb.* p. 248. f. 16.

Brassica Dobrica, *Turn. Herb.* p. 90.

Brassica marina sylvestris multiflora monospermos. *Lob. Adv. nov.* p. 93.

Sea Kale, *Anglis.*

Sponte nascitur in Ins. *Great Britain* littoribus abunde, solo præcipue argillaceo et lapidoso.

Floret *Maio, Junio.*

The

The particular places on record where this plant grows wild, are below Maryport; also between Ravenglass and Bootle, in Cumberland; at Roosebeck, in Low Furness, Lancashire; near Conway, plentifully, but in the most inaccessible rocks; promontory of Llyn, and near Cruccaeth, in Carnarvonshire; between Rhuddgaer and Llandwyn, in the Isle of Anglesea; about Port Inon, in Glamorganshire; near Megavissey, in Cornwall; marly cliffs, near Teignmouth, and Sidmouth, in Devonshire; on Chesil Bank, chalk cliffs at Weymouth, Lulworth Cove, and about Poole, in Dorsetshire; at Western Court, in Hampshire; near Worthing and Shoreham, cliffs at Beachy Head, and near Hastings, in Sussex: between Folkstone and Dover; at St. Margaret's and Langdon Bays, between Whitstable and the Isle of Thanet, at Lidde, in Kent; near Harwich, in Essex; on the North coast of Norfolk, abundantly; near Fast-castle, Berwickshire. According to Dr. Smith, sandy shores are its natural soil, but by what I can learn from others, as well as my own personal observation, it prefers loamy cliffs, mixed with gravel. I found it near Dover, also in Sussex, in stiff loam: to the extensive beach of pure sand, both above and below Scarborough, in Yorkshire, it is, I believe, quite a stranger.

The whole plant is smooth, of a beautiful glaucous hue, covered with a very fine meal; occasionally, however, it varies like the wallflower-leaved ten-weeks stock, with quite green leaves. Root dark brown, perennial, running deep into the ground, divided into numerous wide-spreading branches, but not creeping *. Radical leaves

* Root not creeping, in the proper sense of that word, as Parkinson, Miller and Bryant have described it; but if the branches be divided into a number of pieces, each piece will grow if committed to the

leaves very large, and spreading wide upon the ground, waved, more or less sinuated and indented, containing a bud, or rudiment of the next year's stem at the bottom of the leafstalk, dying away in the autumn *. Stems several, from one foot and a half to two feet high, erect, branching alternately, and terminating in large panicles of spiked flowers, which smell somewhat like honey. Peduncles, as the fruit swells, considerably elongated. Calyx often tinged with purple, its leaflets nearly equal. Petals cream-coloured, with purple claws, larger than in many genera of this natural order. Filaments purple. Anthers pale yellow. Glands of the receptacle between the longer filaments yellowish green. Stigma pale yellow. Pouch, as the accurate Mr. Woodward describes it in Withering's work, at first egg-shaped, afterwards nearly globular, fleshy, falling off when ripe, about August, with the seed in it, which is large, and of a pale brown colour.

The *Crambe Maritima* was known, and sent from this kingdom to the continent more than two hundred years ago, by L'Obel and Turner †; but our immortal countryman,

the earth; and as it is impossible to dig among the widely-extended roots of these plants without cutting many of them, and leaving a number of fragments, plants arise from such around the original, and give to it the appearance of having creeping roots. CURT.

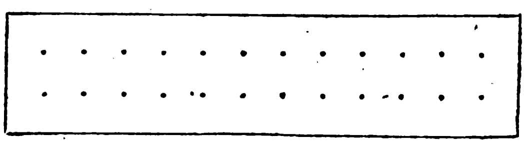
* Parkinson perhaps never committed a more egregious blunder, than in the account he has given of this part of the plant's economy; "The root is somewhat great, keeping the green leaves all the winter." Bryant, in his Fl. Diæt. misled, perhaps, by this account, says, "The radical leaves, being green all the winter," are cut by the inhabitants where the plant grows, and boiled as cabbage. CURT.

† It would be difficult to ascertain the precise period of its being first used with us as a culinary plant; on many parts of the sea coast, the inhabitants for time immemorial have been in the practice of seeking for the plant in the spring, where it grows spontaneously; and,

 removing,

tryman, Philip Miller, has the honour of being the first who wrote upon it professionally, as an esculent, telling us, in the first edition of his Gardener's Dictionary, published in 1731, that the inhabitants of Sussex gather the wild plant to eat in spring, soon after the heads are thrust out of the ground, otherwise it would be tough and rank. Professor Martyn, next, in the last edition of the same work, has printed some valuable additional instructions, how to cultivate this plant, from the MS. of the Rev. Mr. Laurent. Lastly, the late celebrated Mr. Curtis has done more to recommend it, and diffuse the knowledge of it, in the dissertation above quoted, than any of his predecessors.

To grow this vegetable in the highest perfection, prepare the ground in December or January, by trenching it two feet and a half deep; if not that depth naturally, and light, it must be made so artificially, by adding a due proportion of fine white sand, and very rotten vegetable mould: if your ground is wet in winter, it must be effectually drained, so that no water may stand within a foot at least of the bottom: for the strength of your plants depends on the dryness of the bottom, and richness of your soil. Then divide the ground into beds, four feet wide, with alleys of eighteen inches; after which, at the distance of every two feet each way, sow five or six seeds



removing the sand or pebbles, they cut off the young shoots as yet blanched, close to the root. Mr. William Jones, of Chelsea, saw bundles of it in a cultivated state, exposed for sale, in Chichester market, in the year 1753. CURT.

two

two inches deep, in a circle of about four inches diameter; this operation must be performed with strict care and regularity, as the plants are afterwards to be covered with blanching pots *, and both the health and beauty of the crop depends upon their standing at equal distances. In the months of May and June, if the seeds are sound, the young plants will appear. When they have made three or four leaves, take away all but three of the best plants from each circle, planting out those you pull up (which by a careful hand may be drawn with all their tap-root) in a spare bed for extra-forcing, or to repair accidents. The turnip-fly and wire-worm are great enemies to the whole class of tetradynamia plants. I know no remedy for the latter, but picking them out of the ground by hand; the former may be prevented from doing much damage, by a circle of quick lime strewed round the young plants. If the months of June and July prove dry, water the whole beds plentifully. In the following November, as soon as the leaves are decayed, clear them away, and cover the beds an inch thick with fresh light earth and sand, that has laid in a heap and been turned over at least three times the preceding summer; this, and indeed all composts, should be kept scrupulously free from weeds, many of which nourish insects, and the compost is too often filled with their eggs and grubs. Upon this dressing of sandy loam throw about six inches in depth of light stable litter, which finishes every thing to be done the first year.

In the spring of the second year, when the plants are beginning to push, rake off the stable litter, digging a

* It appears to me, that for forcing, it would be a great improvement to make the blanching pots in two pieces, the uppermost of which should fit like a cap upon the lower; the crop might then be examined at all periods without disturbing the hot dung. SECR.

little

little of the most rotten into the alleys, and add another inch in depth of fresh loam and sand. Abstain from cutting this year, though some of the plants will probably rise very strong, treating the beds the succeeding winter exactly as before.

The third season, a little before the plants begin to stir, rake off the winter covering, laying on now an inch in depth of pure dry sand, or fine gravel. Then cover each parcel with one of the blanching pots, pressing it very firmly into the ground, so as to exclude all light and air; for the colour and flavour of the *Sea Kale* is greatly injured by being exposed to either. If the beds are twenty-six feet long, and four wide, they will hold twenty-four blanching pots, with three plants under each, making seventy-two plants in a bed. Examine them from time to time, cutting the young stems, when about three inches above ground, carefully, so as not to injure any of the remaning buds below, some of which will immediately begin to swell; in this method, a succession of gatherings may be continued for the space of six weeks, after which period the plants should be uncovered, and their leaves suffered to grow, that they may acquire and return nutriment to the root for the next year's buds. The flowers, when seeds are not wanted, ought to be nipped off with the finger and thumb, as long as they appear. If a gentleman does not choose to be at the expense of blanching pots, the beds must be covered with a larger portion of loose gravel, and mats; but the time and trouble of taking away the gravel from about the plants, to cut the crop, and replaoing it, is so great, that there is no real economy in it. In this way *Sea Kale* has been cut in Mr. Beale's garden, which measured ten, eleven, and even twelve inches in circumference, and

and upon an average each blanching pot affords a dish twice in a season.

No vegetable can be so easily forced as this, or with so little expense and trouble; for the dung is in the finest possible order for spring hot-beds, after the *Sea Kale* is gathered. The only thing necessary, is to be very particular in guarding against too much heat, keeping the temperature under the blanching pots as near to fifty-five degrees of Fahrenheit's thermometer as may be, but never higher than sixty. For this purpose, in November and December, according as you want your *Sea Kale*, prepare a sufficient quantity of fresh stable dung, to cover both the beds and alleys, from two to three feet high; for in the quantity to be laid on, a great deal must always be left to the good sense of the gardener, and the mildness or severity of the season. It should be closely pressed down between the blanching pots, placing heat-sticks at proper intervals, which by being examined occasionally will indicate the heat below. After the dung has remained four or five days, examine the pots. Worms often spring above the surface, and spoil the delicacy of the young shoots: the best remedy against which, is to cover with dry sea-coal ashes, sifted neither very small nor very large; salt also effectually destroys them, and will not injure the *Sea Kale*. The crop will be ready to gather in three weeks or a month from first applying the heat; but so much mischief ensues when this is violent, that I would advise every one to begin time enough, and force slowly, rather than quickly. It is also necessary to cut the leaves off a fortnight or three weeks before they decay, from such plants as you intend to force very early.

Method

Method of preserving Turnips in the Winter Season. By Mr. JAMES DEAN, *of Exeter.*

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

The Thanks of the Society were voted to Mr. DEAN *for this Communication.*

WHEN surveying an estate in the South-Hams of Devon, in February last, my attention was attracted by the singular appearance of a crop of turnips in an orchard, so thick as to touch each other, and closely surround the stems of the apple-trees. I enquired of the farmer the reason of so unusual a crop, and I received from him some curious information. It was the constant practice, he said, in his neighbourhood, for farmers, after they had broken up ley ground, first to take a crop of turnips, and in the autumn, or rather winter, to sow wheat in the same ground. Should winter fodder be scarce, they then preserved the turnip crop for stock, and consequently could not put in wheat before January; and even then with no probability of having more than two thirds of an usual crop, because of the late sowing. This was an evil of great magnitude, and led him, he added, to make trial of a mode peculiarly successful, enabling him to sow his seed in the proper season, and to save the most valuable of his turnip crop during the winter.

He got, he said, his turnip seed into the ground early in June; and in October, by which time the turnips would have grown to a large size, he had the largest of them drawn without injuring the leaves, and then placed close to each other on the grass in the orchard, in the same position in which they grew. Their leaves preserved

served them from external injury; and their tap-roots put out in a short time other fibrous roots into the grass, which in orchards is generally long in the autumn; and thus the turnips were preserved good for use.

I enquired whether the turnips acquired any additional size after their removal into the orchard, and whether, from the warmth occasioned by the turnips to the ground, any advantageous effect was apparent in the apple trees. On these questions he was not able to speak positively, though he thought the turnips had increased in size; and he thought, likewise, that the crops of apples appeared larger, and the annual bearings more certain in the orchard I was observing, than in those where no turnips were put; though, till the time I spoke, he had not even guessed at the cause.

Description of a new Kind of Agricultural Implement.

By M. CAPRIATA, *Member of the Agricultural Society of Turin.*

FROM SONNINI'S JOURNAL.

With a Plate.

I HAVE frequently remarked that these parts of meadows over which the carts usually passed produced more hay than the others, provided their passage was not so frequent as to destroy entirely, or too much to damage, the turf. I was greatly surprised at this; for, those parts being rough and trodden down, it appeared to me that they would naturally produce less than that which remained undisturbed and perfectly smooth. I enquired the cause of this fact of a distinguished farmer, who accounted for it in a manner that I thought very unsatisfactory. But, when I learnt that our illustrious member, M. Ratti Casalasco, by cutting roots caused them to shoot better,

better, I was amazed at my own want of judgment, in not having perceived at once that the plentiful produce of which I have been speaking must be owing to the cutting of the roots by the wheels of the carriage and the feet of the cattle.

Indeed, I know very well that gardeners cut the points of the main shoots of young melons, in order to multiply the lateral shoots; and I was not ignorant that, by cutting the principal root of plants, they put forth on all sides little roots, which grow and spread in a short time.

Lastly, I had observed that trunks of trees, deprived of their branches, would produce several new ones in the place of one that had been lopped off; and I knew that vegetation acts in the same manner on roots as on branches. Yet, notwithstanding this averred knowledge, I did not find out the true cause of these effects. So true is it that we often neither seek nor discover the true cause of facts that we every day see, although we consider them with astonishment and attention.

I was still, however, fully persuaded of the advantages of the cutting plough, improved by M. Ratti, and invented by Mess. Chateauvieux and Duhamel. I thought it even very proper for the object proposed, namely, to make the manure penetrate to the roots of the plants.

It even appeared to me that not more than half the tillage would be sufficient to restore a meadow entirely, and thus to render it in a manner perpetual, without its even requiring to be entirely cleared, and put again into tillage after a certain number of years; first, because the manure, which must be well prepared, penetrates to the root of the plant, nourishes it, and enriches the earth; secondly, because the roots are regenerated by the cutting, and numberless young ones spring up among the old, which, separated from the main stem, cease to suck the

the moisture from the surrounding earth, remain without force, and even manure it with their own substance, which rots, and the young roots sink separately, upon land that may be said to be still new, to abandon it afterwards when it is time to cut them; so that a portion of the land will in a manner be at rest while the other is in produce, in order that it may in its turn be suffered to remain inactive, provided that, without regenerating the roots, this portion about which they are wrapped be always employed, and the other left at rest; thirdly, because the cutters of the plough, in cutting the stems of the plants, even of those that appear the thickest, regenerate them by this means, and the plant is in a manner pruned.

If from long experience we had been accustomed to contemplate this method, we should perceive a great advantage in thus regenerating the meadow lands, since it is no trifling injury that is sustained in certain provinces from the necessity of renewing them with the plough.

I was going to provide myself with a similar plough, when I reflected that I could not apply it to the meadows of my country, which being mostly composed of stone, gravel, and the roots of trees, which lie nearly even with the surface of the ground, I imagined that the cutters of this plough would soon be broken, or that they would tear up the roots of the plants, which would infallibly perish, so that I should have been rather a loser than a gainer by employing it.

I judged, however, that an implement possessing the following properties might be useful: first, of cutting the turf, and piercing it to a greater or less depth, according to the quality of the land; so that, if it is gravelly, the cutter shall go no further than the superficies; secondly, of not turning up the earth, so that the superficies shall remain united, and still be separated from the gravel or earth beneath it; thirdly, that, when it encounters stones or the roots of trees, it should pass over without cutting or breaking them, and without any damage to the implement itself; fourthly, that, although the progress of the implement must necessarily be impeded by meeting with a stone or the root of a tree, its operation should only be suspended at the single point that happens to come in contact with the impediment, and at no other; for, if every stone or root was to render the implement useless in every point on which it acts, it would be of no use at all in a meadow containing many stones or roots, since it would be every instant arrested in some one or other of those points; fifthly, and lastly, that it should be capable of executing the operation in a short time on an extensive piece of ground.

I had formerly made a kind of harrow, which appeared to comprise all these qualities; but, when I set it to work, I discovered an essential defect in it, namely, that it collected on the edge of the cutters, as upon so many teeth, all the refuse of the straw or hay that remained on the meadow, so that it required constant cleaning. This was a great loss of time to the workman.

I have now invented another implement, formed upon the principle of that above mentioned, and which is indisputably useful. It is only desirable that a method may be found of rendering it less expensive, in order to extend its use.

Description of the Implement, and the Manner of using it.

Fig. 1. (Plate XII.) represents a wheel formed of a single block of wood A, its circumference is furnished with three sharp cutters, *a a a*, fixed to the wheel by a screw that is marked in the same figure; at the centre C is a large hole, in order that when the wheel is in motion, and

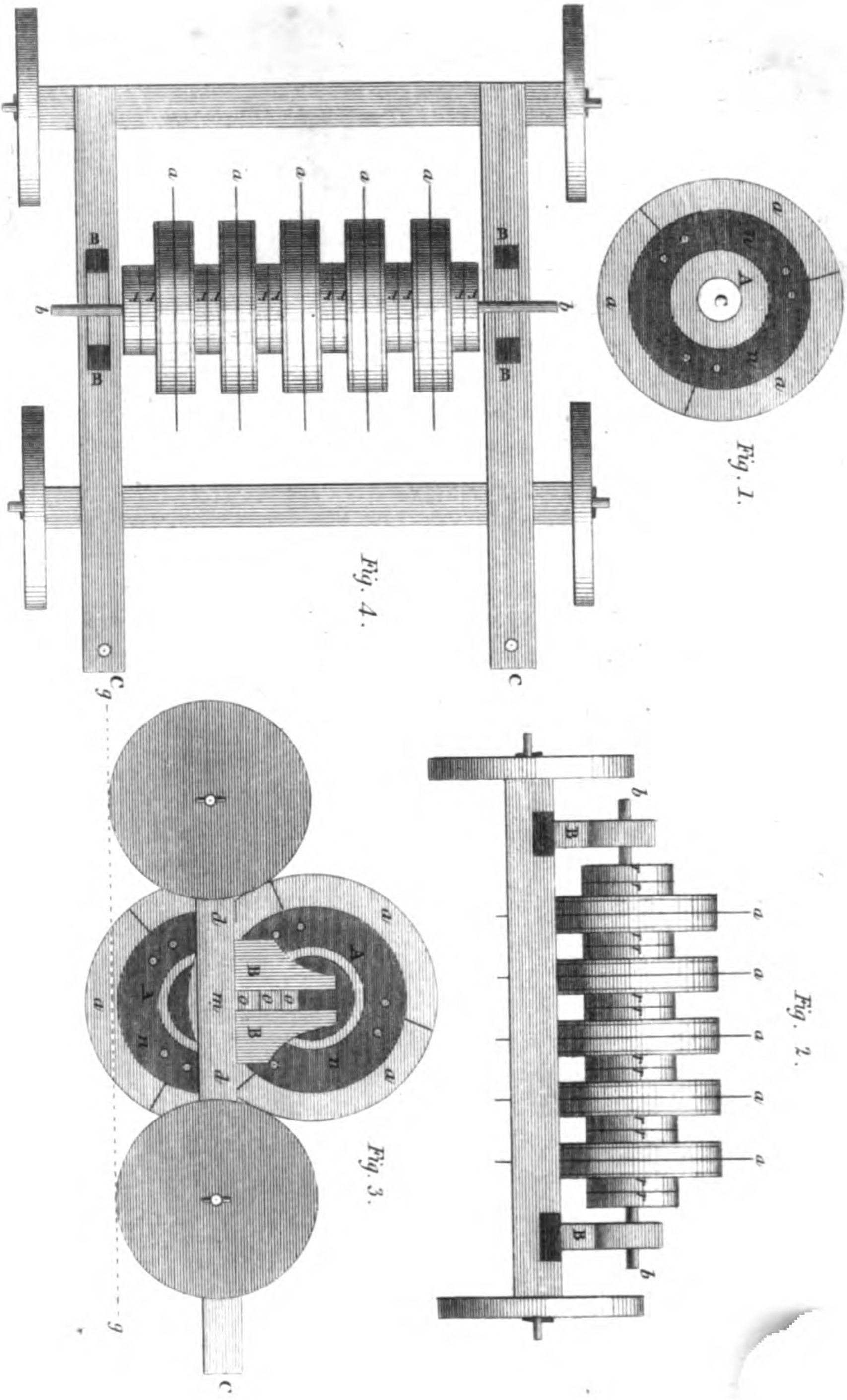


Fig. 1.
Fig. 2.
Fig. 3.
Fig. 4.

and turns, supported by a rod of iron, if it meets with a stone or the root of a tree, it may rise and pass over it, while the others will continue in action, and that it may afterwards resume its station as before.

In Fig. 2, there are five wheels of equal size sustained by a rod of iron *b b*, which is square at the ends and cylindrical in its other parts, on this rod the wheels are in some sort suspended, yet it does not serve as an axis, but they are simply supported in the same manner as an iron rod fixed in a wall supports the circle of a coach wheel that is suspended to it. Between the wheels there are two ferules of wood *r r*, Fig. 2, which serve to fix the wheels and to maintain them at their respective distances; they have at the centre a large opening, in order that they may turn more easily if required.

The rod and of course the cutting wheels, are supported on a carriage of the usual form, as we see in Fig. 4, which may be easily drawn by an animal on the side C C.

This machine is so constructed, that the cutting wheels may be raised from the ground when it is conducted to be worked, to prevent the cutters from being spoiled; and when it arrives at the place of action, they may be lowered again, either more or less, according to the quality of the land or turf that is to be cut. This is effected by placing under the extremity of the rod, a plank or wooden wedges.

Fig. 3 represents a side view of the machine. When a plank or some wedges *o o o* are placed under the rod, the wheel A is raised in order to be conducted to the meadow without damage to the cutters. When the wedges are removed, the rod is supported on the joist *d d* of the carriage, and rests upon *m*, and then the cutting wheel A *a*, falling, cuts the surface of the meadow *g g*, because the

the cutters *a a* descend so much that they are lower than the ground plane of the land *g g;* the two planks B B, fixed upon the little joist of the carriage, in the middle of which I place the rod, retain it in its place; and lastly, in the middle between both I place the wedges, which serve to raise the iron rod, as I have before observed. It is very easy to raise or lower this iron rod, because its ends, which extend considerably beyond the block B B, as is shewn in Fig, 2, *b b*, serve as handles.

I must remark that after I had made a trial of the machine, I found that the united weight of the cutting wheels and the cutters were not sufficient to make them enter into the earth, although well sharpened; I found it therefore necessary to add to the side of each wheel, the weight of about forty pounds of lead, see Fig. 1, *n n*.

Observations on the Combination of fixed Oils with the Oxyds of Lead and Alkalies. By M. F. Fremy.

From the Annales de Chimie.

SCHEELE was the first who observed that the water which had served as an intermedium, when fat oils are treated with litharge, retains in solution a substance to which he gives the name of "the sweet principle of oils," because in fact it has a very decided saccharine taste. But as according to the observations of this celebrated chemist, this water also holds in solution a certain quantity of oxyd of lead, may we not suppose that the taste which has procured it the name of "the sweet principle," proceeds from the property which this metal possesses of communicating a sweet taste to most of its combinations? It would be interesting to enquire how this principle is formed?

formed? What are its properties? In what state the oil remains after being deprived of the principles that have produced this sweet taste? Whether this privation is absolutely necessary to render the oil capable of combining with the oxyd of lead? And from the experiments to which these researches would lead, to establish the theory of one of the most important operations of pharmacy, and the relation that probably exists between its results and the alkaline soaps.

I put into a tubulated vessel equal parts of olive oil, litharge and water; I adapted a tube to be immersed in lime-water, and to its orifice a bladder to keep out the air; this bladder was so disposed as to allow me to move in the interior of the vessel a wooden spatula, to prevent the matter from adhering to its bottom. When the mixture boiled, I perceived the oxyd of lead pass from red to yellow, and from yellow to white; whilst this experiment lasted, it almost always disengaged carbonic acid. I left the apparatus to cool in order to examine the results successively.

The water that had served as an inter-medium had a strong metallic taste. When mixed with yeast at the necessary temperature, I never could make it ferment *.

It was sensibly precipitated by sulphuric acid and the hydrogenated sulphurets †. I treated it with sulphuretted hydrogen until it ceased to precipitate; I then filtered it to separate the sulphuret of lead.

* I was led into a momentary error, because I had employed yeast, which not having been washed still contained alcohol.

† I satisfied myself from various experiments that it made no difference, in the solution of the oxyd of lead, if the fat or oil be rancid; although Scheele thought otherwise. Indeed we shall see by the sequel, that this circumstance has no effect whatever on the dissolution.

The

The filtered liquor still retained a strong sweet taste; I evaporated it to the consistence of a syrup; the acetate of lead at this period, gave no signs of the presence of sulphuretted hydrogen, and my attempts to make it ferment were as fruitless as they were previously to the separation of the oxyd of lead; exposed to the air it attracted much moisture; thrown upon lighted charcoal it inflamed like oil; boiled with the red, the yellow, or white oxyds of lead, it dissolved only the yellow; repeatedly distilled with nitric acid, it forms the oxalic acid; distilled in a retort over a naked fire, a part rose in distillation (as Scheele observed); by augmenting the fire, we obtain empyreumatic oil, acetic acid, carbonic acid, carbonated hydrogen gas, and a light and spungy charcoal which contains no oxyd of lead.

From what I have here described, it was to be presumed that oil, when combined with the white oxyd of lead, would not remain in the same state as before this combination took place.

To separate it from this oxyd, I used acetic acid, because the solubility of the acetate of lead, furnished me with a ready method of separating it from the oil, which I intended to examine.

This oil has the consistence of grease, and the taste of this animal substance when rancid; it is insoluble in water, is soluble in alcohol, is precipitated by water, like the volatile oils, and like them it partly volatilises by distillation *.

The slightest ebullition is sufficient to combine it perfectly with the white oxyd of lead, and to give a strong

* All fat oils dissolve in alcohol; but those which have been treated with litharge are far from possessing this property.

plastic

plastic consistency, which does not take place with litharge and massicot.

The yellow and white oxyds of lead will not combine with the common oils. I was convinced of this fact, from an experiment in which I continued the ebullition much longer than would have been necessary if I had employed litharge.

From these experiments it is to be concluded, that when we treat fat oils with litharge, the oxygen of the latter deprives them of carbon and previously of hydrogen, which form water and carbonic acid.

That this subtraction makes the oxygen more plentiful in the oils, and is the cause of that sweet substance, which Scheele has denominated the sweet principle of volatile oils.

That this sweet principle differs from the mucous sweetness, by possessing the property of dissolving the yellow oxyd of lead; that its sweet taste does not depend on the presence of the oxyd; that it differs from sugar by its volatility and the impossibility of making it ferment.

That the oil when deprived of the principles which have produced the sweet principle, and of the quantity of hydrogen and carbon that rendered it fixed oil, acquires several of the properties of the volatile oils.

Lastly, that in this state only the oil is capable of combining with the white oxyd of lead.

From the knowledge I had thus acquired of the theory of this combination of oils, I judged it proper to ascertain with what foundation several chemists have considered pharmaceutical plasters as true metallic soaps. The analogy between these plasters and soap could only be established by observing in their respective combinations a similarity of phenomena or at least of results.

 I mixed

I mixed some very pure soap-makers ley with olive oil, and exposed this mixture to the air under a jar. At the end of eight days there was only a slight absorption, the soap had still a strong alkaline savour, and the oil in it would not entirely dissolve in alcohol; but at the end of six weeks, the absorption of the oxygen was complete; the soap was very white, and of a good consistence; the alkaline taste was very weak; dilute sulphuric acid disengaged carbonic acid; the oil that proceeded from this decomposition had the same consistence as that proceeding from plasters; it dissolved in cold alcohol with the greatest facility, and was precipitated by water.

I made some soap in the manner of soap-makers; I examined with the greatest care the liquor that remained after the complete formation of the soap, but I could not discover any trace of the sweet principle.

As the absence of this principle in the making of alkaline soaps depends probably on the greater or less quantity of carbon or hydrogen that is subtracted; and that as the action of the oxygen on the oil and the state of the oil, are absolutely the same in the fabrication of plasters as in soap, I think that the plasters should be considered in relation to soap, as the insoluble metallic salts are in relation to the alkaline salts.

I am persuaded that the want of consistency in the soap made from potash, by no means depends on the state of the oil, but rather on the sort of combination that takes place; for I only obtained a soft soap by treating with potash the oil proceeding from soap made from very dry soda.

Facts

Facts towards the History of the Gallic Acid.

By Bouillon Lagrange.

(Concluded from Page 236.)

I HAVE already pointed out the analogy that exists between M. Richter's acid and Scheele's; however, these two acids appear to me to differ from that obtained by sublimation; the latter contains a small quantity of volatile oil that is combined with it, and which, with the help of heat, takes a character that approaches to the nature of oils rendered resinous.

We may ascertain whether it possesses this property by dissolving this sublimed acid either in ether or alcohol. If the liquid is volatilised by rubbing on the skin, we experience an effect similar to that produced by resin dissolved in alcohol.

It is not without difficulty, as may be supposed, that we can become completely acquainted with the nature of the gallic acid. Does this acid exist entirely formed in gall-nuts? can we consider it as a peculiar acid? or, is it not rather, the result of a combination of a vegetable acid with tannin, the extractive or other substance existing in the galls? These questions still remain to be solved. I have sought, by a course of experiments, to add some facts to those already known; and, if they do not yet lead to a complete solution, I think they will at least be found to offer some new results, which may tend to explain the nature and properties of the gallic acid.

Examination of the Action of Caloric and Water on Nutgalls.

Action of Caloric.

M. Deyeux having examined in a particular manner the products of nut-galls distilled by a naked fire, I shall only consider the acid liquor obtained from this substance.

This operation has been conducted according to the directions given by this chemist: the liquor of the recipient was aromatic, rather milky, very acid, and precipitated with gelatine. With sulphate of iron it produced a violet blue, that changed to a dirty green. Lime and barytes gave it a peach-blossom colour. Nitrate of mercury afforded a blackish precipitate; and it became white with acetate of lead and muriate of tin.

I saturated the acid liquor with potash, and obtained by evaporation a brown empyreumatic matter, which, by the addition of sulphuric acid, disengaged a sharp odour similar to that of acetic acid.

Action of Water on Nut-galls.

I shook some nut-galls finely pulverized, in cold water, for the space of four minutes; the liquor when filtered was of a golden yellow: one part was distilled in a retort in a sand bath; and the other saturated with carbonate of soda.

The product of the distillation was a limpid liquor, without colour and slightly acid, precipitating neither glue nor sulphate of iron.

The liquor saturated with an alkaline base was evaporated to dryness; afterwards dissolved in distilled water, sulphuric acid added to a slight excess, and distilled in a retort; I examined the products successively; at first it was

was a liquid without taste or smell, which soon became acid, and contained neither sulphuric nor gallic acid.

I made a similar experiment with boiling water in place of the cold water: the liquor remained always turbid, even when filtered; submitted to distillation and combined with soda in the same manner, it yielded the same results.

It was these experiments that gave me the first glimpse of the existence of a ready-formed acid in galls, and of the possibility of obtaining it by distillation.

I therefore boiled, in a common alembic, one kilogramme of nut-galls coarsely pounded, with two kilogrammes of water. The distilled liquor was, as M. Deveux observed, a little milky, aromatic, and deposited a flocculent sediment when left at rest. I changed the recipient when about two thirds of the distilled liquor had come over; afterwards continued the distillation until it became coloured.

The first product was acid, reddened the tincture of turnsol, and had no effect on lime and barytes water. on nitrate of mercury, acetate of lead, sulphate of iron, and gelatin.

The second product was turbid, coloured and slightly empyreumatic; its acidity was more decided, it precipitated the metallic solutions above mentioned, but had no effect on the solution of gelatin.

These two acid liquors were each saturated with potash. The first formed a flaky salt, which, with sulphuric acid, afforded an odour of acetic acid. A portion of this salt was dissolved in distilled water: the excess of its base was accurately saturated with nitric acid, and I poured into this solution nitrate of mercury at the *minimum*; it formed a precipitate that exhibited all the characters of acetate of mercury. In order to be farther satisfied of the pre-

sence

sence of the acetic acid, I treated neutral acetate of potash in the same manner, and obtained the same results.

The second product was saturated with potash, in the same manner; the liquor became very brown; a slight pellicle formed on the surface, which augmented during the evaporation, and the saline matter was deeply coloured and empyreumatic. When submitted to the same tests as the preceding, I observed similar phenomena.

These experiments leave no doubt of the existence of acetic acid in nut-galls; they prove that it may be obtained by distillation with water, and that caloric, by acting more immediately on this acid, facilitates its combination with a small quantity of empyreumatic oil, and perhaps with a little tannin, although its presence cannot be demonstrated by glue; but as this liquor acts upon sulphate of iron in the same manner as the sublimed acid, we may suppose a sort of analogy in their composition, admitting, however, this difference, that the sublimated acid contains no empyreumatic oil, but a peculiar aromatic volatile oil.

We may discover this oil, by dissolving the acid in very pure sulphuric ether. If we add a little water to it, we see a few drops of oil swim on the surface of the ether, that disappear if it is agitated.

If, instead of the water, we employ the concentrated solution of caustic potash, it separates a white milky matter, that afterwards requires much water to dissolve it, but the liquor remains always turbid.

This ethereal tincture yields a fine blue with sulphate of iron.

When evaporated in the open air, it leaves a very acid, brilliant substance, which separates in scales, and has the appearance of a varnish.

The

The same phenomena take place, if we digest the nut-galls in ether; but the matter contains a greater quantity of tannin.

Examination of some earthy and alkaline Gallates.

Although it appears to be proved that acetic acid exists completely formed in nut-galls, we cannot have too many proofs to establish the fact, and to demonstrate that this acid, combined with other substances, constitutes the gallic acid.

With this view, I formed gallates of lime, barytes, potash and soda. These neutral combinations produced a violet-red colour with a solution of sulphate of iron, and scarcely precipitated any glue, whilst the acid employed had the property of forming with it an abundant precipitate. I poured upon these salts, when dried, some very weak sulphuric acid. I distilled them with a gentle heat, and I uniformly obtained acetic acid.

The retorts contained a very deep brown matter. I crystallised the salts that were capable of this operation, and I obtained sulphates. The supernatant mother-water had the property of slightly browning the solution of sulphate of iron; but this phenomenon is no proof of the presence of gallic acid, for the black tincture of the mother-water is alone capable of giving it this colour.

If we treat one of these gallates, that of soda for instance, with charcoal, the tannin is entirely destroyed; so that the solution no longer precipitates gelatin, and after several ebullitions upon fresh doses of charcoal, it has no farther effect on sulphate of iron. The liquor, when afterwards evaporated to dryness, and distilled with very weak sulphuric acid, still affords the acetic acid.

I shall not insist farther on the possibility of obtaining the acetic acid by decomposing the gallic acid. I could bring

bring forward other experiments to support the preceding; but they would be unnecessary additions to the facts that have already adduced.

I shall conclude with an experiment that is in my opinion very important, since it tends to ascertain the nature of the elastic fluids resulting from the complete decomposition of the gallic acid by caloric. M. Deyeux has stated that he obtained only oxygen gas and carbon. M. Berthollèt, who repeated this experiment, had no oxygen gas, but constantly carbonic acid.

These results, of which no other vegetable acid has given an example, necessarily claimed the attention of chemists. In fact, it was difficult not to admit hydrogen in the composition of the gallic acid; and M. Fourcroy has stated his doubts on this subject, in his *Système des Connoissances Chimiques;* but the question has not yet been decided by experiment.

I have, in consequence, heated some gallic acid in a retort; the fire was gradually increased, until the retort was red-hot. During this action of the caloric, I obtained several jars full of elastic fluid. The first contained only atmospheric air; the others, carbonic acid gas: at least the fluid had all its characters; but the phenomena that took place, during the decomposition of the gallic acid, caused me to suspect, that if there had been a disengagement of hydrogen gas, it could only exist in it in a very small quantity. I shall not therefore content myself with the trial by lime-water, and the extinction of a candle in this gas. Having observed that the hydrogen gas which is mixed with much carbonic acid, cannot be made to burn, because the acid acts too promptly on the flame of the candle, I passed a little caustic potash under the last-obtained jar of gas; I agitated it in order to absorb the carbonic acid gas; I afterwards immersed a candle

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in the remaining gas, which burnt with a flame, and thus afforded a proof of the presence of carbonated hydrogen gas.

This acid therefore, like other vegetable acids, is composed of oxygen, hydrogen and carbon. If we can obtain only a small quantity of hydrogen, it is because, during the decomposition of the acid, there is a formation of water, so that it is only when there is very little oxygen remaining to act upon the carbon, that the hydrogen passes over.

I have endeavoured to shew that the gallic acid is only a compound acid. Its formation by Scheele's process appears to favour this opinion. Indeed, if we compare the quantity of acid, extracted from the aqueous infusion exposed to the air, with that produced by sublimation, we shall judge that it is easy to account for its augmentation. It is certain that acetic acid is formed in the liquor, and by acting upon a portion of tannin and extractive matter constitutes the gallic acid of Scheele; but this combination becomes more intimate, and even varies with the help of heat; of which we have a proof when this acid is obtained by sublimation; for not only the tannin is decomposed, but the acid remains combined with a volatile oil that is formed. Perhaps this acid may contain a small portion of tannin very intimately combined, whence comes, no doubt, the property of producing a momentary blue with sulphate of iron; but its presence cannot be demonstrated. This acid then must possess properties different from Scheele's; and if it were possible to assimilate it to other vegetable acids, it would have the greatest analogy to the benzoic acid. Should we also consider it as a modification of the gallic acid? I think not. It is the same with other vegetable acids, and it is probable that no modification of them exists. The acetous acid appears

pears to be the only vegetable acid ; it dissolves, it retains in various proportions many of the immediate products of vegetables; and in the operations to which we subject vegetable substances, we facilitate its combination in a more intimate manner, and frequently even augment the quantity of this acid. Several chemists have already perceived the possibility of the acetic acid's dissolving and remaining combined with fixed and empyreumatic oils, and animal matters; they have even gone so far as to imitate acids of this sort. The formic acids, pyrolipic, tartarous and mucuous, have been classed by Messrs. Fourcroy and Vauquelin among the compound acids; it is the same with the lactic acid, the composition of which was pointed out at the same time by these chemists, M. Thenard and myself; and lastly, we can also prove, according to M. Thenard, the existence of this acid in urine and sweat, as well as in the sebacic and ozonic acids. I might also add to these observations, (if we were not already persuaded that the acetic acid is found every where) that it exists in the vegetable as in the animal matters, where it is almost always in a state of combination, and that the equilibrium in the proportions being once established, it gives rise to compounds hitherto unalterable, and of which the affinity cannot be destroyed, but by reducing them to their primary elements: oxygen, hydrogen, carbon, and azot.

The following are the results of the facts announced in this memoir.

1. That the gallic acids of Scheele and Richter, differ essentially from that obtained by sublimation, and that, as a re-agent, that which is crystallised must be preferable, by reason of the uniform colour that this acid gives with iron.

2. That this acid appears to be composed of acetic acid,

acid, tannin and extractive matter, and that even crystallisation will not entirely deprive it of tannin.

3. That the acid obtained by sublimation contains no tannin, at least that is appreciable by gelatin; and that it cannot, in any case, supply the place of the crystallised acid.

4. That this sublimed acid appears also to be composed of acetic acid united with a peculiar aromatic volatile oil.

5. That with the assistance of water poured into the ethereal tincture of nutgalls or into ether containing sublimed acid, an oily matter is separated.

6. That there exists no known process for completely purifying Scheele's acid; that is to say, that we cannot deprive it of the whole of its tannin but by reducing it to the state of acetic acid; which proves, that the portion of tannin it retains is necessary to constitute the gallic acid, whence results its excellent properties in the art of dyeing.

7. That the red oxyd of mercury, and the oxyd of tin, as well as carbon, decomposes this acid.

8. That we may obtain acetic acid by the distillation of nut-galls with water, and that it is by the help of heat, which acts more immediately on the nut-galls, that we favour a more intimate combination between the acid and the tannin.

9. That the earthy and alkaline gallates also yield acetic acid by their decomposition.

10. And, lastly, that the gallic acid, like other vegetable acids, is composed of oxygen, hydrogen and carbon.

If these results be accurate, we may conceive the

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possibility of arriving at the synthesis; some attempts that I have already made, have given me the hope of accomplishing it. I shall have the honour of communicating to the class the results of my labours, if they should be worth their attention.

Memoir on the Desulphuration of Metals.

By M. GUENIVEAU.

From the JOURNAL DES MINES.

AMONG the great number of *metallic sulphurets* that nature affords us, the decomposition of many of them is found to be of great importance to the arts. The sulphurets of iron, copper, lead, mercury, &c. occasion metallurgical processes that should be particularly attended to by those who study the chemical arts.

The nature and properties of these compounds have been well known since chemists have made them the subjects of their labours; but this knowledge has not yet been of service in the progress of the science, because the facts that have been collected in the laboratories have not been carefully compared with those furnished by the large way, notwithstanding it is well known that this is the best means of arriving at useful results, and at the theory of the various operations to which the sulphurets are submitted. I propose in this memoir to supply what is wanting in this respect; and, with this view, I have collected many long-known experiments and observations, to which I have added some of my own; and, from their investigation, I have deduced consequences which tend to make some changes in the ideas that generally prevail on the treatment of metallic sulphurets.

Of

Of the Action of Heat on metallic Sulphurets.

The action of *heat* on metallic sulphurets should be first examined, because it is always necessary to the decomposition of these substances to be enabled to form an accurate judgment. I have chosen to make my observations on experiments in which this action is entirely isolated. This is of consequence to be remarked, because it is from neglecting to analyse the effects produced by several causes that, in metallurgy, a desulphurating power has been attributed to caloric only, which, in my opinion, it does not possess in a very high degree.

The sulphurets of mercury and arsenic are volatilized in close vessels, when they are exposed to a temperature a little elevated. The sublimated sulphuret has often a colour different from that which it had before; and the experiments of Messrs. Proust and Thenard shew that this change is the consequence of a variation in the proportion of the elements of this compound.

The natural sulphuret of iron (pyrites of iron) suffers only a partial decomposition from caloric: by distilling it in a retort we cannot extract from it half the sulphur it contains. In Saxony, the distillation of pyrites in the large way never yields more than 13 or 14 per cent. of its weight of sulphur.

These facts not being sufficient to fix my opinion on the effects of heat, and because all the experiments that have come within my knowledge have been made at a low temperature, I undertook the following: I put some pulverized iron pyrites into a crucible lined with a mixture of charcoal and clay; I covered it over with charcoal powder, and heated it for an hour in a forge, and it became a mass which still preserved all the characters of pyrites;

pyrites: it appeared to have been completely melted, and retained two thirds of the sulphur contained in the natural pyrites. As I repeated this experiment, I was left in no uncertainty as to the effects of heat alone upon sulphuret of iron; and I thought I might conclude from it that, whatever the temperature may be, it will only effect a partial decomposition.

Heat produces the same effects on sulphuretted copper and copper pyrites as on those of iron; the distillation of copper pyrites afforded but very little sulphur. These two kinds of copper ore may finally be considered as mixtures of the sulphurets of copper and iron, and the sulphur that the heat separates from them proceeds almost solely from the sulphuret of iron.

The sulphuret of lead or galena is more variously treated than any other ore. All chemists agree in considering it as a compound of sulphur and lead only, in the proportions of ,15 parts of the first, and ,85 of the second. I was the more careful to observe the effects of caloric on the galena, because, by attempting to separate the sulphur from it by this agent, I might hope to obtain metallic lead, the weight and fusibility of which renders the union of its particles very easy.

I put into a retort 30 grammes of galena reduced to a powder, which I heated for two hours, gently enough to keep it from becoming glutinous. It disengaged only a little sulphurous acid that was produced by the action of the air of the vessels; and I perceived no sublimated sulphur in the neck of the retort. I augmented the fire for two hours longer, till the galena, and the vessel that contained it, both began to fuse. The sulphur volatilized in this second part of the operation was in such a small quantity, that it was not possible to detach it,

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and weigh it. The residuum had preserved the metallic brilliancy; it was glutinous, and contained not an atom of ductile lead *.

As the heat in this experiment had not been very strong, I submitted to the fire of a forge some pulverized galena in a crucible lined as above, and covered it over with charcoal powder. It afforded a mass that had been well melted, and was like what is called *lead matt* in metallurgy. No lead was collected; but only some portions of the ingot were a little ductile. On analysing it, I found that there remained about three fifths of sulphur contained in the galena. I attributed a part of the loss that it sustained from the action of the fire, and which was 27 per cent. to the natural volatilization of the sulphuret of lead; for that, owing to the separation of the sulphur, could not amount to more than 6 per cent. at the most. Thus the heat effected a very incomplete decomposition of the galena.

I shall not speak particularly of the sulphurets of zinc, antimony, &c. because I am not acquainted with a sufficient number of experiments to determine with certainty the effect of heat upon them; but, from analogy, I should think that it does not decompose them completely.

All the facts that I have here given appear to me to establish the opinion, that the action of caloric alone upon metallic sulphurets, and particularly on those of iron, copper, and lead, is limited to the depriving them of a small portion of the sulphur they contain, and afterwards melting, and even volatilizing them.

* There are few chemists who have not made this experiment, and obtained the same results. I cannot help anticipating what I have to say in the sequel, by remarking that the same heat, continued for an equal length of time, would, *with the contact of the air*, have effected a complete roasting of the galena.

Of

Of the simultaneous Action of Heat and the atmospheric Air on metallic Sulphurets.

The metallurgical operation that is employed for the desulphuration of metals is known under the name of *roasting*. Most of the authors who have treated of it seem to acknowledge no other agent of decomposition besides heat; and even those who, since the introduction of the new chemical theories, have remarked the influence of the atmospheric air, have never considered this influence as essential *. The experiments that I have collected having shewn how much the action of heat alone is insufficient for decomposing a metallic sulphuret, we must necessarily consider the atmospheric oxygen as having the greatest share in the desulphuration of metals by *roasting*. The affinities of sulphur and metallic substances for this principle render this assertion very probable; it is also proved by the chemical examination of the products of all the *roastings*, as well as by the way in which the operation is conducted. Instead of seeing the volatilization of the sulphur, by the roasting of the sulphurets, *effected by a long-continued and well-managed heat*, it is the decomposition of a sulphuret by the simultaneous action of the air and of caloric; and the hitherto acknowledged

* Maquer was also of this opinion; for we find in his *Chemical Dictionary* the following passage: "There are several methods of separating the sulphur from metallic substances; first, as the sulphur is volatile, and as these substances are more or less fixed, or at least almost all of them are less volatile than the sulphur, *the action of heat alone is sufficient to separate the sulphur from most metals.*" It appears, however, that he was sensible of the importance of the contact of the atmospheric air in the roastings, since he says, when speaking of the sulphuret of mercury and arsenic, "it would not be impossible to desulphurate them without an intermedium, by a well-managed and long-continued heat, and *with the concurring action of the air.*"

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necessity of not suffering the minerals to melt will appear to have arisen from the fear of communicating to it a cohesive force that would oppose the separation of the sulphur; but, more simply speaking, because, when in a liquid state, the action of the air is limited to a surface which, as it cannot be changed, would soon be covered with a metallic oxyd. The combination of the oxygen with the elements of the sulphurets produces *oxyds* and *acids*, the affinities of which have great influence on the separation of the sulphur and on the results of a roasting. These usually afford a mixture of oxyd, sulphate, and sulphuret not decomposed. I shall examine separately and minutely the roasting of several kinds of sulphuret, because the nature of the metal occasions great modifications in their results; I shall afterwards shew how, and under what form, the sulphur is separated.

Roasting of Copper Pyrites.

Some pieces of copper pyrites are arranged upon faggots in the most convenient manner for sustaining a long-continued combustion. The first heat separates a part of the sulphur, which is in a manner distilled, and may be collected; but it is the sulphur itself which afterwards serves, in burning, to continue the operation. It disengages some sulphurous acid, the elasticity of which being augmented by the elevation of the temperature, prevents the combination with the metallic oxyds. The sulphuric acid, which is formed notwithstanding the care that is taken to slacken the combustion, unites with the oxyds of iron and copper; but the sulphate of iron is partly decomposed by the super-oxydation of the metal.

The iron pyrites, submitted to the same operations, underwent similar decompositions.

The roasting of copper pyrites in a reverberating fur-

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nace occasions the same phenomena, and might be reasonably expected to allow a much more complete separation of the sulphur than is done in the open air; and, if this is not the case, it is no doubt owing to the difficulty of preventing the agglutination of the sulphuret, which is produced by the elevation of temperature that takes place from the rapid and inevitable combustion of a great quantity of sulphur.

It now remains for me to speak of a furnace in which the melting and roasting of copper pyrites may (to a certain point) be effected, at the same time; it is the same as is used at Falhun in Sweden *; it has an interior basin,

* We have the following account of it in Jars's Metallurgical Travels. The melting of an ore roasted a single time is effected in a furnace "having an interior basin, which is destined to contain the product of the operation."—"When it is heated it is charged with a large quantity of scoria proceeding from the melting of black copper, some quartz and a little ore."—"The *quartz* is not mixed with the ore, but is added to it, particularly when there is reason to fear some embarrassment in the interior basin."—"The melting of matts is effected in a similar furnace, but smaller."—"The materials remain longer in the furnace, for the matter is run out but twice in 24 hours. *Very little rich matt* is extracted from them, but a very large ingot of black copper."—"This method of melting the pyrites is certainly the only one that can be employed; and, notwithstanding the inconveniences that attend it, may nevertheless be the means of great advantages: whatever it may be, we would advise comparative trials always to be made with it."

Another very valuable advantage is the *concentration* of the metal contained in the *fluid matter which is continually agitated by the wind from the bellows.* A smaller quantity of matt is extracted from it, but it is proportionably richer. We confess our surprize at the melting of the black copper "(that which yields the black copper) to see the little rich matt that proceeded from another very middling one, and which did not appear ever *to have been roasted.*" In fact, we may believe with M. Jars that this method of melting the copper pyrites is one of the best, if it does not volatilize more copper than by the other processes; but basin, which receives the product of a melting of 24 or 48 hours, and where a separation, or, more properly speaking, the combustion of the sulphur is effected.

The bellows blow upon the bath with sufficient force to disperse the scoria, and to burn a portion of the sulphur that is found on the surface; the iron also is oxydised, and some quartz is added, to vitrify it in proportion as the roasting takes effect. We may thus explain the concentration of the metal, and the general result of the melting which so much surprized M. Jars. This is perhaps the only process in which sulphur and iron are separated at the same time in equally large quantities.

The desulphuration of copper pyrites appears to be effected, first, by the sublimation of a small portion of sulphur, which may be collected, or is consumed in the air secondly, by the disengagement of sulphurous acid, which is most plentiful when the operation is best conducted * thirdly, by the evaporation of a little sulphuric acid, of which however the greatest part remains united to the copper.

Roasting of the Galena.

Galena is very difficult to desulphurate completely by *roasting*: the affinity of its ingredients for oxygen renders the separation indeed prompt enough; but that of the new compounds, *the sulphuric acid and the oxyd of*

but if, as I think we may, we can substitute the *reverberating furnace* for that of Falhun, following at the same time the same course of operations, it would undoubtedly be much more convenient than the operation of melting at the blast-furnace.

* Some recent experiments of Messrs. Clement and Desormes, have shewn that the combustion of the sulphur does not afford sulphuric acid so easily as it has been imagined, but that its formation is determined by different particular circumstances, such as the presence of alkalies, oxyds, &c.

lead, produces a new combination which retains the sulphur, and thus forms an impediment to the desulphuration: it is to this affinity of the oxyd of lead for the sulphuric acid, that we must attribute the facility with which this acid is formed in the roasting of galena.

I shall give the detail of the various processes, which this important decomposition has occasioned, because I think I can account for the numerous and complicated phenomena they present.

Whatever precautions we may take in roasting galena in a calcining dish, it is impossible to convert all the sulphur into sulphurous acid, and to prevent the formation of the sulphuric acid; the result always presents a mixture of oxyd and sulphate of lead.

In roasting in the large way, upon floors expressly prepared for the purpose, the proportion of sulphate of lead is much more considerable, which is owing to the temperature and the facility with which the air penetrates the ore. A number of analyses that were made at *l'Ecole des Mines* led me to conclude that the roasted *schlich* of the mine at Pezey contained from one-third to a half of its weight of sulphate of lead; whence it follows that, supposing even all the galena to be decomposed, the roasting does not separate half of the sulphur that it contains.

The reverberating furnace is employed with great success for roasting the ores of sulphuretted lead. It happens even in certain foundries, that in this furnace the separation of the sulphur is so completely effected, that when the roasting is judged to be finished, it only requires the addition of charcoal to produce immediately a large quantity of metallic lead. Yet it is certain, that much sulphate of lead is formed, which is, as we have seen, a natural result of the action of the air on the galena,

lena, when submitted to an elevated temperature; the chimnies of the furnaces are also filled with it. The decomposition of this sulphate by the charcoal produces a sulphuret or a *matt* of lead; and though sulphurous acid may be disengaged, it is very difficult to explain how the addition of charcoal can make the lead run in a considerable quantity. I conjectured that the sulphate of lead was decomposed during the roasting, and that nothing more remained after this operation than a little impure oxyd; and I think I have found the cause of this decomposition in the action of still undecomposed galena on the sulphate that is formed. The following experiments will shew the nature and the result of this action.

I put a mixture of one part of sulphuret of lead pulverized, and three of sulphate (made in the humid way) into a retort; I heated it slowly at first. When the retort was red, a considerable disengagement of sulphurous acid gas took place; it lasted an hour, at the end of which time the retort entered into fusion; the residuum had been melted, and afforded a mixture of oxyd and sulphate of lead. I was satisfied that the sulphurous acid which had been collected in water, was not mixed with sulphuric acid.

This experiment demonstrated the decomposition of the sulphate of lead by the sulphuret, or rather that of the sulphuric acid it contains, by the sulphur and the lead of the galena. The sulphurous acid undoubtedly proceeds from the oxygenation of the sulphur, and the demi-decomposition of the acid; for I am certain that no sulphate remained in the residuum. I have repeated this decomposition by employing equal parts of galena and sulphate; the disengagement of sulphurous acid was more abundant, and there remained in the retort a mixture of oxyd and sulphuret, whence I concluded, that if

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in the first experiment, the proportion of the sulphuret of lead was too weak, it was too strong in the last. I made still another attempt to come at the exact proportions requisite for the mutual decomposition, and I hoped at the same time to be assured of the oxydation of the lead contained in a metallic state in the galena. I put fourteen grammes of sulphate well mixed with eight grammes of sulphuret, in a crucible not lined, which I suffered to get gradually red. I remarked that a considerable bubbling was produced, which was occasioned by the disengagement of sulphurous acid; I did not remove the crucible till I saw that the melted matter was at rest. I found two substances perfectly separated; that which occupied the lower part was only melted sulphuret of lead without any mixture of *ductile lead;* the other had all the characters of the oxyd of lead called *glass of lead;* this portion was a combination of *oxyd* and *silex* proceeding from the crucible, without any traces of sulphate of lead.

This experiment proved that the lead of the galena was oxydated at the expense of the sulphuric acid; but it did not determine the quantity of galena that is necessary for the complete decomposition of the sulphate. I believe however that the proportion of one part of the first to two of the second, would be nearly right; besides, it approaches very nearly the proportions which would result from the decompositions of these substances.

TO BE CONCLUDED IN OUR NEXT.

Memoir

Memoir on the Proportion of Light pr duced by different combustible Substances, and on the Degrees of Brightness obtained from different Lamps, according to the Nature of the Oil employed. By M. HASSENFRATZ.

From the ANNALES DE CHIMIE.

I WAS commissioned by the government to make some experiments for the purpose of determining the most economical means of obtaining light, both by comparing the value with the consumption of the different combustible matters, and by varying the manner of employing them.

I accordingly made a great number of experiments in order to resolve the question; but the results to which they led me differed so widely from those which I had expected, that I could not determine upon publishing them; however, after having satisfied myself of their accuracy, I resolved to give them to the public, when I read, in the *Bibliotheque Britannique*, an account of similar experiments, the results of which were also different from mine. I therefore deferred the publication of my experiments till they should be confirmed or invalidated by new ones; and it was not till after I had assured myself, by several repetitions, that there was nothing which required alteration in my first results, that I finally determined to make them known to the public.

The great difference between my results and those of Count Rumford, is the conclusion to which he was naturally led, that the lamps, with a current of air and circular wick, generally called Argand's or Quinquet's lamps, to produce a given quantity of light, consume less oil than the ordinary lamps without a current of air. I was likewise of this opinion when I made my experiments,

ments, and the contrary result to which I was led, was the cause that prevented me from publishing them sooner. I hope, in the sequel of this memoir, to shew upon what this difference depends, though I by no means promise to explain how it has happened that in two similar experiments, made by Count Rumford and by me, we have obtained such different results. It will remain for those men of science who shall repeat them, to decide between the experiments of that philosopher and mine. I shall consider myself happy to have directed the public attention to a question of domestic economy, which interests every class of society.

What I chiefly proposed to myself, in the experiments which I have made, was to compare together the lights produced by wax, spermaceti and tallow candles, and the oils of poppy, fish and cole-seed.

In the experiments upon the different oils I employed pump-lamps, with round wicks, consisting of 36 filaments of cotton, of which 33 metres weighed 148 centigrammes, and Argand's lamps with the circular wicks usually met with in commerce.

The tallow candles which I used were moulded, six to the pound; and the wax and spermaceti candles five to the pound.

For comparing the intensities of the different lights I employed the process indicated by Bouguer, and which was practised, in 1785, by Messrs. Vandermonde and Monge, when they were commissioned by the Academy of Sciences to compare the intensities of the light produced by the lamps with a current of air. Count Rumford has employed the same method. It consists in placing the two lights at two different distances from a piece of white paper, placing near to this paper a small opaque cylinder, and removing the lights to such distances at which

which the shades respectively produced by each have the same intensities. The intensities of the lights are in the ratio of the squares of the distances of the luminous bodies from the line at which the two shades meet upon the white paper.

I must here observe, with Count Rumford, that these experiments require much care and assiduity, and present many difficulties. Of these the two principal are, first, the variation of the light according to the length, and the carbonization of the wicks of the burning substances; and, secondly, the difference of the colour of the shades compared.

As to the first of these difficulties, I endeavoured to obviate it by frequently snuffing the wicks of the candles and of the ordinary lamps, by keeping the wicks of the Argand's lamps at a nearly equal light; and the second, by comparing together lights, the intensities of which did not differ much from each other.

In order to determine the quantity of the combustible matters consumed hourly by the different luminous bodies, I kept them burning for eight or ten hours in succession, compared the light produced during the whole continuance of the combustion, and from the sum of the lights compared during the whole duration of the experiment, I deduced an average intensity of light. I have several times repeated the same experiment, and have taken for the result the average of all those which I made in the course of six months upon the same substance, and in the same manner.

TO BE CONCLUDED IN OUR NEXT.

Intelligence relating to Arts, Manufactures, &c.

(Authentic Communications for this Department of our Work will be thankfully received.)

On the Use of Broad-Wheel Carriages, &c.

The following Article is extracted from the REPORTS *of the Committee of the House of Commons on Acts regarding the Use of* BROAD-WHEELS, *and other Matters relating to the Preservation of the Turnpike-Roads and Highways of the Kingdom.*

THE Committee were appointed to take into consideration the Acts in force regarding the use of broad wheels, and to examine what shape is best calculated for ease of draught, and the preservation of the roads; also to suggest such additional regulations as may contribute to the preservation of the turnpike roads and highways of the kingdom; and were instructed to consider of an Act for limiting the number of persons to be carried on the outside of stage-coaches or other carriages. They proceeded to examine the important subjects recommended to their attention; and conceiving the regulations as to the number of outside passengers to be conveyed on stage-coaches, to be not only connected with the preservation of the roads, but also in other respects interesting to the public, they thought it incumbent upon them to lose no time in reporting to the House some particulars on that subject. They state that regulations of this nature were first made by an Act passed in the year 1788, which was afterward altered, explained and amended by an Act passed in the year 1790: it appeared, however, to them, that the salutary regulations provided by these Acts had been, by a variety of contrivances, most grossly evaded, insomuch

insomuch that, instead of six (the number limited by the original Act), twenty passengers and more were often seen carried on the outside of stage-coaches; and that it was not unusual to see ten on the roof, three on the box (besides the driver), four behind on what is called the *Gamon-board*, and six on the dicky or chair. These evasions of the Law the Committee thought to be in several respects of great public disadvantage; for it cannot be doubted that machines conveying such a number of persons and their luggage must be extremely destructive to the roads; the wheels are narrow, and the weight great; and as these carriages are not liable to the regulations regarding weighing-engines, the weight they carry has no limit; and from the enormous weight, and injudicious manner in which such a number of passengers and their luggage is frequently conveyed, accidents are daily happening in one part of the kingdom or another, and, indeed, scarcely a week passes without some of those carriages breaking down, to the imminent danger of the unfortunate passengers who trusted themselves to that mode of conveyance. They concluded by expressing their persuasion that it was unnecessary to dwell any longer upon a subject which they conceived to be so well entitled to the immediate attention of Parliament.

This report had been no sooner presented to the House of Commons in June 1806, than an Act of Parliament passed to prohibit any greater number than ten outside passengers in the winter, and twelve in the summer, besides the coachman and guard, to be carried on or about any coach, of whom one only could be permitted to ride on the box with the coachman. This Act also restrains the packing of luggage on the roof to the height of two feet, and contains many other salutary regulations for the conduct of coachmen and guards, both towards their employers and the passengers: it took place from the 1st September 1806.

In a subsequent Report the Committee lay before the House their observations on the two other points recommended to their attention, namely, the system which ought to be adopted for the greater ease of draught in carriages, and the best means of preserving the turnpike roads and highways of the kingdom; and they trust that the information which they have collected, though they find it impossible to do justice to these investigations, will contain many useful suggestions, which, aided by farther enquiries, may be of the most material service in promoting the general interests of the kingdom.

They remark, that ease of draught, independent of the state of the roads, must principally depend on two circumstances; the general nature of the carriages made use of, and the construction of the wheels. They report that a variety of carriages have been adopted in different countries, from the sledge to the waggon, with wheels rolling a surface of sixteen inches. Waggons upon the largest scale, say they, may certainly be economical to the proprietor, more especially where the wages of men are high, as one trusty person, with an assistant at inferior wages, can manage a number of horses, and convey with the like number of horses and attendants greater burdens, in proportion to the expense, than can be carried on the public roads in any other manner; and if there were no objections to the use of waggons on account of the destruction which they occasion to the roads, (the reparation of which is attended with a very heavy expense to the public,) the use of them would be deserving of encouragement, especially in a commercial country, where it is important that goods should be conveyed at as moderate an expense as possible. The Committee,

mittee, however, were induced to believe, from the information which they acquired, that there are scarcely any materials of which our roads are formed that can bear the pressure of such enormous weights as these waggons are now allowed by Law to carry: in addition to which it may be stated, that the form of their wheels or rollers, whose fellies are sixteen inches broad, and as now constructed, of a conical shape, is particularly injurious to the roads.

Of machines with two wheels for carrying goods and other articles, which are known under the general name of carts or cars, they think single horse carts are in many cases to be preferred; for though they cannot be adopted with equal advantage where roads are crowded with carriages, and each cart must have a distinct person to attend it, yet where one person can take the charge of two or three single horse carts, as is practised in Scotland, there are no means by which a great quantity of goods can be conveyed at so small an expense. Carts have been tried with two horses abreast, but those in use are thought very injurious to the roads, from the great weight they carry on narrow wheels; it has been suggested, that carts with three horses abreast, if they were restricted to use a breadth of wheel proportionate to the weight they carry, as well as to a wheel of a cylindrical form, not only all the horses could be more easily managed by the driver, so as to oblige them to act with all their force together in dragging a machine up a hill, but they would also be equally employed in resisting the weight of the carriage in its descent: this kind of machine, if it answers the expectations formed of it, might be extremely serviceable in the ordnance and military departments.

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The proper form of carriages for the conveyance of goods they consider to be a subject which still requires farther investigation and accurate experiments, before the principles thereof can be fully ascertained; and they proceed to consider the subject under the following heads: 1. the form of the rim or felly; 2. the nature and position of the spokes; 3. the breadth of the wheels; 4. their height, and the line of draught; 5. the position of the axle; 6. the weights allowed to be carried; and, 7. the experiments necessary to be tried for the purpose of ascertaining the nature of the wheels, and the construction of carriages best calculated for ease of draught in different circumstances.

With respect to the first head they observe, that the RIMS of all wheels which have an equal bearing on their whole breadth, must either be of a cylindrical or conical form; but some in common use are rather rounded, and in a few instances the law is evaded by a single stake being raised above the general surface of the tire; by which means wheels of a considerable breadth, having but a narrow bearing on the roads, operate as injuriously on them as narrow wheels. It having been communicated to them that Mr. Cumming, of Pentonville, had long paid particular attention to this branch of the subject, and that he had contrived machinery by which the effects of cylindrical and conical wheels, both in regard to the preservation of the roads and the labour of the cattle, were ascertained, they requested his attendance; when he clearly explained to them, that the description in the Acts which have passed for proportioning the breadth of wheels to the weight of the load; namely, *that the wheel should be flat on the sole, so as to have an equal bearing in its whole breadth*, being equally applicable to conical as

to

to cylindrical wheels, was very ineffectual for the purpose intended; for the effects of those different shapes on the roads, and on the labour of the cattle, are not only different, but contrary to each other, which is plainly elucidated in an essay on that subject, formerly published by Mr. Cummings *; and by an ingenious and well-conducted apparatus he exhibited to them various experiments, from which they feel themselves authorised to infer, that there is a resistance from the partial dragging at the periphery of every wheel which is of a conical shape; that it grinds the hardest materials, and leaves the surface of the roads in a state to imbibe water, and adds considerably to the labour of the cattle; and that this resistance, so injurious to the roads and to the cattle, is increased by increasing the breadth of the conical wheel: that wheels which are cylindrical have no such dragging at their circumference, no such grinding or deranging of the materials; and that the cylindrical wheel, by its progressive dead pressure, consolidates and unites the materials, and leaves the surface smooth, close, and impenetrable to water; and that on a regular well-formed clean road the resistance to the progress of the cylindrical wheel is not increased by increasing the breadth. But, as in deep snow, deep sludge, and in general with deep roads, the resistance is in proportion to the surface presented by the front of the wheel, they do not think proper to recommend, for the present, any greater breadth than from nine to twelve inches; and as many broad wheels are now made rounded on the sole or periphery, and are neither a part of a perfect cylinder or cone, they apprehend their properties must be estimated according to their affinity to the one or the other.

* Inserted in the thirteenth volume of the first series of this work.

From

From the illustrations which Mr. Cumming produced of the contrary effects which wheels of a cylindrical and conical shape must have on the roads, and on the labour of cattle, and the very satisfactory experiments by which every conclusion was supported, they presume that much benefit might arise from his investigating general principles for constructing wheel carriages, and illustrating the principles, by experiments, in the manner which he has already adopted.

The Committee taking it as proved, that the cylindrical shape of the rim is the most advantageous, proceeded to apply their attention to the SPOKES, or radii of the wheel, which connect the nave with the rim or fellies. The position of these, they observe, may be either perpendicular to the axle, oblique or dished, or double dished; when the spokes stand square or at right angles to the axis, they derive no other advantage from that position than the actual strength of the timber of which they are made, and are calculated only to bear a perpendicular pressure: when the spokes stand oblique, it gives the wheel a concave appearance on the side that is farthest from the carriage, which is called *dishing*; and the dishing gives to the wheel, in some positions, much additional strength, from the affinity which it has to an arch: though the dishing of the wheel might at first have been the consequence of the bending of the axis, and it being found that the dishing of wheels was attended with other advantages besides strength, they may have been generally preferred; for when the obliquity of the spokes is adapted to the bending of the axis, those which are immediately below the axis stand perpendicular to the road, and are consequently best able to resist the perpendicular pressure. Spokes that consist of two rows, and that are dished

dished in opposite directions, have of late years been occasionally used in low wheels, where much strength is required: these are represented to be peculiarly calculated for wheels whose rims are of considerable breadth; for as each row of these spokes have all the advantages of the single dishing, and as they are directed towards the opposite sides of the wheel, it must be much stronger than if made with a single row, and equally calculated to resist lateral shocks in both directions as to bear a perpendicular pressure.

It having been proved by the experiments of Mr. Cummings *, that when the rim of a wheel is truly cylindrical the resistance to its progress on a smooth regular surface is not increased by increasing its breadth, and the advantages of a broad bearing of the wheel on the road being too obvious to be doubted; yet as deep snow, deep sludge, or deep roads must obstruct the progress of a broad wheel much more than of a narrow one, the Committee are of opinion, that THE BREADTH OF WHEELS fit for general use must ultimately be determined by experience and local circumstances: though it should ever be held in remembrance, that the narrower the rim the more damage it does the roads; and if cylindrical, the broader it is, consistently with other circumstances, the more it improves them.

The opinions regarding THE HEIGHT OF WHEELS are represented to be extremely various, even among men of science; some estimating the advantage of high wheels by the greater facility with which they surmount fixed obstacles, and the diminution of friction on the axis; but as fixed obstacles are removed on all turnpike roads and highways, the first consideration is no longer of import-

* See the thirteenth volume of the first series of this work.

 ance,

ance, and the friction on the axis is only reduced to one half with a wheel of twice the height; but if the double weight of the high wheel in drawing up a hill be compared with the diminution of the friction on the axis, it will be found on a general average to exceed out of all comparison: from which consideration it seems to the Committee that wheels of a moderate height ought to be preferred. Though they admit the most advantageous line of draught to be a subject of great importance, yet they consider it to be involved in so much intricacy in some instances, that it does not appear to have been yet sufficiently investigated, and therefore decline to report upon it.

In the earliest and most simple carriages the axles were probably made straight, and the wheels were fixed on the axle which turned with them; and this appears to the Committee to be in several respects preferable to any other POSITION OF THE AXIS: but when the size of carriages was increased, and the roads yet remained narrow and the ruts deep, the ends of the axle were bent downwards to make more room for the body of the carriages, and at the same time to adapt the wheels to the ruts. They observe that the necessity of bending the axle is done away by the improvements of the roads, and remark that the straight axle is naturally adapted to the cylindrical rim, and will be found in practice as well as theory the best position for the axles of wheel-carriages, except under particular circumstances. And with respect to a mode sometimes practised of bending the axle forward as well as downward, in order to counteract the divergency arising from the conical shape of the wheel, they think that instead of curing this remedy, however plausible, will be found to double the inconvenience it was intended to remove.

Various

Various Acts of Parliament have settled THE WEIGHT ALLOWED TO BE CARRIED according to the breadth of the wheels; but the Committee at the same time are of opinion that some alterations ought to be made in this particular, and have given a series of Resolutions in the Appendix, which, when the high authority from which they emanate is considered, are of sufficient importance to be subjoined to this account.

On the whole it appeared to the Committee that there remain still so many doubtful points to be ascertained, that it would be desirable to institute A COMPLETE SET OF EXPERIMENTS, for the purpose of fixing the principles on which they should be constructed, which ought to be tried not in a cursory manner, but for a considerable length of time, in situations best calculated to produce results which might be depended on for their accuracy and universality.

As far as regards *the preservation of the roads*, the Committee state, it must be obvious that notwithstanding any improvements which may be made in the construction or mode of conducting carriages, yet if equal care and attention is not paid to the original formation, and also to the constant preservation of the roads, all the prudence of the economical carrier, all the skill and ingenuity of the mechanic, are of little avail. The beſt modes of *forming* roads, are now understood and carried into execution in most parts of the kingdom; but some regulations appear to the Committee to be still wanting for their due *preservation* and *management*.

In conclusion, the Committee report that some particulars have come under their consideration in the course of their investigation, which they wish to impress upon the House. The first relates to the improvements which might be made in the general laws regarding high-and turnpikes; and they are decidedly of opinion that these laws require to be reconsidered; and perhaps it would be most adviseable, though it would be an arduous task to repeal the former Laws, and to form the whole into one regular digest. They think it right also to notice a coach invented by the Rev. William Milton, with a view to the greater safety of passengers; but do not hazard an opinion on the merits of this invention *. They conceive the idea of conveying goods and carriages on railways is likely to prevail, the more the subject is considered: in many instances they think them preferable to canals, and an idea is thrown out for the consideration of ingenious men, of forming what may be called *stone railways*. The Commercial-road leading from the West-India Docks is mentioned with considerable approbation; the centre of that road is paved of a convenient breadth for the use of carriages heavily laden, while the lighter carriages and horses pass with ease on each side on a road formed in the usual manner. The direction and the forming of roads are also points which they conceive to merit the attention of Parliament, as it is well known that in former times roads were not conducted in the manner best calculated for the travelling of carriages heavily laden, their course being frequently carried up steep ascents to gain the open country and avoid the vallies; and they are of opinion, that by examining the lines of the present roads, much improvement might be effected, and that, though such alterations must necessarily occasion expense, and be liable to some objections, at the same time it is worth the trial; and they recommend the first experiment to be made on the great line of road between London and Edinburgh, the capitals of the two kingdoms.

* For an account of this invention see the specificatien of the patent in the ninth volume of the present series, page 172.

They

They conceive the points which they have alluded to in the Report, to be of infinite consequence to the convenience, the comfort, the commercial prosperity, and the personal security of their fellow-subjects; and have endeavoured to furnish such information as they trust may be of service, when these particulars come again under the consideration of the House.

Resolutions suggested by a Member of the Committee for promoting the better Preservation of the Roads of the Kingdom, as far as regards the REGULATION OF WEIGHTS.

1. That no waggon whatever should be permitted to be drawn on any highway, which, including the burden contained therein, should weigh more than 6 tons 10 cwt. in summer, or more than 6 tons in winter, except such burden be a single block of stone, a single cable rope, or piece of metal or timber, or such ammunition or artillery as shall belong to His Majesty. No such articles which, including the carriage, shall exceed the greatest weight allowed by law, shall be carried on any carriage having less than four wheels of nine inches breadth in the fellies. All such articles, not being ammunition or artillery actually belonging to His Majesty, to pay additional tolls in proportion to the additional weights.

2. That no cart shall be permitted to be drawn on any highway or turnpike road, which, including the burden contained therein, should weigh more than 3 tons 5 cwt. in summer, or 3 tons in winter.

3. That waggons, the fellies of whose wheels are flat and cylindrical, and the direction of the centre line of their axles straight and horizontal, shall be allowed to be drawn, weighing, with the burden included, as follows:

With

	In Summer.	In Winter.
With the fellies 9 inches broad	6 tons 10 cwt.	6 tons.
8	5 tons 15 cwt.	5 tons 5 cwt.
7	5 tons	4 tons 10 cwt.
6	4 tons 6 cwt.	4 tons.
under 6	3 tons	2 tons 10 cwt.

If the four wheels are so placed as to roll a surface less by two inches than double the breadth of each wheel, to be allowed an additional half ton in such case, so that no carriage, with the burden thereon, at any time weigh more than 6 tons 10 cwt.

	In Summer.	In Winter.
Carts with the fellies 9 inches broad	3 tons 5 cwt.	3 tons.
8	2 tons 17 cwt.	2 tons 12 cwt.
7	2 tons 10 cwt.	2 tons 5 cwt.
6	2 tons 3 cwt.	2 tons.
under 6	1 ton 10 cwt.	1 ton 5 cwt.

4. That no stage coach with four wheels, and drawn by four horses, shall be allowed to be drawn, including the weight of the carriage, weighing more than 2 tons 10 cwt. nor carrying more than 16 persons, in winter or summer, including the coachman and guard.

5. That the tire of the fellies of the wheels of such coaches be flat and cylindrical, and four inches broad, rolling six.

6. That four-wheel coaches, the tire of whose fellies are flat and cylindrical, and three inches broad, rolling five, be not allowed to carry more than 2 tons, including the carriage and passengers, in winter or summer, nor more at any time than 12 persons, including the coachman and guard.

7. That four-wheel stage coaches, having the tire of the wheels flat and cylindrical, and three inches wide, rolling single surfaces, be not allowed to carry more than 1 ton 15 cwt. including the carriage and passengers, nor more at

at any time than 9 persons, including the coachman and guard.

8. That no four-wheel stage coaches, having the tire of the fellies under three inches in breadth, be allowed to carry more than 1 ton 10 cwt. in winter or summer, including the weight of the carriage and of the passengers, nor more at any time than 6 persons, including the attendants.

9. That all carriages carrying fodder and manure should be liable to the same restrictions and limitations with regard to weights, construction of wheels, and the number of horses, as all other carriages, in order to exempt them from the payment of any part of the tolls granted for the maintenance of any turnpike road.

10. That all carriages which are now exempt from the payment of tolls, on account of their carrying fodder or manure, shall, if they pass over more than miles on any turnpike road, be liable to pay one half of the tolls payable by carriages of a similar description on the same road.

11. That from and after years the use of all waggons, if drawn by more than horses, and carts, if drawn by more than one horse, having the tire of the fellies less than six inches in breadth, shall be prohibited to be used on any turnpike road.

12. That from and after years, the use of all waggons, if drawn by more than horses, and of carts, if drawn by more than one horse, having the tire of the fellies of less breadth than six inches, shall be prohibited to be drawn on any highway.

13. That the tire of the fellies of all waggons, carts, and other carriages, shall be flat, the nails counter-sunk, the circumference of the wheels cylindrical, and parallel

to

to each other in the whole of their circumference, and the line of the centre of the axles sraight and horizontal.

14. That Justices of the Peace shall in all cases be empowered to punish offenders against the Highway Laws, at whatever distance they may dwell from the place where the offence has been committed.

List of Patents for Inventions, &c.

(Continued from Page 240.)

ENOCH WOOD, of Burslem, in the county of Stafford, Potter; for a method or contrivance of applying power for the purpose of raising water from a lower to a higher level. Dated July 30, 1807.

ROBERT DICKINSON, of Long Acre, in the county of Middlesex, Esquire; for certain improvements on or in machinery for improving turnpike and other roads, and for other purposes. Dated August 1, 1807.

EDWARD COKE WILMOT, of Birmingham, in the county of Warwick, Gentleman; for an instrument for the purpose of warming beds, and which may be applied to various other purposes. Dated August 10, 1807.

RICHARD REES, of Red Lion-passage, in the County of Middlesex, Cutler; for certain improvements in trusses for persons afflicted with ruptures.
Dated August 25, 1807.

THE

REPERTORY

OF

ARTS, MANUFACTURES,

AND

AGRICULTURE.

No. LXV. SECOND SERIES. Oct. 1807.

Specification of the Patent granted to APSLEY PELLATT, *of St. Paul's Church-yard, in the City of London, Glass Manufacturer; for an improved Method for admitting Light into the internal Parts of Ships, Vessels, Buildings, and other Places.* Dated July 7, 1807.

TO all to whom these presents shall come, &c. Now KNOW YE, that the said Apsley Pellatt, party hereto, in pursuance of the said proviso, clause, condition, and restriction above recited and mentioned to be contained in the above-recited letters patent, doth, by this instrument in writing, under his hand and seal, make, declare, specify, and set forth, the description of the nature of his said invention, and of what materials, and in what manner the same is to be formed, constructed and applied, in manner and form following; that is to say:

This method consists in placing an illuminator in suitable apertures in the decks or sides of ships and vessels, and in buildings and other places, to answer as a winoow or sky-light.

This illuminator is a piece of solid glass, of a circular or elliptical form at the base; but the circular form is the most productive of light, and the strongest against accident: it is convex on the side to be presented outwards, to receive and condense the rays of light, and has a flat or plane surface on the inside of the room or apartment which it is intended to light. It is, or approaches to a segment of a sphere or spheroid; it is in fact a lens: both sides may in general be left polished; but where the illuminator is to be placed in a situation where any danger may be apprehended of its being acted upon as a burning glass, one side at least should be ground or roughed. Its size is various, according to the purpose or situation for which it is designed, and its convexity is increased or diminished according to the size required. The ordinary dimensions are a base of about five inches diameter to one-half inch in height from the centre of the base; the illuminator is fixed in a square or circular frame, made of wood or of metal, with glaziers' putty or other cement.

For decks and other parts of ships its construction is so managed by thickening the edges as to render it capable of resisting any injury from the weight of goods of every description, and the beating of the waves of the sea, in the ports and scuttles. It is let into the deck or other building with the convex part projecting above it so as to receive the rays of light: it is fixed in the deck or other building either with or without a wooden or metal frame, according as the space wherein it is to be fixed will allow; a groove of only one quarter of an inch will be sufficient to keep it firm, and in a deck of three inches thick one quarter of an inch is bearing enough; in decks of less substance the bearing must be increased one-eighth of an inch.

The

The under part of the deck or other building which forms the ceiling of the cabin or place must be sloped away all round, so as to form a small dome, that the rays of light may diverge in all directions: the like method is to be observed in the ports and skuttles of ships, or in what place soever the illuminator is fixed. By being fixed in a square or round frame, with or without hinges, it may be made to open and shut, for the free admission of air in hot climates.

In dwelling-houses, buildings, and all other places, it is far superior to the sky-lights now generally used, not being liable to accident or leakage, nor can water pass under what it is fitted into. For buildings it is necessary that one side should remain unpolished, as the rays of the sun produce the prismatic colours when shining on the illuminator. This precaution is unnecessary in ships decks, as the traffic on them in a short time grinds or roughs the upper surface, but in no degree to prevent the effect, but if any thing conveying a more pleasing light. Under-ground vaults and cellars, wherever any communication may be made with the open air, may also be lighted with this invention, excepting only where from its situation it may be liable to injury from the passing or repassing of horses, &c.

The illuminator will also prove a very important substitute for the glass now used in lanthorns for lighting the powder magazines in ships of war, care being taken that the convex side be in the inside of the lanthorn where the light is placed.

In witness whereof, &c.

Specification of the Patent granted to JOSEPH BOWYER, *of Kidderminster, in the County of Worcester, Carpet Manufacturer; for a Method of working or manufacturing of Carpeting for Carpets and Carpet-Rugs not heretofore used.* Dated May 29, 1807.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Joseph Bowyer do hereby declare, that the nature of my said invention consists in the working and manufacturing carpeting for carpets with a floating ground upon a new principle, and makes it a more firm and durable article, differing very much both in quality and elegance from Brussels and pile carpeting; the groundwork is a firm and even body, which cannot be roved or pulled out by brushing and cleaning, or by the scratching of dog or cat, or any other animal, as Brussels may. The pattern or figure is raised above the ground-work, and appears as needle-work worked upon it, although wove in the same kind of loom or machine, and raised by wires the same as Brussels or pile carpeting is; it may be made both comber and point, and the whole is performed in the following manner. The pattern to be drawn with a plain or figured ground: the figure or figures on the ground may consist of one, two, three, four, five, or more colours, to work under each other; or any other number of colours may be put to work across the pattern as in Brussels or pile carpets, and read in and put into the loom the same as Brussels or pile now in use, (or in any other way which may answer the same purpose,) the ground excepted, which is not to be read in, or pitched up by the reader in, as the draw-boy or person usually employed in making of carpets need not draw or raise any part of the ground-work, unless the weaver wishes it to to be done, for the purpose of making it more easy to himself. A chain or warp is to be prepared to make a floating ground; which chain or warp is to consist of double the number of threads now usually used in one ground frame for making of carpets, or the number of threads may be more or less, as may be thought proper. The chain or warp so prepared is to be turned on a roll or beam, and worked under the frames, or in any other part of the loom, as may by the weaver be thought best; or it may be worked in one or more frames with bobbin and ball, and bobbin and anchor, or by any other means that may answer the same purpose. This ground-work need not work in any of the eyes of what is called by weavers the great harness, but requires two additional shafts added to the little harness, the ground to be made of worsted of any colour, or it may be made with woollen, silk, cotton, or any other like materials. The under or binding part to consist of flax or hempen thread, or any other like article that may answer the same purpose. The little harness to make this work to consist of five or more shafts; if worked with five to be drawn in manner following, that is to say; two to work the floating ground, two to work the linen or binding part of the ground, and one to work the colours that form the figure or flowers, or the one which in making the Brussels carpeting is called the pole-shaft. The above may be worked with four or six treadles. If the weaver chooses to raise the floating part of the ground by his feet he must have six treadles, or he may cause his draw-boy, or employ a person or machine for that purpose, to raise it for him. In that case four treadles will be sufficient, worked as common Brussels are; but if the weaver raises the floating-ground himself, to be worked in the following manner, or in any other mode that will produce the same effect.

In

In the first place, the draw-boy or person employed for the purpose of raising the colours for forming the pattern, draws a lash, and turns up the sword; the weaver at the same time treads the outside treadle on one side, which raises one part of the floating ground, and throws in a shoot of worsted, woollen, silk, cotton, or any other like material that will produce the same effect. He then takes his foot off the outside treadle, the sword remaining up, he puts in a wire rod, or any kind of instrument capable of raising a pile either for cut or drawn. The sword is then taken out. He then treads the second treadle, which raises the same part of the floating ground with one of the binding shafts, throws a binding shute of linen, or any other like article that may be thought best for that purpose. He then treads the third treadle that treads down the binding shaft only, which was raised by the last treadle, and raises the rest. He throws a shute same as on the last treadle, (or any other kind if he thinks proper), which is the binder for that wire. He then proceeds, the draw-boy draws a fresh lash, he treads the outside treadle on the other side, and raises the other part of the floating ground, which was not raised before, and binds it with the two next following treadles in manner as is above described.

The method and nature of performing and making my carpet-rugs is on the same principle, materials, &c. as before described in respect to carpets, with the addition of a strong warp of hemp, flax, or any like strong article, so as to give it more strength or substance to work in with the main body of worsted in the pole shaft, or any other manner or mode so as to give it the same effect; also a larger-sized wire rod, or any like kind of instrument to raise a higher pile.

In witness whereof, &c.

Specification

Specification of the Patent granted to HENRY MAUDSLAY, *of Margaret-street, Cavendish-square, in the County of Middlesex; for certain Improvements in the Construction of Steam-Engines.* Dated June 13, 1807.

With Plates.

TO all to whom these presents shall come, &c. Now KNOW YE, that in compliance with the said proviso, I the said Henry Maudslay do hereby declare that my said improvements consist in reducing the number of parts in the common steam-engine, and so arranging and connecting them as to render it more compact and portable, every part thereof being fixed to and supported by a strong frame, of cast-iron or other materials, perfectly detached from the walls of the building in which it stands, and thereby less expensive in fixing, and not liable to get out of order by the sinking of foundations, &c. The different arrangements and combinations I adopt are fully described by drawings of a one-horse steam-engine hereunto annexed, the same proportions being observed in engines of any power. Observe, the same letters refer to the same parts in each figure throughout the drawings.

Figs. 1 and 2 (Plates XIII and XIV.) represent a front and end elevation.

Fig. 3 a plan.

Figs. 4 and 5 are a sectional elevation and plan, shewing those parts which are unavoidably concealed in the foregoing figures.

Figs. 6 and 7 are certain parts on an enlarged scale, for the sake of illustration. A is the frame-work, of thin cast-iron. B are two cold water cisterns, of cast-iron, no larger than to admit of easy access to the pumps, &c. therein

therein contained, and communicate with each other by a pipe *a*. C is the steam-cylinder, inclosed in a casing of copper or other materials *b*, having the intermediate space filled with wool, or some other bad conductor of heat. D the piston-rod. E the small rods. F a small groved wheel running between two guides *c c*, to preserve the perpendicular motion of the side rods. G the connecting rods. H a three-throwed crank. I a small wheel or roller which works in the fork of, and gives motion to, the cross beam J, to which are attached the rods of the air, and hot and cold water pumps. K the fly-wheel fixed on the crank-shaft. L the condenser containing the air-pump M, simplified in its construction by forming the valves *d e f* of round metal plates; the two latter have holes at their centre *e* for the pump-rod to pass through, and *f* for the stuffing-box. N the hot water cistern. O the hot water pump. P the cold water pump. Q the injection cock, adjusted at the index *g*, while the index *h* adjusts the steam-cock by cranks, levers, rods, &c. R the steam-pipe from the boiler to the cylinder. S the eduction pipe from the cylinder to the condenser. T a four-way'd cock for making the alternate communications from the boiler to the upper and under side of the piston to the condenser, and is moved by an upright arm V, fixed on the cross-beam J, the motions of which are described in Figs. 6 and 7, when the pin *i* works in the crutch W, so formed as not only to move the cock at proper intervals, but almost instantaneously leaving it motionless during the remainder of the stroke.

In witness whereof, &c.

Specification

Fig. 6.

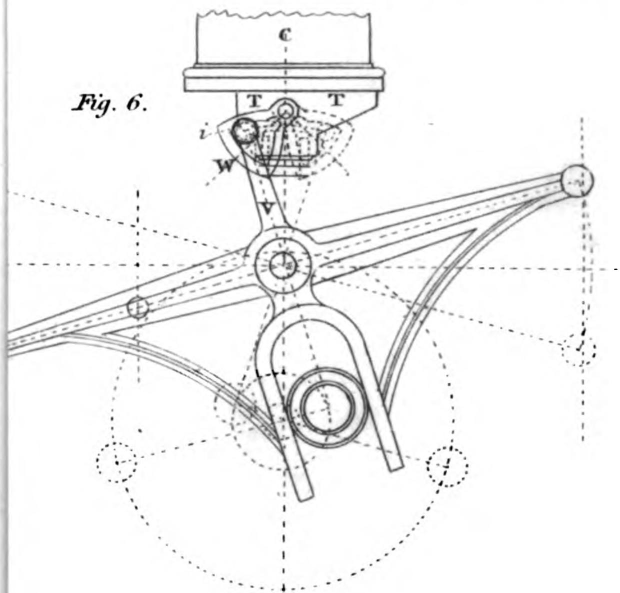


Fig. 7.

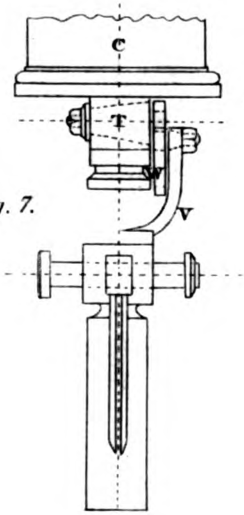


Fig. 2.

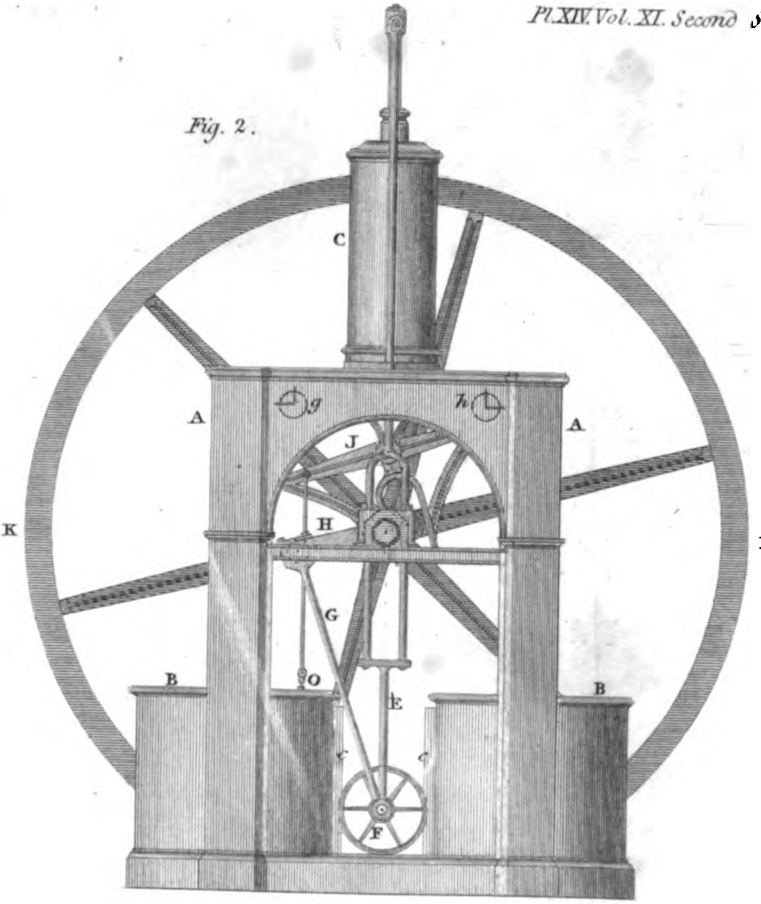
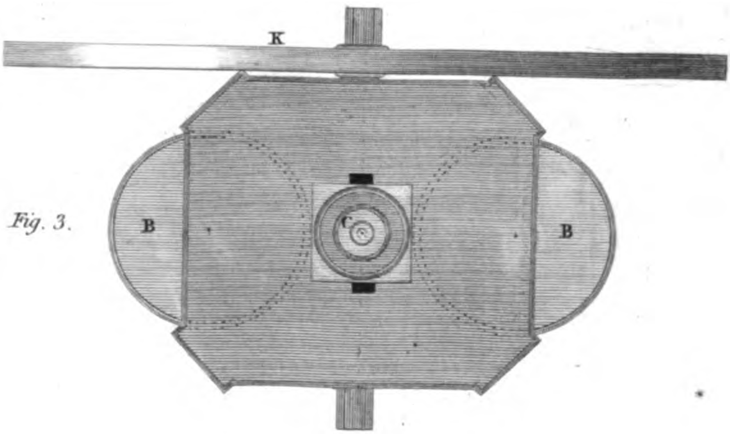


Fig. 3.



Specification of the Patent granted to John Palmer, *of Enon Cottage, Shrewsbury, in the County of Salop; for a new Method of constructing and erecting Bridges.*

Dated June 26, 1807.

TO all to whom these presents shall come, &c. Now know ye, that in compliance with the said proviso, I the said John Palmer do hereby declare that my said invention is described in manner following; that is to say: 1st. The abutments of proper materials, as in the construction of common bridges, inclosing a bar or beam of cast-iron, of sufficient strength and thickness to bear the weight intended, and so secured as to prevent the possibility of its giving way. 2dly. The piers or supporters are to be of cast-iron, erected on platforms or bases of cast-iron, resting on rocks or other hard materials. These supporters may be formed of ten, fifteen or any number of cast-iron columns, according to the width of the bridge and the weight they are intended to bear, with two or more cast-iron stays, to go from each of these columns into the platforms or bases; one large cast-iron beam or more to rest on the top of the columns, so as to unite the whole together and sufficiently strong. There may be many piers or supporters formed in this way proportioned in height, width, and strength to the design of the architect; or the piers may be made of stone or brick, as in other bridges. 3dly. From the abutments to the piers or supporters, and from one of these to another, chains must be passed, made of iron, brass, copper, or any other metallic substance. These chains may be either flat, circular, or oval; or any other construction; and must be placed parallel with each other, and drawn to the same degree of tightness. If they swag, iron or other metal rods should be passed through at proper distances, like basket-work, which will brace them, and being properly braced and fastened (after having been first proved) form a support for the road-way. 4thly. On these chains planks are to be laid of about eight inches wide and four thick. These planks should be fastened to each other with hinges or rings, which would keep them in their places, and yet allow them to move properly with the chains; or rather, the passage from one pier or set of supporters to another may be made in this way: let flat chains be formed of hinge-work, from about four to twelve inches long, sufficiently strong and proved. These are to be laid as the chains, and the planks fastened to them, as in common door-work. A road may be made by these means that would bear any weight. 5thly. The guard or side fences of the bridge may be well-formed by fixing chains of any construction sufficiently strong from one upright to another, placed on the top of the piers or supporters; and if thought necessary, placing iron wire against them on the inside of about nine or ten feet high. Bridges on this plan may be so constructed as to take down and replace at pleasure with very little trouble or expense, and may be repaired with the greatest ease when found necessary.

In witness whereof, &c.

Description

Description of a Stove for heating Rooms or drying different Articles. Invented by Mr. George Field, *of Newman-Street.*

With a Plate.

From the Transactions of the Society for the Encouragement of Arts, Manufactures, and Commerce.

The Silver Medal was voted to Mr. Field *for this Invention.*

Fig. 1 (Plate XV.) represents a longitudinal section of the stove, shewing the course of the air from its entrance into the flues of the stove at A, to its entrance into the upper chamber of the stove at B; and also the course of the smoke from the fire-place at C till it escapes from the stove at D. E E are the doors or openings of the fire-place and ash-hole.

Fig. 2 is a similar section at right angles with the above, exhibiting the course of the air through the chambers of the stove, from its entrance into the chamber No. 1 at B to its entrance beneath the fire-place at F. This figure also shews sections of the flues, with the divisions through which the air and smoke pass separately, the smoke flue in the centre, and the air-flues on each side. G G are doors and openings through which the articles to be dried are introduced into the chambers.

When the fire is lighted, and the doors of the chambers, ash-hole, and fire-place closed, the air by which the fire is supplied enters at A, Fig. 1, passes through the air-flues *a a a a*, enters the upper chamber at B, traverses and descends through the chambers Nos. 1, 2, 3, and arrives beneath the fire at F, Fig. 2. Having supplied the fire with oxygen, it passes through the flue with the smoke, and escapes at D, heating in its protracted course the chambers and air-flues.

As the cold air enters the stove at A, immediately above a plate forming the top of the fire-place, and pursues a similar rout with the fire-flue, it enters the chambers very much heated and rarefied. Hence any moist substance placed in the chambers evaporates in consequence not only of the heated flues circulating round them, but of a stream of warm rarefied air, which, while it continually raises evaporation, as continually bears away the exhaled moisture in its passage to the fire, thus imitating the gradual and efficacious plan of nature in drying by the sun and air. While these effects are taking place within the stove, part of the air which enters at A, Figs. 1 and 2, passes through air-flues on the other side of the fire-flue, pursues a parallel course with the first, and gives out a current of warm air to the room at an aperture H. This effect may be obtained in a much higher degree if the doors of the chambers and ash-hole are opened: should the hand or face be then brought near, they would be fanned with a stream of warm air, especially from the upper chamber.

By means of this stove I have evaporated milk to dryness, without burning or discolouring it; and have dried cherries, plums, and other fruits, so as to imitate those which are received from abroad. I have repeatedly dried colours and the most delicate substances without the slightest injury to them, even though the operation proceeded quickly.

The height of the stove is about five feet and a half; its diameter two feet and a half; and that of the flues four inches. The external part is constructed of brick, and the internal parts of thin Ryegate or fire-stone, except

cept the top of the fire-place, which is a plate of cast-iron. Were it to be wholly formed of iron, its effects would necessarily be more powerful.

Fig. 3 represents an extension of the plan, in which stoves of this kind may be advantageously connected with one or more furnaces for chemical or other uses. The fire-place, brought out, either in front or on one side, by the present position of its crown I, forms a reverberatory furnace, or will make a sand-bath by reversing it.

The space occupied by the fire-place in Fig. 1 may in this be converted into apartments for evaporating substances, or occasionally for cooling them by an opening at K to admit cold air, while the warm air of the stove is excluded by a register or door. The dotted lines shew the manner in which a second furnace may be connected by an opening into the flue at L.

In addition to the uses already pointed out, this stove would probably be found extremely serviceable in drying japanners' goods, and consuming the noxious fumes and gas which arise from the oil and varnish used in this business.

Since the stove is not limited to any certain dimensions, it might be adapted to the drying of malt and hops, perhaps of herbs, corn, and seeds generally. It might also be accommodated to the purposes of the sugar-bakers, connected with the great fires they employ for their boilers. It has been shewn to be useful in the confectioners' art, and probably it may be equally so in baking biscuits for the navy; nor less so in drying linen for the laundress, dyer, calico-printer, and bleacher. I have myself found it well accommodated for a chemical elaboratory.

The efficacy of the stove in ventilating, boiling, and steaming may easily be shewn. In manufactories, and rooms generally, the heated and noxious part of the atmosphere

mosphere ascends towards the cieling : if then the air-flue M, Fig. 5, is continued upwards according to the height of the room in which it is placed, the air will be drawn from the top, and the room become ventilated, while from the opening at N it is supplied, if requisite, with warm air.

It is unnecessary to shew the various ways in which a boiler may be connected with this plan : it is sufficient to observe, that in the space allotted for the fire-place in Fig. 1, there is sufficient room within the body of the stove for this purpose ; and that if the circulating air be made to pass over the boiler, evaporation may be carried on very expeditiously by the air removing the vapour as it arises. Finally, if another division of the flues be made in the manner shewn in Fig. 2, it might form a steam-pipe or flue, running the course of the air and fire flues to convey steam to one or more apartments of the stove ; or extended beyond the stove for heating the room in which it stands. One of the air-flues might occasionally be adapted to this use. It is obvious that the power of steam in a heated apartment would be not only greater, but better kept up. In steaming it would be necessary to close the apartments of the stove, and to give air to the fuel by a different course.

As the stove is not confined in its dimensions, so neither is it necessarily of the form described in the drawing, nor are the apartments necessarily three : all these particulars admit of variation according to local or other circumstances. It is evident that the air-flues themselves may be converted into chambers for drying, &c. ; and the fire-place of Fig. 3 is well adapted to receive an apparatus for the decomposition of coal, &c. ; for producing all the effects of the thermo-lamp, or illuminated smoke, &c. But it is needless to enumerate the many economical

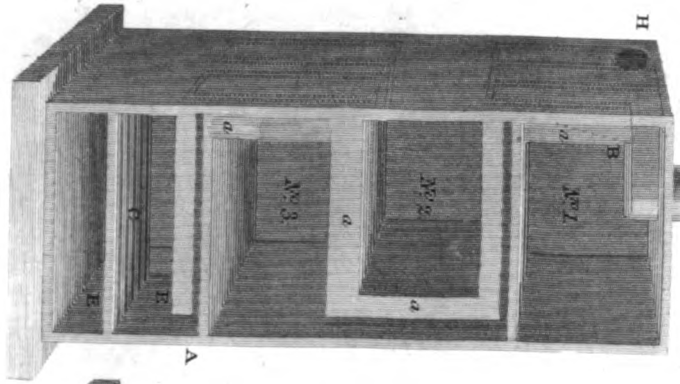


Fig. 1. Side

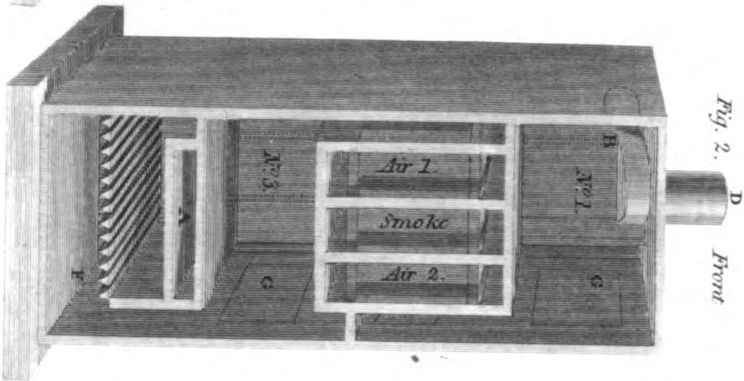


Fig. 2. Front

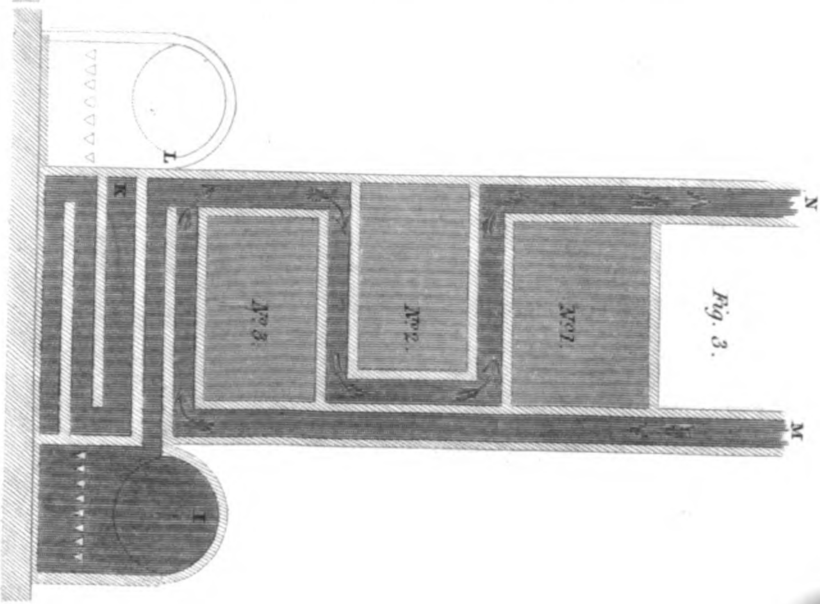


Fig. 3.

economical and philosophical uses to which the stove may be applied. It is sufficient for the present purpose if I have rendered the principle and plan intelligible, the artist and manufacturer will then be at no loss in adapting it to the particular object, which he may require it to accomplish.

A Certificate from Mr. S. Sellers, Chemist, Broad-street, Bloomsbury, accompanied this communication, stating that the effects of the stove in question are as Mr. Field has described them in his paper addressed to the Society.

On the Subject of Weeding; or Improvements to be effected in Agriculture by the Extirpation of Weeds. *By Mr.* WILLIAM PITT, *of Wolverhampton.*

From the COMMUNICATIONS to the BOARD of AGRICULTURE.

THE cleaning of all kind of crops, and keeping them free from weeds, is an essential part of cultivation; which if omitted, neglected, or but partially performed, a part of the cultivated crop will be lost, in proportion to the prevalence of such weeds, from defective preparation, or partial extirpation; for the nourishment drawn from the ground by the roots of all vegetables being somewhat similar, where that nourishment is suffered to be drawn by weeds it is lost to the intended crop, which will therefore be reduced in produce in proportion as it has been deprived of nourishment, and prevented from occupying its whole extent of ground.

The same observation will apply to pastures, to hedges, and to plantations, and to all parts of the earth's surface reclaimed, occupied, and cultivated for the use of man; for

for therein the growth of noxious or useless plants will be injurious to the success of the useful ones; and in proportion as the former abound, the latter must prove defective.

The cleaning of a crop from weeds must be effected in two ways: 1, in the preparation; and, 2, during the growth of the crop. In the preparation, attention must be given to distinguish root-weeds from seedlings, as their destruction must be effected upon different principles.

The vegetables we term weeds are more hardy and tenacious of growth than any others; nor indeed can it be otherwise than that those plants which succeed in spite of opposition, must be of the most hardy kind. The production and growth of weeds is equally consistent with the divine goodness with that of the most valuable plants; for myriads of diminutive creatures, enjoying life and animation, are supported by them, and to whom they are a more natural prey than the dietetic plants of mankind: and man, possessed of reason, reflection, and intelligence, has powers and abilities to select and cultivate such vegetables as are adapted to his use, and proper for his sustenance, and to destroy and extirpate others; and thus to appropriate to himself what proportion he thinks proper of the earth's surface; which if he neglects to dress and cultivate properly, it will in some degree revert to its natural state, producing the hardier and more acrid plants for the sustenance of numberless tribes of insects, and for an infinity of other known and unknown uses; and indeed were it otherwise, the indolence of the human race might in some measure suspend the bounty of Providence, and the fertile parts of the earth's surface, instead of being covered with an universal verdure, would by indolence or neglect be rendered little different to the sterile and barren desert.

The

The plants we term weeds, considered as respecting mankind, are not totally useless; many of them have valuable medical qualities, and some of them may be applied to uses so as to pay something towards the expense of clearing them from the ground: thus, sow-thistles are good food for rabbits or hogs: the hog-weed *(Heracleum)* is good for either hogs or cattle: horses are said to be fond of young thistles when partially dried, and the seed may be prevented from spreading by gathering the down, which makes good pillows; however there is some danger in trusting them to this stage of growth, as a high wind would, and frequently does, disperse them over a whole country. Chadlock, when drawn, may be given to cows, who are very fond of it, particularly of the smooth kind; and in the Oxford Report it is stated that it can be converted into good hay.

Nettles, fern, and the more bulky hedge-weeds, are in Staffordshire collected annually about Midsummer, and burnt; their ashes being afterwards formed into balls, which are of considerable value, being used in composing a ley for scouring and cleaning linen and other clothes.

It is said that pigeons are of use in picking up the seeds of many weeds that would otherwise vegetate; and I have no doubt but a prodigious quantity of the seeds of weeds are eaten by small birds, particularly of most of the lake-weeds *(Polygonums)*, of the spurrey *(Spergula)*, and, in severe weather, of the different sorts of chadlocks *(Sinapis, Brassica,* and *Raphanus)*, and of many other kinds.

It has been observed, that bees have not thriven so well in this island since the extirpation of weeds has been more attended to.

In Japan and in China (it is said) not a weed is to be seen; and that they only make use of night-soil as a manure, partly with a view of preventing any risk of weeds.

Weeds, like all other vegetables, may be distinguished into annuals, biennials, and perennials, according to their term of duration.

Annuals are those which continue only one year, the plant dying after perfecting their seeds: these are generally very prolific in seeds.

Biennials are those which continue two years, and die after perfecting their seeds the second year: these are also prolific in seeds.

Perennials are those which continue many years; some of these perfect their seeds every year, and others being very tenacious of growth by their roots, and having the faculty of reproducing themselves in this way, are less prolific in seeds; but many of them increase both by roots and seeds.

A list or catalogue of weeds, or plants injurious to cultivation, formed by a person whose observations have been chiefly confined to a local spot, must evidently be imperfect, as many kinds common and noxious in other places may be unobserved there, and omissions will be the consequence; this may be, in some measure, the case with this Paper, for though the writer of it has seen many other parts of the kingdom than his own neighbourhood, yet he may not have examined them particularly enough to be minutely acquainted with their spontaneous productions; additions will therefore be wanting from observations made elsewhere.

The following is a list of weeds or plants injurious or noxious to cultivation, or cultivated land, principally observed by the writer hereof, growing in

I. Gardens,

II. Corn-fields,

III. Meadows and pastures,

IV. Waste and uncultivated land,

V. Hedges,

V. Hedges,

VI. Woods and plantations;

with some observations on their injurious tendency, methods of extirpation, and instruments made use of for that purpose.

I. *Garden Weeds, are,*

1. Couch grass, or, as here called, squitch; the roots of the hardy perennial grasses, extremely tenacious of growth; they are the dog's grass *(Triticum repens)*, the white bent grass *(Agrostis alba)*, and the tall oat grass *(Avena elatior)*. The distinction between these grasses is very observable in their flowering stems, and in the ears or awns containing their seeds, which are as separately distinct as those of the different kinds of grain; moreover, the latter *(Avena elatior)* has a bulbous jointed root, which affords shelter to various destructive grubs, worms, and insects; there cannot therefore be too much pains used to destroy them: they are to be destroyed in gardens by carefully picking out the roots in digging, and as carefully rooting up whatever remaining fragments of the roots may send out a shoot above ground; the roots of the two former are so very vigorous and tenacious of growth, that they will even perforate a potatoe: if they are suffered to get a head they will form a perfect matting beneath the surface, and a green carpet above, to the almost total extermination of any other plant; they cannot, therefore, be suffered where any other plant is cultivated.

2. Suffolk grass, dwarf meadow grass *(Poa annua)*, almost harmless in its roots, but increasing so rapidly and abundantly by its seeds, as soon to occupy the whole extent of ground near it, if not timely prevented; common in gravel walks and pavements, or other spots where the surface is not repeatedly disturbed by the spade or

 hoe;

hoe; so very prolific in its seeds, that it will produce and reproduce itself four times in one summer: may be destroyed by taking care to root it out before its seeds are perfected and shed, otherwise the vegetation will be so abundant as almost to bid defiance to the weeders. Mr. Curtis recommends scalding it with boiling water, as the most expeditious method of destroying it. This, though a garden weed, is a sweet and good grass in pasture land.

3. Catchweed, goosegrass, cleavers, in Staffordshire commonly called hariff *(Galium aparine)*, more common in hedges than amongst a crop, but if the seeds are permitted to shed will become troublesome, as they are numerous and productive; leaves rough, so as to draw blood from the tongue by once or twice gently drawing along, as I have seen experienced; may be easily destroyed in gardens by drawing up before the seeds are perfected. Young geese are very fond of the branches of this plant; the seeds may be used instead of coffee; the expressed juice of the stem and leaves, taken to the amount of four ounces night and morning, is very efficacious in removing many of those cutaneous eruptions, which are called, though improperly, scorbutic; but it must be continued for several weeks. These observations from Dr. Withering.

4. Garden nightshade *(Solanum nigrum)*, common in gardens near Brompton and Chelsea (as observed to me by Mr. Curtis), but seldom found in the country; though I have found it on dunghills. Being an annual plant, it must be destroyed by rooting up before its seeds are perfected.

5. Goosefoot, wild orache *(Chenopodiums album, viride,* and *hybridum)*, common and luxuriant in our gardens, very prolific in seeds and in produce therefrom, if not rooted out before the seeds are scattered on cultivated land,

land, they being very hardy and tenacious of growth. Like all other annual seedlings to be destroyed only by rooting up.

6. Wild orache, fat-hen *(Atriplex hastata)*, nearly allied to the chenopodiums, from which it is only distinguished by some of the flowers having only pointals, whilst others on the same plant have both chives and pointals, in common with the chenopodiums: flowers small, so that this distinction can only be ascertained by the microscope, growing on rubbish, dunghills, and in kitchen-gardens; an hardy annual, very fertile in seeds; to be prevented or destroyed by the same precaution recommended for the last. It is sometimes gathered as a pot-herb, and eaten in lieu of spinach and other greens. Withering.

7. Fool's parsley, lesser hemlock *(Æthusa cynapium)*, common in our gardens, and in its early growth resembling parsley, for which it is often mistaken, and when eaten it occasions sickness: if the curled-leaved parsley alone was cultivated, no such mistakes would happen (Withering): when running to seed it detects itself, in that state differing much from parsley; it should then be rooted out.

8. Knot grass *(Polygonum aviculare)*, sometimes growing on gravel walks, trailing a considerable length in all directions, very prolific in seeds; care should therefore be taken to root it up before the seeds ripen: hogs are fond of it.

9. Ground ash *(Ægopodium podragraria)*, described to me by Mr. Curtis as a very troublesome weed in gardens near London; but, as far as I have observed it, confined mostly to the shade of hedges; the leaves may be eaten early in the spring with other pot-herbs. (Withering.) The plant is, I believe, perennial, and should be prevented

vented gaining a footing in land intended for other crops.

10. Chickweed *(Alsine media)*, sometimes growing with great rapidity and luxuriance on land much pulverized by operose cultivation; an annual plant, very productive of seeds, and where it abounds it is perhaps improper to give the land a fine culture till it in some measure disappears; the young shoots and leaves, when boiled, can hardly be distinguished from spinach, and are equally wholesome: swine are extremely fond of this plant, and it is a grateful food to linnets, to the Canary bird, to other small birds, and to young chickens. Withering.

11. Black bind weed, here called bearbind *(Polygonum convolvulus)*, a parasitical plant, often climbing up beans and other garden plants, hardy, and extremely prolific in seeds, of which one plant will sometimes produce many hundreds; if the ground be meant to be kept clean of this plant, the seeds should never be suffered to shed: the seeds contain a fine white flour, and are good for pigeons, poultry, and small birds.

12. Spurge devil's milk *(Euphorbia)*, chiefly I believe the sun spurge *(Euphorbia helioscopa)*, an annual plant, not very troublesome, nor difficult of eradication, yet not uncommon in gardens, where I believe it would soon become extinct if attention were paid to root it out before its seeds were scattered.

13. Red dead nettle, or dee nettle *(Lamium purpureum)*, called an annual plant by Linnæus, and a perennial by Hudson; common in our gardens, and flowering early, and a greater part of the year; the growth doubtless principally from seeds, which therefore should not be suffered to shed. Withering observes that the young leaves may be eaten as a pot-herb, but I believe they seldom or never are in this country.

14. Henbit

14. Henbit (*Lamium amplexicaule*), an annual garden weed, which should be weeded out before its seeds are perfected.

15. Nettle hemp (*Galeopsis tetrahit*), a luxuriant and disagreeable garden weed, which should be rooted out in time.

16. Garden sow-thistle (*Conchus oleraceus*), common, and of luxuriant growth. The seeds of this plant should never be suffered to shed in any situation, for being furnished with feathers, they fly over a country with the wind, and vegetate on the first loose or cultivated ground they settle on. The plant will pay for drawing out of a garden, being a favourite food with rabbits and hogs: the leaves are good amongst other pot-herbs. Withering.

17. Fumitory (*Fumaria officinalis*), common, but not very injurious; an annual plant, which may be destroyed by preventing its seeding. Hoffinan prefers the expressed juice of this plant to all other medicines, as a sweetener of the blood; the dose is two or three ounces; an infusion of the leaves is used as a cosmetic, to remove freckles, and clear the skin. Withering.

18. Common thistle (*Serratula arvensis*); seeds numerous, and furnished with feathers to fly any distance before the wind, on which account they are liable to grow in gardens, though ever so much pains may have been used in their eradication, which when the case they should be drawn up by the roots in moist weather with tongs, for they cannot be handled. The suffering of the seeds of this and many other weeds to ripen and shed (particularly of the class *syngenesia*), is not only a private neglect but a public nuisance, as they will propagate themselves to any distance by means of their feathers, which keep them afloat in the air, and they are wafted about by the various currents of wind till, by degrees, the feathers

feathers no longer supporting them, they are deposited in the crevices of loose or cultivated land, where they vegetate, and produce a plentiful crop, to the surprise of many, who wonder by what means they came there. I have frequently observed a fresh bank of earth dug from the bottom of a canal, produce plentiful and vigorous crops of thistles and coltsfoot, and some people who have seen it have fancied that the seeds or fibres of these plants had been concealed in the earth, not knowing, or not considering, that the seeds had been flying in the air, and that an elevated bank of earth was more liable to arrest their progress than the flat even land; as well as that the seeds were more likely there to vegetate and produce a crop, than on a matting of turf.

19. Groundsel *(Senecio vulgaris)*, another very common garden weed, with seeds feathered as before, and capable of spreading themselves far and near, with this farther chance of propagating themselves, that the plant is extremely quick of growth, insomuch, that after clean-weeding a garden, walk round it in a week or two, and you may be surprised to find many plants of this kind, with the seeds ready to take flight. The eradication of this weed can only be effected by constant and unremitting attention; the plant, with its seed bud, is very acceptable to small birds confined in cages.

20. Common nettle *(Urtica dioica)*, generally growing in hedges or shady places, but sometimes appearing elsewhere, when it must be destroyed by rooting up; the young shoots are gathered in spring to boil in broth; the leaves cut may be mixed with the food of turkies and other poultry. Withering.

21. Mistletoe *(Viscum album)*, very common on fruit-trees near the Severn, and in many other places, and when gotten to a head said to be very injurious in preventing

venting their bearing; it should therefore be plucked off in time.

22. Lastly, I shall add the cultivated potatoe *(Solanum tuberosum)*, which, however valuable as a crop, is very apt to remain in the ground, and intrude amongst other after-crops, to their injury, as well as having a slovenly appearance: this inconvenience is doubtless owing to want of clean getting up the crop; but it is very difficult to get up the crop perfectly clean, and every small root, or part of a root, having the eye or sprout in it, will vegetate if it escapes the winter's frost. As it is now found that the shoots of the potatoe will crop well after transplanting, it seems the better way to draw them from among other crops as they appear, taking the advantage of showery weather, and transplant them into a bed by themselves, where they may succeed some early crop, as winter greens, spinach, early cabbages, &c. by which means your other crops may be cleaned, and potatoes raised without any expense of seed.

These are the principal intruders into the garden, as far as observed by the writer hereof, but many other sorts will occasionally appear from seeds wafted by the wind; as well as be introduced by using raw dung, particularly of hogs and horses, which often contain seeds possessing their vegetative power, and the litter intermixed therewith often contains more. This shews that raw dung is very improper for a garden, but it is often used, particularly for early or other potatoes.

Much labour in weeding will be saved by particular attention in drawing up all seedlings in time, and before they have sown their seeds; for the increase of many weeds in this way is beyond calculation, and the precaution of preventing their seeding should, therefore, never on any account be neglected.

The tools principally used in the gardens of Stafford-shire, for destroying weeds, are, the spade, the three-fanged fork for cleaning out root weeds, and the different kind of hoes, of which the Dutch hoe is used for scuffling over the surface, and the common hoes, of a triangular or parallelogram form, for cutting up weeds, moulding up growing plants, and loosening the surface: these tools are, I believe, very general, and known every where.

II. *Weeds in Corn Fields and Arable Land.*

I think it needless to bestow much time on neutral plants, or such as are not decidedly injurious; many of these, therefore, to be found in arable pastures, will not be mentioned, and others, of a more suspicious character, only slightly touched upon; whilst more particular attention will be paid to the vigorous and luxuriant weeds which infest our corn-fields, as follows:

1. Ivy-leaved chickweed *(Veronica hederifolia)*, sometimes very much abounding amongst wheat very early in the spring, but seeding and leaving the ground early, perhaps not much injuring the crop; the seed is said to ripen in twenty-eight days from the first vegetation of the plant, which appears in March, and often gives a plentiful produce of seeds, which will lay in the ground many years, ready to vegetate next time the land is pulverized early in the spring; this should therefore be done in the fallow, which would occasion the seeds to vegetate, and the plant might be destroyed by ploughing under before its seeds ripen.

2. Lambs lettuce, corn salad *(Valeriana locusta)*. This plant I never observed till last summer, when I certainly believe it was more plentiful than common in this neighbourhood. I observed it on my farm, both in corn-fields and arable pastures, but not in such quantity as to be injurious.

injurious. In a hard tilled field near Lichfield I found it in great abundance; it is an annual plant, not at all formidable as a weed; it is eaten as a salad, and by cattle; for the former purpose little inferior to young lettuce. See Withering and *Flora Rustica*.

3. Dogs grass—*Triticum repens*.
4. Bent grasses—*Agrostis' alba* and *stolonifera*.
5. Tall oat grass—*Avena elatior*.
6. Creeping soft grass—*Holcus mollis*.

The roots of those, and perhaps of some other of the hardy perennial grasses, compose what the farmers call quick, couch, or squitch, that plague and curse to arable cultivation; they are sometimes so interwoven together in the soil, in land that has been under hard tillage and bad management, as to form a perfect matting, and to choke the plough: they abound most in light and mixed soils, not equally infesting strong clays: the first of these, the dogs grass, has been generally referred to by writers, as alone producing couch or squitch, but this idea is now generally known to be erroneous; this grass principally abounding in hedges and gardens, though sometimes plentiful in arable fields, yet not one-tenth part of the squitch of arable land is produced by this grass. The most general arable land squitch grass is of the Agrostis family, but to which particular species that most complained of by farmers belongs, is not yet agreed amongst botanists. Dr. Stokes refers it to the fine bent (*Agrostis capilaris*); Mr. Dickenson assures me it is a variety of the *Agrostis alba*; but Mr. Curtis informed me, in London, that this squitch grass has never yet been rightly specified, that it ought to be termed *Agrostis repens*. I have frequently observed the ear or awn of this grass to have the general habit of the Agrostis, and it is very probable that more species than

 one

one of this genera have the habit of running in the roots, and producing couch or squitch.

The creeping red-stalked bent grass *(Agrostis stolonifera)*, and the creeping soft grass *(Holcus mollis)*, are common squitch grasses on strong or cold wet lands; the tall oat grass *(Avena elatior)*, is a very common squitch grass, on the light gravelly soils of this neighbourhood; its roots are composed of a bunch of bulbs, affording shelter to pernicious grubs, worms, and insects; it is difficult of eradication, and very pernicious to a crop, particularly in wet seasons.

These grasses, though so troublesome and injurious on arable land, are yet, probably, good meadow grasses, where their roots are not so liable to run as on arable land, loosened, broken, and pulverized by tillage.

With regard to their destruction on arable land, it can only be effected by giving an early and complete spring and summer fallow, by repeated ploughings in hot weather, with sufficient harrowings between each ploughing to work out the squitch and bring it to the top; and unless the summer prove dry for some length of time, even this will be insufficient, in which case many active industrious farmers have it forked together by hand and burnt; others carrying it in heaps to rot; and I have known it mixed with quick lime, which is to be commended: it should, however, be observed, that the great increase of the roots of these grasses is occasioned by hard tillage, or bad management, and often by both.

7. Wild oat, hover *(Avena fatua)*, common on hard tilled land, and when abundant very unsightly and injurious to a crop. Dr. Anderson observes, that this plant abounds so much in the corn-fields in most parts of Aberdeenshire, as in many cases to constitute nearly one half of the bear crop (bear is the six-rowed barley, *Hordeum hexastichon*,

hexastichon, which is much grown in Scotland); it may be destroyed by the turnip culture, or by well-managed early fallowing; and prevented by short tillages, and frequent seeding down to grass. It never occurs, I believe, in any considerable quantity, where there is good systematic management, and due attention to clean seed: the awns are used for hygrometers, and the seeds instead of artificial flies in fishing for trout. Withering and *Flora Rustica.*

8. White darnel *(Lolium temulentum)*, often found in a wheat crop, but I believe always produced from seed sown with the wheat; to prevent which, great attention should be paid to clean seed, and particularly that it contain none of this plant, it being extremely prolific, very injurious to a crop when growing, and to its value at market: it is an annual plant, which I never recollect to have seen grow, except in a crop, and very rarely there without neglect in management; the seeds in considerable quantity, ground into flour with wheat, and the bread eaten hot, is said to produce deleterious effects on the human body; and if malted with barley, the ale soon occasions drunkenness. Withering.

9. Goose grass, catchweed, cleavers, here called hariff *(Galium aparine* and *spurium)*, seeds roundish, rough, two from each flower, so large as not all to be easily separated from the grain in dressing. I have known this plant very troublesome in a wheat crop, twining and crawling up the straw or stem: it is not very common in well-managed crops, but more generally confined to hedges.

10. Field scabious *(Scabiosa arvensis)*, found in corn fields and pastures, but not much abounding.

11. Parsleypiert *(Aphanes arvensis)*, a diminutive weed of small account, but sometimes rather too much abounding;

ing; might probably be weakened by very early in the spring pulverizing the land when in fallow, and ploughing the plant under in due time.

12. Dodder *(Cuscuta Europæa)*, a parasitical weed, of which I have not much experience, but am informed by Mr. Dickenson, that it is not uncommon in his neighbourhood. Some years ago, in travelling through Buckinghamshire, I observed this plant twining round the stems of a bean crop, and brought away a specimen; it climbs in a spiral direction round the stems, from which, by means of vessels, it draws its nourishment, and must consequently very much fret and injure any plant to which it is attached: it is called (as stated somewhere in Young's Annals) beggar weed, hell weed, and devils guts, names which sufficiently shew in what estimation it is held by farmers. The plant is annual, and produced from seed, which takes no root in the earth, but in its foster plant.

13. Corn bindweed *(Convolvulus arvensis)*, another troublesome parasitical weed, often growing amongst wheat, and, when abundant, twining round the corn, and very much injuring the crop: when wheat has been laid by heavy rain, I have observed this plant increase in growth so as to hold it down fast, and prevent it rising again: it is not so common here, in Staffordshire, as I have observed it in some counties nearer London, whence we are in the habit of procuring seed wheat; on which account I have sometimes feared we should import it more abundantly by this means, but have since observed that the seed is small, and easily dressed out; the plant is perennial, and much addicted to running in the root. Mr. Curtis has proved, that cutting it off, even below the surface, only tends to spread it farther: it must be destroyed by fallowing, and using the same process as for squitch.

14. Wild

14. Wild carrot *(Daucus carota)*, common, and sometimes troublesome in dry land; a biennial plant, producing seed plentifully; this, in its cultivated state, is the well-known garden carrot (Withering); but Miller informs us, that he could never improve the wild carrot so as to render the roots in any degree comparable with the cultivated carrot; the seeds have been used as diuretic and carminatives, and are highly recommended in fits of the gravel and stone (Withering). Miller says, the shops have been supplied with old seeds of the garden carrot, instead of fresh ones of the wild carrot, to be used medicinally. *Flora Rustica.*

15. Shepherd's needle, here beggar's needle *(Scandix pecten)*, sometimes abounding in hard tilled land, and its seed not easily wholly separated from grain in dressing. It is a small annual plant, producing a plentiful crop of seeds; each seed furnished with a spike or beak from one to two inches long, whence its name of needle: it seldom abounds in well-managed land.

16. Chickweed *(Alsine media)*, sometimes troublesome in a crop on land rendered fine by tillage, from which it should be rooted out. The Rev. Mr. Shaw remarks, that chickweed is an excellent out-of-door barometer: when the flower expands boldly and fully, no rain will happen for four hours or upwards; if it continues in that open state, no rain will disturb the summer's day; when it half conceals its miniature flower, the day is generally showery; but when it entirely shuts up, or veils the white flower with its green mantle, let the traveller put on his great coat, and the ploughman, with his beasts of draught, rest from their labour.

17. Curled dock *(Rumex crispus)*: this plant should never be suffered to shed its seed on any land, but should be rooted up and carried off in time: in arable land, the roots

roots should be carefully picked off during the tillage, or they will produce vigorous luxuriant plants, drawing much nourishment from the soil, to the injury of the intended crop. The plant is a hardy perennial, very tenacious of growth by its roots, and producing a wonderful increase of seeds; too much caution cannot be used in avoiding sowing it, nor too much pains bestowed in its extirpation: it is the pest of clover-fields in Norfolk. Withering.

18. Arsmarts, or lake-weeds (*Polygonums persicaria* and *pensylvanicum*), abound most in wet seasons on moist lands; and being hardy annuals, producing a plentiful crop of seeds, are apt to shew themselves in crops of grain: to be destroyed by fallowing, by draining, and by rooting out.

19. Knott grass (*Polygonum aviculare*); a trailing plant; flourishes most by road sides and on gravel walks: out of the smothering of crops, very prolific in seeds, which are eaten by small birds.

20. Black bindweed, bearbind (*Polygonum convolvulus*); a parasitical plant, twining round any thing it can lay hold of; very productive of seeds, which, being angular, are not easily separated from grain in dressing or winnowing. This plan is not much approved by the Staffordshire or Shropshire farmers, who are very cautious of sowing it. It is nearly allied to the buckwheat (*Polygonum fagopyrum*), to which it is preferred by Dr. Withering, in the following words: "the seeds are quite as good for use as those of buckwheat, are produced in greater quantity, and the plant bears cold better."

21. Knawell (*Scleranthus annuus* and *perennis*); a diminutive plant, but prolific in seeds, and of vigorous growth; have often found it on a piece of poor thin soil on

on my farm when in tillage, but do not think it very pernicious: it may probably be weakened or destroyed by an early spring working of the land when in fallow.

22. Bladder campion *(Cucubalus behen)*, common in wheat and barley crops, and growing in tufts, many stalks from each root, which, when the case, should be rooted out by hand: it is a perennial plant, and has the habit of increasing from its roots.

23. Cockle *(Agrostemma githago)*, a luxuriant, vigorous, annual plant; perfecting many seeds, and drawing much from the soil: care should be taken not to sow this injurious weed. The seeds are so large that they cannot all be dressed from the grain; the plant should therefore be plucked out by hand before the seeds ripen.

24. Red and white campion *(Lychnis dioica)*, perennial weeds, growing in hedges, corn-fields, and pastures; to be weakened or destroyed by well-managed fallows.

25. Mouse-ear *(Cerastium arvense)* has somewhat the habit of chickweed, but of a duller complexion; frequent amongst corn and in pastures.

26. Corn spurrey, or yarr *(Spergula arvensis)* frequent in corn-fields, not very bulky or luxuriant, but quick and tenacious of growth, and producing seed plentifully: as it is of humble growth, I have never observed it to be very injurious to a crop; but Dr. Anderson observes, that in Aberdeenshire it is a pernicious weed, growing in such abundance among the crops as to choke the grain; he has often seen it so thick, that over a vast extent of surface you could not have put down a pin without touching a plant, and the farmers there think it indestructible: he says farther, "I had remarked, that whenever any of the land had been poached, by being used as a road, especially in wet weather, no spurrey appeared there; it was evident this was occasioned by the

clods thus produced not giving room for the small seeds to germinate freely; if, therefore, I could contrive to bring the ground into a cloddy state when sown, I should be free of it for this crop. I had lost a crop of bear (six-rowed barley, *Hordeum hexastichon)*, in one field by it entirely. The soil was in a loose, mealy, incoherent state; I resolved to delay ploughing it next season as long as possible, and to plough it when it was very wet. Fortunately it came a violent rain in the beginning of March; it was ploughed when nearly in the state of a puddle, it turned over more like mud than soil; dry weather succeeding, this mud bound a little on the surface, and produced a kind of clod; the corn was sown, it got a very slight harrowing, barely to cover the seeds, in an imperfect manner, and to leave the field as rough as possible: no yarr appeared, and the crop was one of the most luxuriant I had ever seen." Thus far Dr. Anderson.

Small birds are very fond of the seeds of this plant, it is therefore probable that the surface of the ground lying undisturbed through the winter, a large proportion of the seeds would be devoured by them; I believe in all cases of a stubble very full of small seeds, it is well to defer the ploughing as long as it conveniently can be on this account. Respecting land rendered over fine by tillage, it is well understood by Staffordshire farmers to be a fault, and that it is much better left only knappy, as they call it, that is, in small lumps; this is attained in fallows by working the land early in summer, and letting it lie to consolidate through the latter part of it; and in the turnip culture by the treading of sheep and cattle; and is one great reason why land should not have too many ploughings, but only a sufficient number, judiciously timed; but ploughing in general, particularly of broken land, is much best done when the land is dry. W. P.

27. Base

27. Base rocket *(Reseda lutea)*: I observed this plant amongst some corn in Gloucestershire in the summer of 1795; it is an annual plant, not very much abounding.

28. Dwarf spurge *(Euphorbia exigua)*, common in corn-fields, but generally in single plants, and not very injurious to the crop.

29. Corn poppy *(Papaver rhœas)*, an annual plant, producing numerous small seeds, sometimes very abundant in corn-fields, and a pretty sure indication of a light crop. Query, is the lightness of the crop occasioned by the abundance of this plant, or the increase of this plant encouraged by the lightness of the crop? Probably both: in a full crop it is scarcely to be found; its flowers appear in July. It might, doubtless, be weakened or destroyed in fallows, by encouraging an early vegetation in common with other seedlings.

30. Corn crowfoot *(Ranunculus arvensis)*; sometimes very abundant and injurious to a wheat crop on strong moist land: an annual plant of early growth, which can only be brought into vegetation in the fallow by an early tillage; otherwise the growth of the seeds is deferred to the next spring, to the great injury of the crop. It is observed in the *Flora Rustica*, that " in some countries it has the name of hungerweed, whence it is supposed to indicate a barren soil." The orthography, however, is not derived from the nature of the soil, but from the hungry prospect it holds out to the farmer.

31. Dee nettle, dead nettle *(Lamium album* and *purpureum)*, much abounding amongst crops on some lands, particularly in moist seasons; being perennial plants produced both from seeds and roots, great pains should be used in their extirpation.

32. Calves snout *(Antirrhinum orontium)*: I observed this plant not uncommon amongst corn crops in Hamp-

shire in the summer of 1795, and being in some doubt about it, sent a specimen to Dr. Withering for his investigation. A poisonous plant: (Linnæus.) It appears from Withering's Botany, that other species of this genus are also common in corn-fields; as the sharp-pointed fluellin *(Antirrhinum elatine)*, the round-leaved snap dragon *(Antirrhinum spurium)*, the corn snap dragon *(Antirrhinum arvense)*, the least snap dragon *(Antirrhinum minus)*; these I have not personally examined; they are all annuals; whilst the other species of this genus, common in hedges and on walls, as the *Antirrhinum cymbalaria*, *ripens*, *linaria*, and *majus*, are hardy, and strict perennials.

33. Shepherd's purse, shepherd's pouch *(Thlaspi arvense*, *campestre*, and *bursa pastoris)*; well known as sometimes troublesome weeds on arable land: annual plants, of early appearance, and continuing great part of the year. To be destroyed by early and well-managed fallowing, or by rooting up.

34. Whitlow grass *(Draba verna)*.

35. Codded mouse-ear *(Arabis thaliani)*. Both these are small diminutive weeds, appearing amongst corn early in the spring; but being quick of growth, and soon exhausted, are not of much consequence.

36. Smooth-leaved chadlock *(Brassica napus)*.

37. Rough-leaved chadlock, or wild mustard *(Sinapis arvensis)*.

38. Pale-flowered chadlock, or wild raddish *(Raphanus raphanistrum)*.

These three plants are confounded together by farmers, under the general name of chadlock, pronounced here kedlock, though they are as different and distinct, to the investigating botanist, as wheat, barley, and oats. They are all extremely common, and nearly equally so, if a

large

large range of country be examined; though the different sorts are more or less abounding in different places; in this neighbourhood I can generally gather the three sorts in the same field, but the mustard is much more abundant; in the neighbourhood of Lichfield, where chadlock is indeed very abundant, it is almost universally wild rape. Some years ago I observed in the common fields of Rutlandshire, the whole surface was tinged over with the flowers of the wild raddish: they are all great nuisances, and, when suffered in abundance to ripen their seeds, must draw much from the soil, to the great injury of the crop; and as they are very quick of growth, and perfect their seeds expeditiously, it is not uncommon for these plants to shed their seeds at the rate of several bushels *per* acre; and as it is well known that the seeds will vegetate after lying many years in the ground, it is no wonder they should produce a plentiful crop; yet, being simply annuals, they are not difficult of destruction, if due attention and proper means be used. To destroy these, as well as all other seedlings, the land in tillage should be pulverized early in the spring by ploughing and harrowing; after which, rain and warm weather will soon cause all the seeds to vegetate that are near the surface; they may be permitted to grow till they begin to flower, then plough them in, and again harrow the land, and the next rain will cause most of the remaining seeds to shoot; which must be in due time ploughed under as before; and if any should afterwards appear amongst the crop, they should be hoed or hand wed out; by this means, in one or two tillages, these plants may be totally eradicated; but if they are permitted to shed their seeds, their increase cannot be wondered at, when their prolific nature is considered, as well as the extreme hardiness of their seeds. The seeds, when dressed from

from grain, have, I understand, been frequently manufactured into oil.

39. Wild rocket (*Brassica muralis*). It is observed, in some one of the County Reports, which, for want of an index I cannot now refer to, that this plant has made great progress in their corn-fields, and is considered as a very formidable weed. All the parts of this plant are considerably acrid, and have a rank disagreeable smell, whence it is called by the farmers who have it, *stinkweed*. It may, doubtless, be destroyed by the process above recommended for chadlock.

40. Fumitory (*Fumaria officinalis*): not uncommon in corn-fields, but not very pernicious: an annual plant.

41. Rest harrow (*Ononis arvensis* and *spinosa*); not uncommon in arable lands where there are no very desirable plants. The *arvensis* is common in this country amongst corn, and an hardy perennial plant; if the root can be destroyed in the fallow, there is little danger from the seeds: the roots are so strong as almost to stop the plough, unless the team be pretty strong. The *spinosa* I have often seen at a distance from hence, but it is unknown in this neighbourhood.

42. Tare (*Ervum tetraspermum* and *hirsutum*). The tare is a terrible enemy to a wheat crop, where it abounds in considerable quantity; "in wet seasons whole fields of corn have been overpowered and wholly destroyed by it." Withering. Care should be taken that seed-wheat be perfectly free from tares; and all land subject to it, should if possible be got so forward in the fallow as to bring on the vegetation of this plant previous to sowing the wheat; the seeds are good food for pigeons and poultry.

43. Melilot (*Trifolium melilotus officinalis*), a very injurious corn-weed in many parts of the kingdom. Mr. Miller

Miller marks Cambridgeshire, and Gerard, Essex, for abundance of it. I have heard of it in Bedfordshire, and seen it amongst corn in Gloucestershire and Rutlandshire; in the latter county I was informed that five or six shillings *per* acre has sometimes been expended in weeding it out, without effecting the purpose. W. P. There cannot be a worse weed among bread-corn, for a few of the seeds ground with it spoil the flour, by communicating their peculiarly strong taste; *Flora Rustica.* It flowers in June and July, and the seeds ripen with the corn; it is probably capable of propagating itself both by its roots and seeds, but might doubtless be much weakened by proper fallowing: horses are very fond of it; cows, sheep and swine eat it, and bees are very fond of the flowers; it is therefore, though a corn-weed, a good pasture plant.

44. Sow thistle *(Sonchus arvensis)*, a perennial weed, common amongst corn, which when it occurs ought to be drawn up by hand, before it ripens its seed; which, being furnished with feathers, would otherwise fly over the whole country.

45. Common or way thistle, cursed thistle, or saw wort *(Serratula arvensis)*, universally called thistle, but arranged by Linnæus, not as a *Carduus*, but a *Serratula;* growing every where; may be weakened by good tillage and weeding, but not totally destroyed otherwise than by universal agreement to root it up before its seeds ripen, or by a regulation of police enforcing the same; this weed one should almost conclude to be naturally produced by the soil, in consequence of the curse, "thorns also and thistles, shall it bring forth unto thee;" yet doubtless, strictly speaking, produced only from its numerous fibrous roots (which are hardy and strictly perennial, and which if separated in parts by ploughing

or

or digging, each part will, if left fresh in the soil, often vegetate, and produce a plant); and from its more numerous seeds, which are feathered, and will fly to a great distance with the wind, and when it becomes calm, alighting upon cultivated land, they will there vegetate and grow luxuriantly, so that it is in vain for any person to attempt clearing his land of this weed unless his neighbours also pursue the same plan: the roots of this plant may be pretty effectually destroyed by a well-managed summer fallow; as they will not survive repeated ploughings up in hot weather, and if due attention were bestowed to prevent its seeding, its numbers might be diminished: it is very injurious to all crops.

The goat and ass will eat it: horses will sometimes crop the heads when young and tender, but no other cattle touch it growing. When burnt, it is said to yield a very pure vegetable alkali. *Flora Rustica.*

46. Thistles *(Carduus's)*, called in Staffordshire boar thistles, to distinguish them from the last, and from sow thistles, several sorts, principally the *Carduus lanceolatus*, *pratensis*, and *acaulis;* with other sorts less common; they abound in meadows, pastures, hedge sides, and borders of corn-fields, where they should be rooted up after rain, before their seeds ripen, otherwise such seeds are liable to fly all over the country; these plants grow very luxuriantly, drawing much from the soil, and injuring or preventing the growth of grass near them; are very unsightly, and useless to cattle; some of the species, particularly the meadow thistles, are perennial, others are annual or biennial. Dr. Withering has mentioned the following uses of thistles: he says of the *Carduus lanceolatus.* If a heap of clay is thrown up, nothing would grow upon it for several years, did not seeds of this plant, wafted by the wind, fix and vegetate thereon; under the shelter of these

these other vegetables appear, and the whole soon becomes fertile; and the heads of most of the species, he observes, may be boiled and eaten as artichokes.

47. Coltsfoot *(Tussilago farfara)*, very apt to abound in hard tilled land. Lord Hawke informed me, at the Board of Agriculture, "that the only time to destroy this weed is by cutting it up in those months when it begins to throw out its flower, at which time, if so cut, it will bleed to death;" these months are February and March, at which time all land in fallow, subject to this weed, should certainly be ploughed, and harrowed down, which would doubtless check the growth of, and very much weaken, the plant; neglected at this time it will soon after ripen its seed, which, furnished by Nature with feathers, flies all over the country, and establishes itself very quickly on cultivated land, and banks of earth newly thrown up. This weed may be considerably weakened by repeated summer ploughings, and may afterwards, for the greatest part, be weeded out by hand, as the ground is thus rendered light.

48. Groundsel *(Senecio vulgaris)*, often found in fallows, on good soil rendered fine by cultivation, as its seeds ripen rapidly, and fly over the country with the wind: the plant should be destroyed in time, by weeding out, or ploughing under, and the seed by no means permitted to ripen.

49. Corn marigold, goulans, goul, buddle in Norfolk *(Chrysanthemum segetum)*, an extremely troublesome weed in some soils; an annual plant, producing seed plentifully, which vegetate whenever the soil is cultivated, and very commonly in crops; would doubtless be destroyed, like other annual seedlings, by early and complete fallowing, to bring the seeds in due time into vegetation, and afterwards ploughing the plant under: in

Denmark there is a law to oblige the farmers to root it up. Withering. It is stated in the Statistical Account of Scotland, vol. II. p. 4, that the late Sir William Grerson, of Lag, held *goul (Chrysanthemum)* courts as long as he lived, for the purpose of fining such farmers on whose growing crop three heads, or upwards, of this weed were found ; and it is observed by the President of the Board of Agriculture, that "some regulation of police for fining those who harbour weeds, the seeds of which may be blown into their neighbours' grounds, has no injustice in the principle." If this plant be cut when young in flower, and dried, horses will eat it. *Flora Rustica.*

50. Stinking May weed *(Anthemis cotula)*, common in corn-fields, though often confounded with the corn chamomile *(Anthemis arvensis*, and *Matricaria chamomilla)*, from which it is to be distinguished by its disagreeable smell ; they are all injurious to corn crops, and should be prevented or destroyed by good fallowing, or by weeding out.

51. Blue bottle *(Centaurea cyanus)*, an annual weed, with a somewhat elegant blue flower ; common in corn, where the tillage has been imperfect, or two long carried on without cleaning by turnips or fallow.

52. Great knapweed *(Centaurea scabiosa)*, a perennial corn weed, growing in tufts of many stems from the same root ; should be destroyed in fallow, or by weeding out of the crop.

53. Pansy *(Viola tricolor)*, an annual flower, often found amongst corn, where it is produced by seeds not destroyed in the preparation for the crop : the beauty of the flowers has gained them a place in gardens.

54. Corn horse-tail *(Equisetum arvensis)*, often found in corn-land, the fertile stem appearing early in the spring, with that of coltsfoot, and decaying before the other

other part of the plant appears. Loesel says, if ewes in lamb eat it, abortion is the consequence; but it is believed sheep or cows will not eat it, unless compelled by hunger. It must be destroyed by the same tillage and weeding recommended for coltsfoot.

55. Fern (*Pteris aquilina*), not uncommon in corn-fields on dry sandy land; a hardy perennial, tenacious of growth, and striking a long tap root into the ground, beneath the reach of the plough, which shoots up vigorously when the sun becomes powerful; the plant should be drawn up after soaking rain, but it will sometimes require a good deal of pains and attention to destroy this plant, particularly on land where it has been long established.

These are the principal weeds which the writer hereof is acquainted with, as infesting our corn-fields; and in addition to what has been said before on their extirpation, the following is added here, in which, if there should be any repetition of former expressions, he hopes it will be excused, as the necessity of banishing them from cultivated land can scarcely be too strongly inculcated, or too often repeated.

TO BE CONCLUDED IN OUR NEXT.

Memoir on the Proportion of Light produced by different combustible Substances, and on the Degrees of Brightness obtained from different Lamps, according to the Nature of the Oil employed. By M. HASSENFRATZ.

(Concluded from Page 305.)

COUNT Rumford employed for his standard of comparison the light which he obtained from Argand's lamp; but as the intensity varies according to the height of the wick, and as we can with this lamp obtain all possible

 intensities

intensities of light, I feared that, if I used it, I should not obtain a constant uniform intensity. I therefore preferred using a candle of white wax, which exhibited to me very little variation in its intensity, especially when used a little time after having been lighted, and when its flame is the brightest.

A second reason which determined me to reject the use of Argand's lamp for this purpose, was that the flame of these lamps being always very red in comparison with those of the others, and especially with those of the ordinary lamps, the difference in the colours prevented the degrees of intensity from being so easily compared.

When we compare together two lights of different intensities, we perceive two colours of shade; that which is produced by the weaker light is blue, while that of the stronger is reddish.

When we compare together two lights obtained from different combustible substances, the light is blue or red, in the compound proportion of the intensity and of the colour of the light.

Thus, by comparing together the colours of the shades produced with different lights, I found them successively red and blue in the following order:

The sun.
The moon.
Oil of fish, in Argand's lamp.
—— cole-seed, ditto.
—— poppy, ditto.
Tallow candle.
Wax.
Spermaceti.
Oil of fish, in pump lamps.
—— cole-seed, ditto.
—— poppy, ditto.

That

That means—that when a body is illumined by the sun, and by any one of the other lights, its shade is reddish, while that of the others is blue.

Thus, when a body is illumined by a tallow and by a wax-candle, the shade of the first light is red, while that of the second is blue. In like manner, when a body is illumined by a candle and by an Argand's lamp, the shadow of the candle-light is blue, while that of the lamp is red.

This observation upon the order of the coloured shades is of greater importance than might at first appear; for it influences the beauty, the whiteness, the hues of drapery, and in general of all coloured substances, by producing modifications in their tints.

Every one knows that a substance which is yellow in the light of the sun appears white by candle-light; that the green colours become blue; that colours which have assumed a brownish tinge recover their whiteness by the light of wax or spermaceti candles, and acquire additional lustre. The yellow tint, the light brown, pass more readily into the white, and the green into blue, as the light of the illumining body gives a bluer shade. Thus according to the series of the colours of the shades obtained by the different lights, that which whitens the most, which gives the greatest lustre to the tint, is that produced by poppy oil burnt in ordinary lamps; and that which gives the least lustre, the least whiteness, is the light produced by the combustion of fish-oil in Argand's lamps.

Nevertheless, the lights may, if necessary, be modified by gauzes of different colours, and produce greater or less whitening effects by these modifications; but these considerations are foreign to the subject of the present memoir.

The

The mean results of all my experiments upon the intensities of lights have shewn me, that in order to produce the same intensity of shade upon a piece of white paper, the luminous bodies require to be placed at the following distances.

		Metres.
Argand's lamps,	Poppy-oil - - - -	10
Ditto	Fish-oil - - - - - -	10
Ditto	Cole-seed-oil - - -	9,246
Pump lamps,	Cole-seed-oil - - -	6,774
Ditto	Fish-oil - - - - - -	6,524
Ditto	Poppy-oil - - - -	5,917
Candle, - -	Spermaceti - - - -	5,917
Ditto	Tallow, old - - - -	5,473
Ditto	——— new - - - -	5,473
Ditto	White wax - - - -	4,275

Hence it follows, that of all these lights, the strongest is that produced by the combustion of poppy-oil in Argand's lamp, and the weakest by that of white wax candle.

The intensities of the lights being in the ratio of the square of the distances of the luminous bodies which produce the same intensity of shade, the intensities of those which I have compared will therefore be as follows:

Argand's lamps,	Poppy-oil - - - -	10,000
Ditto	Fish-oil - - - - -	10,000
Ditto	Cole-seed-oil - - -	8,549
Pump lamps,	Cole-seed-oil - - -	4,588
Ditto	Fish-oil - - - - - -	4,556
Ditto	Poppy-oil - - - -	3,501
Candles of -	Spermaceti - - - -	3,501
Ditto	Tallow, old - - - -	2,995
Ditto	——— new - - - -	2,995
Ditto	White wax - - - -	1,827

The

The quantities of the combustible substances, burnt hourly, in order to obtain these different lights, was as follows:

		Grammes.		Grains.
Argand's lamps,	Poppy-oil - -	23	or	434
Ditto	Fish-oil - - -	23,77	—	448
Ditto	Cole-seed-oil -	14,18	—	276
Pump lamps,	Cole-seed-oil -	8,81	—	166
Ditto	Fish-oil - - -	9,14	—	172
Ditto	Poppy-oil - -	7,05	—	133
Candles, - -	Spermaceti - -	9,23	—	174
Ditto	Tallow, old - -	7,54	—	142
Ditto	——— new - -	8,23	—	155
Ditto	White wax - -	9,54	—	180

Thus the luminous body which consumes the greatest quantity of combustible in the hour is the Argand's lamp burning with fish-oil; and that which consumes the least is the pump lamp burning with poppy-oil.

In order to compare the proportions of combustible which each luminous body employed to produce the same intensity of light, Count Rumford united several wicks of each kind of lamps, in order to obtain an uniform light for the standard of comparison. I conceived this method to be superfluous, since I could, by a simple rule of proportion, deduce from my first observations the quantities of combustible matters which my luminous bodies had employed to produce a given light. For since an intensity of light expressed by 3,501 was produced by a consumption of 9,23 grammes of spermaceti candle in the hour, the same luminous body would have produced a light of 10,000 intensity, by burning in the same space of time a quantity of spermaceti $= \frac{10,000 \times 9,23}{3,501} = 26,27$ grammes, or 497 grains.

This

This method of deducing the quantities of the combustibles employed for producing a given intensity of light, appeared to me more simple and accurate than that of Count Rumford, because, in employing his process, I perceived that it could be applied only to the ordinary lamps, and that even in this circumstance, the light varied so considerably during the course of the experiment that it was impossible to ascertain whether the two lights had been equal.

It is by this simple method of calculation that I have determined, that in order to produce with each combustible a light whose intensity should be expressed by 10,000, it would be necessary to employ,

		Grammes.		Grains.
Argand's lamps,	Poppy-oil, - - -	23	or	434
Ditto	Fish-oil - - -	23,77	—	448
Ditto	Cole-seed-oil -	16,59	—	323
Pump lamps,	Cole-seed-oil -	19, 2	—	362
Ditto	Fish-oil - - -	20,06	—	378
Ditto	Poppy-oil - -	20,14	—	379
Candles - -	Spermaceti - -	26,37	—	497
Ditto	Tallow, old - -	25,17	—	494
Ditto	——— new - -	27,48	—	517
Ditto	White wax - -	53	—	987

Hence it follows, that the luminous body which consumes the greatest quantity of matter to produce a given light is the white wax candle, and that which consumes the least is Argand's lamp burning with cole-seed-oil.

The

The commercial values of the combustibles which I employed in my experiments have been stated to me by M. Lepêcheux to be as follows:

		Francs.		Livres.	Sols.	
Candles,	Wax	0,61	the 100 grammes	3	0	the Pound Poids de Marc.
Ditto	Spermaceti	0,51	ditto	2	10	ditto.
Ditto	Tallow	0,153	ditto	0	15	ditto.
Oil of	Fish 2d quality	0,143	ditto	0	14	ditto.
Ditto	Poppy	0,122	ditto	0	12	ditto.
Ditto	Cole-seed	0,1105	ditto	0	11	ditto.

If we apply these values to the different combustible substances upon which I have made my experiments, we see that the expense of the consumption *per* hour, in order to obtain the whole quantity of light which each luminous substance generally produces, is,

			Per Hour.		In 10 Hours.	
		Francs.	Sols.	Deniers.	Sols.	Den.
Argand's lamps,	Poppy-oil	0,0282	0	6,8	5	8
Ditto	Fish-oil	0,034	0	8,2	6	9,6
Ditto	Cole-seed-oil	0,0165	0	3,96	3	3,6
Pump lamps,	Cole-seed-oil	0,0099	0	2,38	1	10,8
Ditto	Fish-oil	0,013	0	3,12	2	7,2
Ditto	Poppy-oil	0,0086	0	1,48	1	8,4
Candles,	Spermaceti	0,047	0	11,28	9	4
Ditto	Tallow, old	0,0115	0	2,77	2	3,6
Ditto	—— new	0,0126	0	3,02	2	6
Ditto	White wax	0,585	1	2,04	11	8,4

 Thus,

Thus, according to these values, the order of dearness of the combustibles employed to produce the whole of their light is,

		sols.	den.	
Candles, - -	White wax - -	1	2,04	*per* hour.
Ditto	Spermaceti - -	0	11,28	
Argand's lamps,	Fish-oil - - -	0	8,2	
Ditto	Poppy-oil - -	0	6,8	
Ditto	Cole-seed-oil - -	0	3,96	
Pump lamp with	Fish-oil - - -	0	3,12	
Candles, - -	Tallow, new -	0	3,02	
Ditto	——— old - -	0	2,77	
Pump lamps,	Oil of cole-seed -	0	2,38	
Ditto	—— poppy -	0	1,48	

Hence it appears that the dearest light is that which we obtain from white wax candle; and that the cheapest is that of poppy-oil burnt in pump lamps.

We see also that the white wax candle costs 1 sol. 2 deniers *per* hour, whilst that of spermaceti costs only 11,28 den. Nevertheless, the latter produces a more vivid light and a bluer shade; consequently it illuminates more powerfully, gives greater whiteness, and renders the tints more agreeable.

If we wish only to illuminate a small apartment, where the intensity of the light obtained is no material object, we may employ any kind of light that may be found most convenient or economical.

The candles of white wax and of spermaceti have the advantage, that when they are lighted they require no care, and emit no smell; they may be taken in the hand without soiling or greasing it, and they do not require to be snuffed. These conveniencies may be sufficient to counterbalance the greater expense with which their use is attended.

The

The Argand's lamps produce a bright light, require little attention when they have been prepared, emit no smoke when they are carefully adjusted, and thus in some measure partake of the advantages of the wax and spermaceti candles; but when they are neglected they smoke, and sometimes let fall drops of oil, which may soil the substances with which they come into contact: the intense light which they emit fatigues the eye, which has a natural tendency to fix itself upon them; their brightness often renders it necessary to cover them with a piece of light gauze, by which addition a great part of their light is absorbed, and the advantage which they had over a great number of luminous bodies is destroyed.

The ordinary lamps are, among all the means of obtaining light, the most inconvenient and the most disagreeable; it is difficult to prevent their smoking and blackening the apartments; they require to be very often snuffed; they run, and if they fall, the oil spreads itself about, and stains whatever it touches. To remedy a part of their inconveniencies, the pump lamps have been contrived, which are more portable, and less subject to the accidents to which the others are exposed.

Tallow candles are preferred to the ordinary lamps, as being more portable and blackening the apartments less; but they require to be continually snuffed, in order to make them produce the whole of their light; they are always accompanied with a disagreeable smell of grease, and they cannot be touched with the hands without their smell remaining upon them for some time.

If we attend to it, we shall find that the relations of convenience, economy, brightness, care required, are nearly proportional to the value of each combustible.

The wax and spermaceti candles, which give the most convenient, the most agreeable, and the best light, are the dearest; while oil burnt in the ordinary lamps, the combustion of which is the most disagreeable, requires the most attention, and soils the most, produces the cheapest light.

For lighting large apartments, assembly-rooms, theatres, &c. the determination of the combustible substance that ought to be employed depends upon the relation of its value with that of the light produced, of the convenience or the accidents with which it is attended, and of the arrangement which it requires, in order that as little shadow as possible be produced.

We have considered above the respective value of each of the luminous substances, and their mutual relations with respect to brightness. These relations are such, that in order to produce as much light as 100 Argand's lamps supplied with poppy-oil, there would be required,

100	Argand's lamps, supplied with fish-oil.
117	——— with cole-seed-oil.
218	Pump lamps, with cole-seed-oil.
219	——— with fish-oil.
285	——— with poppy-oil.
285	Spermaceti candles.
333	Old tallow candles.
333	New tallow candles.
546	Wax candles.

But as all these luminous bodies employ different proportions of combustible, and as these combustibles themselves have particular values, the scale of expense attendant upon the lighting of an assembly-room with the different luminous substances, in the same manner as if a hundred Argand's lamps supplied with poppy-oil were employed, would be *per* hour as follows:

Argand's

		Francs.		Liv.	Sols.	Den.
Argand's lamps with	Poppy-oil -	2,806	or	2	16	1
Ditto	Fish-oil - -	3,399	—	3	7	11
Ditto	Cole-seed-oil	1,833	—	1	16	8
Pump lamps with	Cole-seed-oil	2,122	—	2	2	6
Ditto	Fish-oil - -	2,868	—	2	17	4
Ditto	Poppy-oil -	2,457	—	2	9	1
Candles, - - -	Spermaceti -	13,448	—	13	8	11
Ditto	Tallow, old	3,85	—	3	17	0
Ditto	——— new	4,2	—	4	4	0
Ditto	White wax -	32,33	—	32	6	7

Thus the order in which the luminous bodies ought to be ranged with regard to the expense of their light, in order to produce the same degree of illumination, is *per* hour,

	£.	s.	d.
White wax candles - - - - - - - -	32	6	7
Spermaceti ditto - - - - - - - -	13	8	11
New tallow ditto - - - - - - - -	4	2	0
Old ——— ditto - - - - - - - -	3	17	0
Argand's lamps with fish-oil - - - -	3	7	11
Pump lamps with ditto - - - - - -	2	17	4
Argand's lamps with poppy-oil - - -	2	16	1
Pump lamps with ditto - - - - - -	2	9	1
——————— with cole-seed-oil - - -	2	2	5
Argand's lamps with ditto - - - -	1	16	8

Thus it appears that the dearest light for illuminating an assembly-room is that of white wax candles; and the cheapest, that produced by the combustion of cole-seed-oil in Argand's lamps.

As to the lamps, we see that the cost of their light is mixed; that fish-oil, burnt in Argand's lamps, produces the most expensive light,

This

This mixture of the cost of the light between the Argand's lamps and the pump lamps, and especially this inferiority of expense attending the lighting with pump lamps, must appear the more extraordinary, as it proved that in the pump-lamps there is a quantity of oil which, without being decomposed, is converted into vapour, together with a portion of the carbon that entered into its composition. It is the vaporisation of the oil which produces the disagreeable smell which is perceived, and that of the carbon, which blackens the apartments in which these lamps are employed. In the Argand's lamps, on the contrary, the whole of the oil is decomposed by the high temperature which the top of the wick experiences, and the whole of the hydrogen gas, as well as of the carbon which enter into the composition of the oil, are burnt by the large quantity of oxygen gas which is brought into contact with them by the rapid currents of atmospheric air which are formed both without and within the circumference of the wick.

As the light produced by a given body is proportionate to the quantity of combustible which combines with oxygen, and as in a pound of oil burnt in pump lamps there is more combustible lost than in the same quantity of oil burnt in Argand's lamps, it ought to follow that the Argand's lamps must consume less combustible than the pump lamps, in order to produce a given quantity of light. Nevertheless, my results do not confirm this inference; and in this circumstance, as I have already said, they differ from those which Count Rumford asserts that he has obtained.

Two causes destroy a part of the intensity of the light which is obtained from Argand's lamps; the first is the absorption of light produced by the tube of glass through which it is obliged to pass; and the other is the loss of light produced by the interior of the wick.

Count

Count Rumford and I perfectly agree with regard to the loss of light occasioned by its passage through the tube of glass, since he estimates this loss at $\frac{1854}{10000}$. But we do not agree with respect to the loss occasioned by the interior of the wick.

In a circular wick, the light which is emitted from its exterior part is diffused without impediment wherever nothing interrupts its direction; but that which is emitted from its interior is obliged to pass through the flame in order to make its exit, and diffuse itself; and it is in this passage that the absorption takes place.

Count Rumford says that he has ascertained, that when two wicks are placed the one at the side of the other, the intensity of their light is the same as when the lights are placed the one behind the other. I have repeated this experiment several different times, both with lamps and with tallow and wax candles, and have constantly found that the light was stronger when the lamps or candles were placed side by side than when they were placed one behind the other. As this difference of the intensity of the light can take place only in consequence of the loss occasioned by passing through the flame, it is evident that in Argand's lamps with circular wicks there must be a loss of part of the light which passes from the interior surface of the wick.

As to the use of the different luminous bodies, each possesses advantages and disadvantages which are peculiar to it.

In order that a large hall be well lighted, it is necessary that the lights be so distributed as to produce every where an equal degree of illumination; that the directions of the lights be multiplied in such a manner as mutually to obliterate the shades which they might otherwise produce, and that they require little care, and do not in any manner endanger the company.

The

The two first conditions are independent of the nature of the luminous bodies, whilst the two others depend entirely upon it.

The great chandeliers with Argand's lamps placed in the upper part of assembly-rooms or theatres, have a very inconvenient manner of lighting; they produce a focus of light to which the eye cannot be directed without experiencing a disagreeable sensation; a great part of the light which is thrown upon the upper part of the theatre is entirely lost; the light issuing from a single focus produces very large shadows, which no other light is sufficient to obliterate; the persons in the front of the boxes upon whom the direct rays of the light fall, have shadows cast upon their figures from every projecting part, which produce the appearance of black spots, and sometimes give them a ludicrous aspect. Thus the shadow of the nose forms a black triangle upon the mouth and chin, and that of the eye-brows throws a blackness over the eyes which deprives them of all their brilliancy.

To obviate this inconvenience, the lights must be distributed round the room, and others placed in chandeliers, suspended in such a manner as to produce the greatest possible variety of directions; in short, the old method of lighting these places should be retained.

Whatever may be the nature of the luminous bodies, the lights may be distributed in the same manner; only that they must be more multiplied when the light which they produce is weak, and less dispersed when they cast a strong light.

If the same attention could be paid to the Argand's lamps in theatres and assembly-rooms as may be done in a private room, where every care may be bestowed upon them which they require in order to obviate all their inconveniencies, the use of these lamps would be the best method of lighting such places; but generally the

the persons whose business it is to attend to them neglect them; they draw the wick too far out in lighting them, in order that their light may last during the whole time of the spectacle, in consequence of which the flame becomes lengthened, the lamps smoke, they have little brilliancy, and are attended with all the inconveniences of the ordinary lamps; namely, the smell, the smoke, the dropping of the oil, besides being considerably more expensive; for the vaporisation of the oil, the carbon not burnt by the oxygen, and which diffuses itself throughout the room, are so many causes that augment the consumption of the oil without producing more light.

The remedy for these inconveniences would be to bestow more attention upon these lamps, not to draw out the wick more than is necessary, in order to make it produce its maximum of light without emitting any smoke, and to trim the lamps sufficiently often during the course of the assembly to prevent their producing any of these disagreeable effects.

When a saloon is lighted by a single chandelier it is easy to give the requiste attention to the lamps, as the whole of the business is done at one spot; but when the lamps are dispersed in different parts of the room, the same inconvenience recurs which has caused the use of candles to be relinquished for lighting assembly-rooms and theatres; namely, the necessity of continual attention and frequently snuffing them. The Argand's lamps, when badly attended to, are, like candles, exposed to the dangerous accident of dropping grease upon the clothes of the company, though they are rather less subject to it than the latter.

The substances which appear the best adapted for lighting assembly-rooms and theatres are the spermaceti candles; their use is attended with more than one-half less expense than that of white wax candles; they produce an agreeable light, not too intense for the eye to dwell upon; the necessity of multiplying the candles in order to procure a strong light, as nearly three times as many of them are required as of Argand's lamps, admits of their being placed in such a variety of positions that no shade can be cast by any one of them which is not immediately obliterated by the light of the rest. The spermaceti candles do not require snuffing, the smallness of the wick permits the cotton to be entirely consumed in proportion to the combustion of the spermaceti; they do not run more frequently than lamps, tallow or wax candles; whilst they have the advantage that the melted matter which drops from them does not soil the clothes, but hardens upon the surface of the drapery on which it falls, and may be removed by slight friction—another advantage, therefore, which they have over wax candles.

The only objection which can be made against the spermaceti candles is, that their light is nearly four times as expensive as that of Argand's lamps well attended to; since it costs 13 liv. 8 s. 11 d. *per* hour to produce with these candles the same light which would be afforded by fish-oil burnt in an Argand's lamp, well attended to, at the expense of 3 liv. 7 s. 11 d. *per* hour.

However, to obviate a mistake, I must observe that this expense of 3 liv. 7s. 11d. is only upon the supposition that these lamps are well attended to; for if they are neglected the expense may be twice as much; and as this is generally the case in assembly-rooms and theatres, it follows that the lighting them with spermaceti candles, which require no attention, would cost only twice as much as lighting them with Argand's lamps.

On

On the Means of judging of the Quality of Glass, principally Table or Window Glass; and of distinguishing that which is subject to Alteration. *By M.* Guyton.

From the Annales de Chimie.

When I proposed to the *Societé d' Encouragement*, nearly two years since, to call the attention of philosophers and artists to those defects in window-glass which so soon appear in it after exposure to the air, and by which it acquires the name of fat or spotted glass, which we see so commonly used even in our handsomest structures, although not only disagreeable to the eye, but deficient in transparency; I was not ignorant that chemistry affords, to those who are acquainted with its principles, various means of judging when a piece of glass, from the nature and proportion of its ingredients, is in a state to resist the power of certain agents; and I was in hopes that some person would, before this time, have attempted to collect all the facts calculated to elucidate this subject, that, after having examined and compared the different processes that would afford a solution of the question, they would have been enabled to point out a cheap and easy method for the use and within the reach of those whose interest it would be to practise it.

The publicity that the society would have given to such a work, would, in my opinion, have contributed greatly towards the abolition of the impositions that are frequently practised in this branch of trade, by enabling every individual to judge for himself of the quality of the glass he purchases, and whether it is likely to lose its transparency after some months; and by warning architects against employing such glass as has not been proved.

I shall examine successively the different proofs to which we may have recourse, in order to decide on the best processes, the degree of confidence they merit, and to which preference should be given.

1. *The specific gravity* is one of the best means by which we may judge of the nature of bodies; it may serve as a means of comparing the products of compositions which we previously know to have been formed nearly alike, or at least of the same materials, in proportions that have been but little varied. With this view it is that M. Loysel has very justly recommended this test in his *Essai sur le Verrerie.* "When," says he, "we have in a manufacture, two results well known to serve as means of comparison, the simple determination of the specific gravity is sufficient to shew when there has been any variation in the fabrication." But he observes at the same time, that the density increases rapidly if lime enter into the composition, as it usually does. We know that when the specific gravity of some kinds of white glass is only 2.38, they resist the most powerful acids, while some kinds of black glass, which are more than 2.73, are corroded by them. The presence of the metallic oxyds has a still more sensible influence on their density, and is not a more certain evidence of their strength. This test would therefore in this case be very insufficient; especially as it requires to be expertly managed, and with very delicate instruments.

2. *The inspection of the fracture*, even by the most experienced eye, can afford only very doubtful conjectures. According to M. Ducloseau the fracture of glass of a good quality is always undulated, and its angles are more or less sharp. He assures us that he has been confirmed in this opinion by other proofs, from various kinds of bottle glass. It is, doubtless, not impossible, that in the ex-

tremes

tremes of a good and bad composition a very sensible difference is perceptible; but to make a general application it is necessary that the fracture should constantly present fragments of an uniform and decided shape. This effect has never yet been obtained from glass, though it is certainly in the condition of all homogeneous bodies, which, in passing from a fluid to a solid state, engender masses by the aggregation of similar molecules. The most attentive examination has convinced me, that there is often a more decided difference in the fractures of the same piece of glass than in those of glass of very unequal quality.

3. The degree of *hardness* varies, not only in glass of different kinds, but even in that of the same sort. The workmen who are accustomed to use the diamond, easily distinguish the glass that is soft to cut and that which is harsh. It appears then that we may deduce from this observation an indication of its good or bad quality, especially as, theoretically speaking, the result should be very nearly uniform from one and the same composition. But it is extremely difficult to decide, with any precision, on its hardness, even by comparison: this is acknowledged by those mineralogists who are accustomed to judge by this test: of two bodies of which one will scratch or cut the other, that which proves the softest is placed in an inferior rank; their rule has no other foundation.

There are many substances that will cut or scratch the most perfect glass, such as emerald, rock crystal, silex, finely pointed steel, &c. &c. They must therefore be entirely set aside as tests, since they would lead the observer to form a very uncertain judgment respecting the greater or less depth of the traces. The immature asbeste, the zeolite, and tremolite, have appeared to me to be the

the only stones that are capable of making traces on different kinds of glass, of a perceptible inequality of depth; especially the latter, when it happens to be pressed on one of the obtuse angles of its crystals, but the acute angle breaks with the slightest pressure. In the trials that I made with them on window-glass, with the quality of which I was previously acquainted, I remarked that those which were changeable were most easily cut, and most deeply furrowed by them. I should, however, observe, that this proof has been found defective, when applied to various samples of good glass; and what should render us more circumspect in the conclusions we draw from them is, that the fragments of the same piece of glass will reciprocally cut each other, when the sharp angle of one is applied to the surface of the other. The same fact occurs, though less sensibly, with two needles of rock crystal. Indeed the traces are most evident upon that kind of glass that is called *fat*; so that if we have a piece of good table glass we may use it with advantage for cutting other samples of glass, and for comparing them at the same time with the traces that its own fragments would make upon itself. This is the only use that can be made of this method of proving.

We know that the glass which is called *fat* is a bad insulator of electricity; and even hardly susceptible of electricity from friction. It may therefore prove of some importance to examine if this property would not furnish us with a satisfactory means of proving window-glass, inasmuch as its changeable nature is probably owing to the same causes, that is, to an excess of saline fluxes, or to its having been imperfectly refined; so that what is called *Sandiver*, or Salt of Glass, remains in .

The result of the experiments that I have made upon more than 30 different kinds of glass, or of different manufacture,

nufacture, have almost always confirmed these conclusions when I have taken the necessary precautions to remove such causes as might have some degree of influence. I have observed, that the commonest window-glass is easily electrified, by rubbing it on a bit of cloth; that the glass called *à boudine*, thus rubbed, acts strongly upon the electrometer of *Saussure*; that the metallic oxyds in the composition of glass, such as flint-glass, blue-glass, green-glass, black-glass, and even the hard enamel of the potters, make no difference in this property; that the good and bad sheet glass acquires even a sensible degree of electricity, whilst the glass which could not resist the other tests, was not in the slightest degree affected by the small electrical needle.

Such persons therefore as know how to remove the causes that frequently impede the free action of this instrument may safely employ it.

5. Bad glass is very easily alterable by fire. Placed upon coal, it becomes tarnished, and more or less farinaceous on its surface. The same effect is observable, both more speedily and sensibly, before the flame of a blow-pipe and an enameller's lamp. But in all the trials we must not only know how to prevent the action of the heat from being too rapid and unequal, but also to regulate its duration and intensity. A long-continued heat would render opaque the most perfect glass by devitrification; and even by operating with caution upon a fragment of fat glass at an enameller's lamp, we succeed in completely refining it, and rendering it pure and susceptible of uniting with glass of a better quality.

7. The experiments that I have made with the neutral salts have convinced me that this method of proof, which would have been the most convenient, is absolutely inefficacious. The solutions of alkaline and earthy muriates

riates, have no action, even by ebullition to dryness, except on glass of such inferior quality that it is needless to make use of it. Nevertheless I must mention, that I was somewhat surprised to meet with, among the commonest window-glass, which is generally unalterable, a sort which underwent a sensible change on its surface by the single ebullition of a solution of alum, mixed with muriate of soda.

8. There are few kinds of glass, which, when reduced to an impalpable powder, are not slightly affected by *concentrated acids*; but, previous to this mechanical division, all well-composed glass resists even sulphuric acid, which is the most powerful of any, although aided by heat. On the contrary, it attacks glass of a bad quality, even cold, with the greatest facility. I have seen bottles of black glass, in which concentrated sulphuric acid had been put, at the end of a few days pierced with several holes, which bottles, when opened, presented on the inside white grains, formed by the combination of the sulphuric acid with the soluble earth contained in the glass. But all glass that is susceptible of alteration in the air, is not equally defective in its composition; in order to judge of it therefore, it must be kept in digestion in the acid, and the heat increased till it rises in vapour. It leaves untouched only such glass as is well made and well tempered, whatever may be in other respects its nature, its limpidity and its colour, from the flint, chrystal, mirror, round and window glass, to the black glass.

It possesses, therefore, all the requisites of a test. I have foreseen, however, that this chemical instrument would be often rejected on account of the accidents to which it would expose those who are not in the habit of using it. Accordingly, I have found a substitute for it of equal power, which is more easily procured, and may be employed without danger.

8. This

8. This agent is the *sulphate of iron* (the green copperas of commerce).

After having placed in a small Hessian crucible some plates of glass intended to be proved, either by itself or by comparison, we nearly fill the crucible with this sulphate coarsely pulverized, and place it on burning charcoal, or even on a fire at acommon fire-place, which has the advantage of carrying off the vapour; we keep up the fire till the metallic salt assumes a red colour, and it is only necessary to plunge the plates in water, after they are cool, to judge whether they have been altered or not, and the degree of alteration they have undergone.

We see that this process is not expensive, requires no apparatus, and that any one may practise it. The results I have obtained from it, and which I submit to the society, together with those afforded by the different methods that I have mentioned, appear to me to leave no doubt of its superiority.

Memoir on the Desulphuration of Metals.

By M. Guéniveau.

(Concluded from Page 302.)

THE natural consequences of these facts are the following: first, galena and sulphate of lead mutually decompose each other at an elevated temperature; secondly, this decomposition occasions the formation and disengagement of a great quantity of sulphurous acid, and consequently the separation of a considerable portion of sulphur contained in the ore *; thirdly, the result is oxyd

* If we admit that a mixture of one part of sulphur and two of sulphate become entirely decomposed, and are reduced to oxyd of lead, the

oxyd of lead, when the proportions are right; and in the contrary case, a mixture of oxyd and sulphate, or of oxyd of galena. The application of these consequences to the roasting of sulphuret of lead in this reverberating furnace is easy to be made. I shall give the theory of this operation according to my own conception of it.

The pulverised galena or *schlich* of lead, extended on the bottom of the furnace in a bed some inches thick, the upper part or surface of which is exposed to the action of the air, produces the phenomena that we have observed in the ordinary roastings. The heat vaporises a little sulphur; the air converts one portion of the surface on which it acts into sulphurous acid, which is disengaged, and another more considerable portion into sulphuric acid, which at the same time combines with the oxyd of lead. We stir the ores: the sulphate of lead becomes mixed with the undecomposed *schlich*, and their decomposition produces some sulphurous acid; the surface of the bed which has been revived reproduces some sulphate which afterwards serves to effect a fresh disengagement of gas, and thus to continue the desulphuration to which we see no other end than the complete decomposition of the galena. If the operation has been well conducted, and if too much sulphate of lead has not been formed, the result of the roasting will be oxyd of lead almost pure; in the contrary case, some sulphate is likely to remain in it, which the charcoal will reconvert to the state of sulphuret, and its decomposition will be effected like that of the galena. We may judge from this exposition, how important it is not to suffer the sulphuret of lead

the quantity of sulphur separated will be one-fifth: so that one of sulphate in an indefinite quantity of galena, will separate one-fifth part of sulphur, and one of sulphuret in sulphate will separate two-fifths.

whilst

whilst roasting to melt; for the action of the air upon the melted ore would soon be rendered ineffectual by the formation of oxyd of lead which would cover it, and as the sulphate would no longer be capable of mixing with the galena, there would remain no other means of desulphuration.

The roasting of galena in a reverberating furnace is reduced then to the conversion of the sulphur it contains into *sulphurous acid*; and as it is effected in a great measure by the intermedium of the sulphate of lead which is continually formed, this process admits of a more complete desulphuration than the others.

The same decomposition of the sulphuret of lead, by the sulphate, appears to me to take place in the treatment of the ores of lead in the Scotch furnaces. In Scotland the roasting and melting of the galena is performed in one uninterrupted operation, by employing oil and turf.

This kind of furnace is successfully employed in the mine at Pezey for melting *roasted* galena, containing at least one-third of its weight of sulphate of lead. The final result affords no *matt*, which proves that it permits the decomposition of the sulphate, and the separation of the sulphur contained in it; I think that the action of the portion that is reduced to the state of *sulphuret*, by the contact of the charcoal upon the undecomposed sulphate, is one of the principles of the desulphuration that takes place.

We have had occasion to speak of furnaces (those of Falhun and the Scotch furnaces) in which the metallic sulphurets undergo an actual roasting; but there are others in which this effect is hardly sensible. I think I may in this place introduce with propriety a few remarks on the difference of the furnaces in this respect, because

 they

they are likely to be rendered interesting from being intimately connected with our subject; and will explain some of the phenomena which cannot be understood according to the manner in which the operation of roasting is usually regarded.

It is a fact well known in foundries, that furnaces of the most elevated temperature produce the least degree of desulphuration, or, in metallurgical language, they produce the most *matt:* if we wish to prove this, we have only to relate that we have seen at Pezey the ores of roasted lead, containing much sulphate of lead, which when cast in Scotch furnaces produced no matt, and afforded a great quantity when the operation was performed with a blast furnace.

If heat alone would easily and completely decompose the metallic sulphurets, the upper part of the strongly-heated furnaces would serve to effect the roasting of the ore; for, besides that the temperature in that part is low enough, the air that comes into it, being deprived of a portion of its oxygen, forms hardly any more of these sulphates which oppose the separation of the sulphur: but it is quite otherwise, and this is in my opinion a fresh proof of the little effect of the action of the caloric alone on the substances.

The sulphur separates from the sulphurets, in the manner we have seen, in the state of sulphurous acid, and the oxygen is indispensible for its formation; in the furnaces that are little elevated in temperature, the air that touches the recently charged ore, still contains much oxygen, the sulphurous acid that is formed is soon separated by the disoxydizing action of the charcoals; if a small portion is decomposed, it forms a new sulphuret, which is afterwards roasted as the ore; in a Scotch furnace, for instance, when the matt is run, it is afterwards thrown

into

into the furnace, and that which has escaped a first operation, is decomposed by a second: in the blast furnace, on the contrary, the ore placed in the upper part undergoes but a very incomplete desulphuration, because the air that touches it contains but very little free oxygen, the sulphurous acid is chiefly decomposed by crossing the top of the furnace filled with charcoal, and the sulphuret forms again; this latter has a tendency, owing to its weight, to fall into the basin, which it does not reach till after a succession of decompositions, which cannot take place but with a considerable loss of metal.

The facts collected in this paragraph seem to me to leave no doubt of this proposition: the decomposition of the metallic sulphurets by roasting is produced by the oxygenation of their component parts, and the sulphur is more or less completely separated in the state of sulphurous acid.

Desulphuration of Metals independent of the Action of the Air.

The various affinities of sulphur for different mineral substances offer means for the decomposition of certain sulphurets; and metallurgists have already employed several with success. For, in order that the decomposition of a metallic sulphuret by any mineral whatever may become the base of a metallurgical process, it is not sufficient that the affinity of this mineral for the sulphur exceeds that of the metal; we must also, besides the conditions which, for the sake of œconomy, must be observed, be satisfied of several others which are absolutely necessary to the success of the operation, and which greatly diminish the number of agents pointed out by chemistry: for example, if the sulphuret resulting from the

the decomposition is not fusible, or very little so; if it has the property of combining with the metal that it has separated, or rather with the sulphuret that remains undecomposed, it is evident that we shall not attain the end we propose, namely, the complete subtraction of the metallic substance. Hitherto we have hardly used any thing but lime and iron.

Desulphuration of Mercury.

The sulphuret of mercury is extremely easy to be decomposed; it is only necessary to present to the sulphur a substance that is capable of retaining it, and the mercury only is volatilised. It is thus that iron and lime are employed, either together or separately, in the treatment of cinabar ores.

Desulphuration of Copper.

Copper pyrites is melted in an apparatus, with lime, sometimes with a blast furnace, and sometimes with a reverberating furnace; but this process is not sufficiently known in detail to enable us to judge of the efficacy of this agent.

I once imagined, in common with some other metallurgists, that the acknowledged superiority of the affinity of iron for sulphur over that which copper has for the same combustible, is capable of determining the decomposition of the *sulphuret of copper* by this metal, at least in certain cases: but the experiments that I am going to relate have caused me to change this opinion.

Experiment I. I made a mixture of 10 grammes of copper pyrites, with the composition of which I was well acquainted, with 4 grammes of iron, 3 of them in filings; I put it into a crucible, covered it with charcoal-powder, and

and heated it for three quarters of an hour at a forge. The proportion of iron had been calculated, so that it sufficed to take up all the sulphur that was combined with the copper in the ore employed. I found in the crucible a mass perfectly homogeneous, weighing 13 grammes, which contained not the *least globule of metallic copper*, nor any indication of a *separation* between the *sulphuret of iron* and that of *copper* *.

Experiment II. Another trial was made by employing 10 grammes of copper pyrites, and 5 of the same ore *roasted*; this is nearly the case when the ore or the matt is not completely desulphurated; the proportion of iron was still sufficient to separate the copper, which was very abundant in the mixture. I heated it for three quarters of an hour, and found, as in the preceding experiment, a homogeneous mass, without any appearance either of metallic copper, or of pure sulphuret of copper: it was a true matt of copper.

Experiment III. A third experiment, in which crude copper pyrites and some that had been roasted were mixed in equal parts, soaked with olive-oil, and heated strongly for half an hour in a coated crucible, yielded only a powder which had undergone no fusion; this was undoubtedly owing to the superabundance of iron.

I believe these few trials are enough to prove that the *desulphuration* of *copper* by iron will always be very difficult, because it forms a *triple combination in all proportions of sulphur, iron, and copper*, or rather a combination between *the sulphurets of copper and iron*, which prevents the separation of the *copper*.

* In the decomposition of *galena* by *iron* we observe, when there is too little of the latter, three distinct substances, namely, lead, sulphuret of lead, and lastly sulphuret of iron on the top.

Desul-

Desulphuration of the Galena.

Galena is one of the sulphurets which are most easily decomposed; the fusibility of lead, which facilitates its collecting itself together, as well as the little affinity it has for the sulphur, are the causes of the success of the trials that have been made in this way. *Lime* and *iron* are employed in different circumstances for the desulphuration of galena; the use of lime is not very general, and it is impossible to judge of its effects from the knowledge we possess of the properties of sulphuret of lime. The treatment of galena by cast iron in the state of shot is most used, and appears very advantageous.

At *L'Ecole des Mines*, at Montblanc, a great number of experiments have been made on the desulphuration of *galena* by *iron*; and the results are sufficiently important to be made public.

This memoir comprises numerous facts that may be applied in metallurgy, and serve to suggest various experiments to those who apply themselves to the study of ores; and I do not presume to point out any, because I am persuaded that they will occur of themselves to such persons as are capable of undertaking them.

All the experimental researches have been made in the laboratory *du Conseil des Mines*, under the inspection of M. Descortils, whose assistance has been extremely useful to me, by giving them that accuracy which pervades in all his works.

Extract from Essays, by M. JOUSSELIN, *on the Improvement of Pottery in general, or the Art of making, at a less Expense, Vessels for all Purposes, handsomer, stronger, and more salubrious, without employing either Lead or Tin in the Composition of the glasing the Enamel and the Varnish. By M.* GUYTON.

From the ANNALES DE CHIMIE.

IN the pamphlet that has appeared under this title, the author, after having shewn the importance of this art, passes rapidly over the periods in which the porcelains of Japan and China were brought into Europe, of the introduction of the middling sort of earthen-ware into France (which was not before the fifteenth century), of the growth of the art in this country, where it has long been an advantageous object of foreign commerce; in fine, of the importation of the white pottery from England, and the establishments that have been formed in imitation of her manufactories.

The author then gives us, if not as a generally received principle, at least as the opinion of all persons who are at all acquainted with the subject, that there is no kind of earthen-ware really good except stone-ware and porcelain. These only, he says, are found to unite strength and salubrity.

Before he discloses the proofs, M. Jousselin justly observes that this principle not only concerns the progress of the art, but that it also merits the greatest attention under political and commercial relations, in so much the more as it would necessarily render us less tributary to foreigners for this branch of commerce, and would save very considerable sums, if it were only as much as is now expended in purchasing the lead and tin that are requisite in the composition of the coatings.

The *common earthen-ware*, destined to bear fire, is a porous biscuit, which is slightly baked, to render it more susceptible of the transition from heat to cold, and because its composition is not refractory enough to support a greater degree of heat in the manufacturing. For the same reason it will only take a very fusible glazing, which is usually composed of sulphuret of lead, and of the oxyds of copper, iron, and manganese.

The middling sort (*La Faience*) which was certainly an excellent invention in its time, on account of the beauty of its enamel,) has also the defect of being only baked to such a degree as to glaze the enamel, and which degree cannot be exceeded without altering it; hence it is necessary to add to it enough of lime to give it a little consistence by a commencement of fusion.

Its coating is composed of glass, lead, and silex, which, rendered white and opaque by oxyd of tin, is incapable of sustaining the alternatives of heat and cold, while the biscuit is subject to the inconvenience of absorbing greasy substances.

These defects, added to the necessity of procuring the tin at a great expense from abroad, led M. Jousselin to think it desirable that this sort should be entirely supplanted by a handsomer, stronger, and cheaper sort of earthen-ware, having neither tin nor lead in its composition.

The *pipe-clay*, or white pottery in imitation of the English, is lighter; its biscuit is stronger, being composed of purer clay and of prepared flints; it is baked beforehand; but the coating that is given to it is much more fusible than the enamel of *la Faience*: it is a kind of glass that will not bear so great a degree of heat. It is subject

subject to crackle, it is easily scratched, and then greasy substances penetrate the biscuit, leave blemishes or spots in it, and if the glass of lead happens to be in excess, which unfortunately is too often the case, oils and vegetable acids will attack it, and thus its use is rendered dangerous.

The memoir published by an able chemist (M. Proust), tending to encourage the use of this article, (see vol. IX. p. 38, of the second series of this work,) engaged M. Gay Lussac and myself to bestow great attention upon this object, at the time of the last exposition of the products of French industry. We found very few sorts that we could not score with a knife; and when thus scored, this earthen-ware was incapable even of resisting the action of boiling acetic acid, and yolk of egg baked to dryness.

We must therefore adopt the opinion of M. Jousselin, that whatever attempts may be made for the improvement of this manufacture, an earthen-ware perfectly good can never be produced.

It follows from these general reflections, that in the systems of this art we should not admit of more than two kinds of earthen-ware: the *stone* (or common porcelain) and the true porcelain.

Now, is it possible to give to the *stone*-ware all the desirable properties, and, in short, to make it serve all the purposes of the common earthen-ware *la Faience*, and that of pipe-clay? M. Jousselin affirms that he is convinced it may be done from numberless experiments; but as he proposes to form an establishment, he has not communicated the processes he has discovered, and from his account of them he appears to merit the confidence of such capitalists as are disposed to encourage the progress of national industry.

 Without

Without seeking to penetrate the secret of this manufacturer, I shall say, in support of this opinion, that it might have been very reasonably contested, when the art of making porcelain was yet only a traditional practice; when the stone-ware was made of a hard paste, incapable of sustaining fire without cracking: it might have been doubted previous to the experiments of Lamaguais in 1762, the period in which M. Jousselin relates that the first idea arose of making common porcelain, and which he regrets was not more encouraged. It might have been doubted, when we were ignorant of the property that magnesia possesses of arresting the fusion without altering the colour, the property of barytes of supplying the place of the saline fluxes; before the analysis of feldspath had taught us to compose it artificially of very common materials; when we had as yet no suspicion that pumice-stone would produce an invulnerable coating; when the inventor of this process (Fourmi), who was crowned by the Institute in the year 12, had not yet fabricated his *hygioceramés*, a kind of common porcelain for bearing fire; when the effects of heat prolonged to devitrification had not been observed; finally, when we had not yet seen the products of the manufactories of Utschneider, Lambert, and Mittenhof, which the jury of the exposition of 1806 acknowledged to be the true stone-ware for bearing fire, that is, the common porcelain *.

Thus

* In this place I can only point out the principal facts. I could mention many others which would tend greatly to strengthen this opinion: for instance, *Keffekil*, to which Kirwan has given the name of *magnésite*, such as the Turks employ for making their pipes, contains, according to Klaproth's analysis, only 0,50 of silex, and 0,17 of magnesia. I have observed that it loses 0.23 of its weight in the fire; it stops at the same time the vitrification, and the shrinking of the composition into which it enters. M. Giobert has shewn, in the

" Memoirs

Thus, in the actual state of our knowledge, it is by no means impossible that an artist, instructed by practice, might succeed in fabricating, as M. Jousselin proposes to do, the three kinds of earthen-ware that should serve to replace, 1st. the hard stone-ware destined to contain liquids, fats, &c. with or without glazing; 2d. the softer stone-ware, coated on the outside with a brown varnish, and with a white enamel on the inside, for kitchen utensils; 3d. *les Faiences* and white pottery, by preserving the elegance of form, and the brilliancy of the varnish, without using metal in the composition.

The enamel that M. Jousselin has discovered is purely earthy, and composed of such low-priced materials, that the enamel which at present costs 320 francs, would in a short time come to no more than 15 or 20.

"Memoirs de l'Academie de Turin," of 1802, that the earth of Baudissero, so long looked upon as alumine almost pure, and employed with success in the manufacture of porcelain at Vinovo, was only a magnesian earth, containing about 0,14 of silex. Among the results of the synthetic experiments, made in my laboratory at the Polytechnic school, I obtained a glass perfectly similar to that afforded by the feldspath of Baveno, by melting in a platina crucible a mixture of 62 parts of silex, 16 of alumine, 10 of lime, and 12 of potash. I even formed without kaolin, a biscuit possessing the stability, demi-transparency, and grain of porcelain, by giving the proper degree of baking to a paste composed of 50 parts of silex, 20 of alumine, 24 of magnesia, and 6 of lime. It is needless to say that it would be very easy to use the same proportions of silex and alumine, by employing good clay, without being obliged to take away the alum earth.

Method

Method of preserving the Cream and a great Part of the Milk during the rearing of Calves.

By M. SCHNEE.

From the BIBLIOTHEQUE PHYSICO-ECONOMIQUE.

IT has hitherto been supposed, in most countries, that the best method of rearing calves, either for slaughter or for the flock, is to make them suck their mother; but it is now ascertained that the following is to be preferred.

Put some water on the fire, nearly the quantity that the calf can drink. When it boils, throw into it one or two handfuls of oatmeal, and suffer the whole to boil for a minute. It is then left to cool until it is no warmer than new milk. Then mix with it one or two quarts of milk that has stood twelve hours and has been skimmed; stir the whole, and give it the calf to drink. At first it is necessary to make the calf drink by presenting the fingers to it, but it soon learns to do without this help, and will grow incomparably faster than by the old method. This new method is not only a theoretical truth, but its success is confirmed by experience.

The economical advantages that result from it are the following. According to the old method, a calf intended for slaughter is made to suck for three weeks, and those intended for agriculture from six to eight weeks. Supposing the cow gives only a moderate quantity of milk, the value of it will amount in three weeks to nearly the value of the calf. If, on the contrary, we rear a calf according to this new method, we consume during the three

three weeks only three quarts of oatmeal, at most, and the skimmed milk.

M. Schnée adds, that he has practised this method himself; and that his calves have been always as healthy and strong as his neighbours, and not subject to disease. The only alteration he makes in it is, that he does not suffer calves to suck at all, but gives them the pure milk of the mother to drink for the first four days; because, he has observed, that the separation after four days is more painful to the mother than when the calf is taken from her soon after its birth. He makes no exception, only when the cow calves for the first time, because he thinks he has observed that in this case the lacteal vessels open more, and the cows are more easily milked, if the calf is allowed to suck for a few days.

Intelligence relating to Arts, Manufactures, &c.

(Authentic Communications for this Department of our Work will be thankfully received.)

Tunnel under the Thames.

THE novel and interesting project of making a tunnel under the Thames, which has been before attempted by two companies, is now in a fair way of being accomplished from Rotherhithe to Limehouse, by a third set of subscribers, whom it seems were not damped by former failures, occasioned no doubt by the want of that information, and acquaintance with subjects of this nature, that such works indispensably require; and which, it is understood, has been the particular care of the directors of the present undertaking to obtain. Difficulties indeed have been encountered and overcome by skill

and

and perseverance, and more may naturally be expected; but none, in the opinion of the ablest engineers and miners, that are likely to prevent the final completion of the work under the same cautious management which has hitherto directed it. The head-way is now actually proceeding under the immediate bed of the river.

List of Patents for Inventions, &c.

(Continued from Page 320.)

SAMUEL HILL, of Whiteley Wood, in the county of York, Saw-maker; for a method of making iron and steel backs for fixing upon, and using with, the blades of scythes, and of straw and hay knives, whether the blades thereof be rolled, forged, cast, hammered, or otherwise manufactured. Dated August 26, 1807.

RALPH DODD, of Exchange-alley, in the City of London, Engineer; for a still or alembic, with a refrigeratory worm or condenser, and a piston and rod, for the use of distillers, brewers, and other persons using the like machinery. Dated September 8, 1807.

JAMES DAY, of Church-lane, Whitechapel, in the county of Middlesex, Merchant; for a method of making and compounding a certain liquid composition, called *Danzic or Dantzic Spruce*, or *Danzig or Dantzic Black Beer*. Dated September 9, 1807.

THE

REPERTORY

OF

ARTS, MANUFACTURES,

AND

AGRICULTURE.

No. LXVI. SECOND SERIES. Nov. 1807.

Specification of the Patent granted to ALEXANDER JOHN FORSYTH, *Clerk, of Belhelvie, Aberdeenshire, in Scotland; for a Method of discharging or giving Fire to Artillery, and all other Fire-Arms, Mines, Chambers, Cavities, and Places in which Gunpowder, or other Combustible Matter, is or may be put for the Purpose of Explosion.* Dated April 11, 1807.

With a Plate.

TO all to whom these presents shall come, &c. Now KNOW YE, that in compliance with the said proviso, I the said Alexander John Forsyth do hereby declare, that the nature of my said invention of an advantageous method of discharging or giving fire to artillery, and all other fire-arms, mines, chambers, cavities, and places in which gunpowder, or other combustible matter, is or may be put for the purpose of explosion, is expressed in the foregoing general description thereof, and the manner in which the same is to be performed is as follows; that is to to say: First; as to the chemical plan and principles thereof. Instead of permitting the touch-hole or vent of the pieces of artillery, fire-arms, mines, chambers, cavities, or places, to communicate with the open air; and instead of giving fire to the charge by a lighted match, or by flint and steel, or by any other matter in a state of actual combustion applied to a priming in an open pan, I do close the touch-hole or vent by means of a plug or sliding piece, or other fit piece of metal, or suitable material or materials, so as to exclude the open air, and to prevent any sensible escape of the blast or explosive gas or vapour outwards, or from the priming or charge, and as much as possible to force the said priming to go in the direction of the charge, and to set fire to the same, and not to be wasted in the open air. And, as a priming, I do make use of some or one of those chemical compounds which are so easily inflammable as to be capable of taking fire and exploding without any actual fire being applied thereto, and merely by a blow, or by any sudden or strong pressure or friction given or applied thereto without extraordinary violence; that is to say, I do make use of some one of the compounds of combustible matter, such as sulphur, or sulphur and charcoal, with an oxymuriatic salt; for example, the salt formed of dephlogisticated marine acid and potash (or potasse), which salt is otherwise called oxymuriate of potash; or I do make use of such of the fulminating metallic compounds as may be used with safety; for example, fulminating mercury, or of common gunpowder mixed in due quantity with any of the before-mentioned substances, or with an oxymuriatic salt as aforesaid, or of suitable mixtures of any of the before-mentioned compounds; and these compounds, or mixtures of compounds, I find to be much better

better for priming than gunpowder used alone, which cannot be made to explode without some sparks or actual fire applied thereto, or else without such a degree of extraordinary and violent percussion as cannot conveniently be made use of in gunnery, or with any of the fire-arms or artillery that are in most general use. But it is to be observed, that I do not lay claim to the invention of any of the said compounds or matters to be used for priming; my invention in regard thereto being confined to the use and application thereof to the purposes of artillery and fire-arms as aforesaid. And the manner of priming and exploding which I use, is to introduce into the touch-hole or vent, or into a small and strong chamber, or place between the said touch-hole and vent, and the plug or sliding piece, or other piece by which the communication with the external air is cut off, a small portion of some or one of the chemical compounds herein before mentioned (for example, as for priming to a musket about the eighth part of a grain); and when the required discharge is to be made, I do cause the said chemical compound or priming to take fire and explode by giving a stroke, or sudden and strong pressure to the same, communicated by and through the said plug or sliding piece, or other piece before mentioned or described, in consequence of which the fire of the priming is immediately communicated to the contents or charge placed within the said piece of artillery, fire-arm, mine, chamber, cavity, or place, and the discharge accordingly follows.

And, secondly, I do hereby farther declare, for the better illustration of my said invention, and as auxiliary to the use thereof, in relation to the mechanical parts thereof, that I have hereunto annexed drawings or sketches, exhibiting several constructions which may be made and adopted in conformity to the foregoing plan and principles, out of an endless variety which the subject admits of.

Fig. 1 (Plate XVI.) represents the section of a piece of artillery, where the charge is inflamed upon the upper side.

Fig. 2 represents the section of a piece of artillery, where the charge is inflamed at one of its ends through a touch-hole in the line of direction of the barrel or bore of the piece.

Fig. 3 is a representation of the same thing as Fig. 2, except that the narrow part of the touch-hole is lengthened more than in Fig. 2.

The same letters answer for the description of Figs. 1, 2, and 3.

In Fig. 1, A A, represent the section of a piece of artillery. B the touch-hole, of a cylindrical bore, excepting at the bottom, where it becomes a small perforation, leading to the chamber. C is a cylindrical punch or plug fitting the bore of B, and (if need be) clothed, packed, or faced near its upper part with leather or binding, or any other material proper to render its fitting more correct, and its motion easy and smooth. The lower part of C is made to fit the lower part of the touch-hole B, and there is a small internal cavity at the lower part of C, in which a portion of the said chemical compound may be lodged by dipping the said punch or plug therein; or a sufficient quantity of the said chemical compound is let fall into B, part of which lodges upon the shoulder at B, Fig. 1, or in the bottom of the bore at B, Figs. 2 and 3, and in this state the said punch or plug C is to be inserted in the touch-hole; and a smart blow being given on its upper end, the said chemical compound being suddenly compressed between the two faces nearly in contact, will explode, and give fire to the remaining portion, and

and also to the charge. The apparatus, Figs. 1, 2, and 3, is chiefly to be recommended for its simplicity, but it is attended with several obvious inconveniences.

Fig. 4 represents the section of an apparatus which may be used to prime and discharge a musket, or any other fire-arm, a great number of times, even although the breech of the same is under water. A A represents a section of the barrel of the piece. D the chamber of the barrel, which is contracted to a narrow touch-hole at I and opened up to about double the diameter of the narrowmost part of the touch-hole at B *b*. Into B *b* is introduced the rod or plug C C C at *b*, where the touch-hole is opened wider. There is another hole F. of the same diameter as B *b*; and at right angles to B *b* a cylindrical piece, of any proper metal, with a hole nearly through it, in the line of direction of the axis, passes through the solid breech of the barrel as near to I and *b* as can be done with safety and convenience. There is also another hole in one side of the cylinder at right angles to its axis, and corresponding with the hole F in the breech of the gun when the cylinder is fixed in its proper place; or, as the cylinder must be accurately fitted into the breech, and move round freely, this last-mentioned hole may stand either at F or K. This first-mentioned hole in the cylinder E is filled with any of the chemical compounds before mentioned. When the piece is to be primed, the hole in the side of the cylinder E is brought directly over F, and the powder falls out of the cylinder through F into the small cavity at *b*, between the point of the rod or plug CCC, and the contracted part of the touch-hole at I, where the piece is to be discharged. The side hole in the cylinder E is turned round to K, and the rod or plug C C C impelled forward by the stroke of a hammer or spiral spring as at G G G, or by any other mechanical contrivance, so that by its pressure or concussion against the

the shoulder at I it fires the priming contained in the cavity at *b*. H H * is a screw by which the power of the action of the spiral spring G G G may be increased or diminished as necessary.

Figs. 5 and 6 represent another apparatus, which may be used in the same manner as the preceding. The inner circle B represents a section of a flat cylindrical piece, having a central stem on the opposite side or face to be screwed into the barrel where the touch-hole is commonly placed. (Another section of the cylinder B is given in Fig. 7.) The axis or central line of the said stem is perforated or drilled up to half the thickness of the cylindrical piece, so as to meet another hole D B drilled or made in the edge of the said piece. The space A A between the inner and outer circles denotes another flat piece, of which the inner part is hollowed out so as very accurately to fit the outside of the first-mentioned cylindrical piece, and to be capable of revolving upon it when turned by the handle C. At E is a plug or punch inserted in the hole in the edge of the moveable piece, and kept from immediately touching the same by means of a spring, of any suitable form. On the opposite part of the circumference of the moveable piece, and through the handle at C, there is bored a hole or cavity K, quite through to its inner surface, in which a considerable quantity of the chemical compound before mentioned is put and confined. G is a cock or arm for giving a stroke upon E. It may be set, discharged, and impelled by the same machinery and means as are used with respect to the cock of a common gun-lock; or the stroke may be given by any other means. The several parts of the mechanism are secured in their places by caps and screws, or by any other well-known means commonly used in

* These letters are not marked on the drawing attached to the record, and there are other letters on parts to which there is no reference.

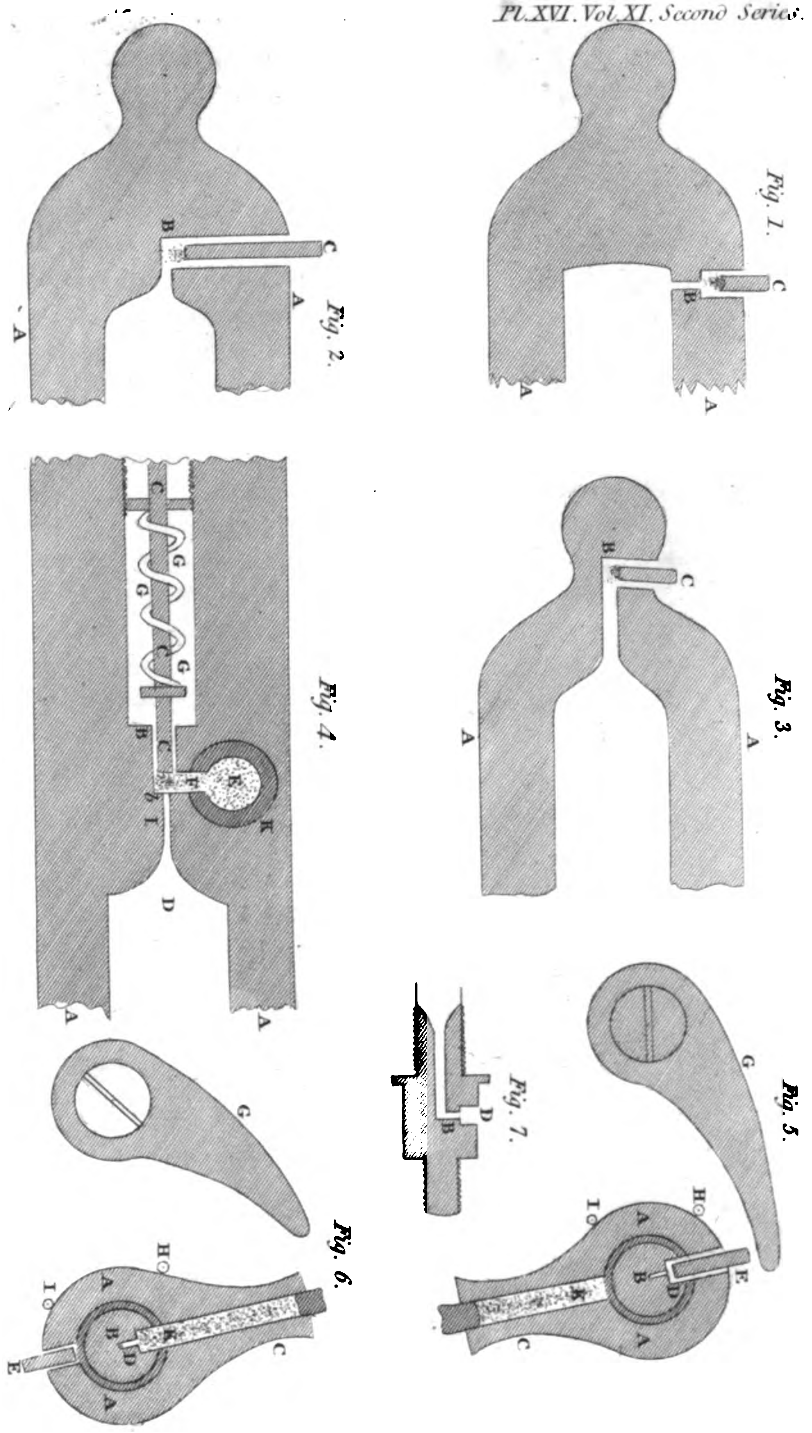


Fig. 1.
Fig. 2.
Fig. 3.
Fig. 4.
Fig. 5.
Fig. 6.
Fig. 7.

works of this kind. In the use of the apparatus last described, the hammer G is to be raised and cocked, and the handle C brought round to the position as in Fig. 6, where it is stopped by a pin or projecting piece H. At this instant the hole or cavity K is brought immediately over the channel or hole D B, into which a priming falls out of K, in consequence of the slight stroke or jar produced by the sudden stoppage of C. Immediately after this operation the handle is to be returned to its first position, as at Fig. 5, which brings the plug or punch E directly over the channel or hole D B, in which position only it is possible to give the stroke so as to inflame the priming, and discharge the piece. When this last effect is required to be produced, the trigger is to be drawn, and then G strikes E, and the contents of D B taking fire, explode through the touch-hole, and set fire to the charge, without allowing the escape of the gas or vapour in any direction but into the chamber and towards the muzzle of the piece. In witness whereof, &c.

Specification of the Patent granted to JOHN LAMB, *of the State of New York, in North America, at present residing in King-street, in the City of London, Merchant; for certain Improvements in and upon a Machine for extracting Fresh Water from the Salt Water of the Ocean, (by Distillation,) and other Purposes, at Sea and elsewhere.* Dated July 25, 1806.

TO all to whom these presents shall come, &c. Now KNOW YE, that in compliance with the said proviso, I the said John Lamb do describe my invention and improvements as follows:

First. My machine or machinery, which I call a hearth or camboose, for the use of ships and vessels, or otherwise

wise, for the purposes of cooking at sea, as also supplying, from the evaporation and condensation of sea or salt water, a sufficiency of good fresh water for the ship's use. The hearth or camboose is to be made of cast or wrought iron, or any other proper metal or material, of either a square, oblong, or other convenient figure.

Secondly. The front range or fire-place, where the fuel is introduced, to be in one or two parts, and one or two dampers or douters made so as to raise up and slide down on to the front grate, or a door or doors, oval or bulk, or any other convenient shape, so as to *close and shut up the front*, and *confine the heat* arising from the fuel consumed.

Thirdly. The oven to be about the length of the whole front range or fire-place, and at a suitable distance back from the front, with a door at one end, as usual; and (if required) a partition across, and a door at the other end.

Fourthly. Two dampers, made to be raised, and when necessary, to fall perpendicularly on to the top of the oven, by which the whole front fire is commanded; that is to say, by raising both dampers the fire draws under, and communicates to all the kettles, boilers, or coppers, for the purpose of cooking, and also to supply from the evaporation and condensation, or distillation of sea or salt water, good fresh water, for the ship's use, at the same time of cooking. By raising up one damper the fire communicates to two or more boilers, or to one boiler only, as may be required, by raising up the other damper. When no fire is required in the front, the dampers are to be down, and the fuel introduced (into a small door made by the side of the oven) directly under the two or more cooking boilers. All the boilers are to be placed in the back part of the hearth or camboose; and by drawing out a horizontal damper, to be made in the back side of the

the hearth or camboose, and to draw out from between the cooking boilers and the distilling boiler, will admit the fire to draw under the distilling boiler, which boils it the most rapidly by the draught of heat which otherwise would be lost, by going out at the flue or common smoke pipe.

Fifthly. The hearth or camboose and boilers, and all belonging thereto, must in capacity be proportioned to the size of the vessel, and number of people.

Sixthly. On part of the top of the distilling boiler (where the sea or salt water is only introduced) is to be fitted a moveable cover, to shut steam-tight; by the end or side of which (to cover the other part) is to be fitted a permanent cover, steam-tight, in the centre of which is to be a hole, with a collar convenient for fitting on (steam-tight, permanent or moveable) a pewter (or other proper material) still head, into which the steam rises and passes along a pipe, tube or worm (to be made for that purpose) into a refrigerating or condensing vessel, to be made square, oblong, or round, or of any other convenient shape, to fit apertures in any convenient place. In this refrigerating or condensing vessel is to be fitted a worm, pipe or tube, which is to wind or turn therein, along which the steam must pass; and where, by the effect of cold sea water, with which the refrigerating or condensing vessel is to be filled, the steam is condensed, and the fresh water flows out of the lower end of the worm (outside of the condensing vessel) into a reservoir placed underneath for the reception of fresh water.

Seventhly. On the top of one or more of the cooking boilers is also to be fitted covers, still-head, and pipe, tube or worm, to communicate with a separate worm, pipe or tube, to be fitted in the same refrigerating or condensing vessel, along which the steam must pass and condense, and the fresh water flow out of the lower end of the said worm into a separate reservoir, all to be made and to operate exactly in the same manner as is mentioned in the making and operation of the still-boiler, covers, head, pipe, tube or worm, and the steam condensed by the same means in the refrigerating or condensing vessel, as before mentioned, with this addition (that is to say) in the centre of the moveable cover of one or more of the *cooking boilers* is to be a hole, in which is to be fitted a steam-kettle, for cooking with steam when necessary.

Eighthly. In the *cover* or top of the *refrigerating* or *condensing* vessel is to be a hole to admit a steam-kettle, of sufficient size for cooking with steam when necessary; the steam to be let into the said kettle by a pipe or tube leading from the head-pipe or tube, fitted to the cooking-boiler, and the steam to pass out of the said kettle into a pipe or tube fitted thereto, and leading directly into the same worm, fitted in the refrigerating vessel. In this vessel is to be fitted a hand-pump, or any other conveniency, for the purpose of throwing out, or drawing off, the water when it becomes hot, so as to admit cold sea-water for condensing the evaporation as before mentioned.

I the said John Lamb do hereby farther declare, that from frequent experiments since the first day of January, 1803, in the operation of the aforesaid machine or machinery at sea and on land, the great utility consisteth in confining the whole of the heat, arising from the fuel consumed, to the purposes of cooking, as also to extract fresh water from salt water for the ship's use; the consumption

sumption of fuel will be lessened, and a greater effect produced than in the usual mode. Whether the condensation be in a vessel of the kind or shape above mentioned, or by passing along in pipes or tubes, in trunks filled with cold sea water, or in part under the surface of the sea, I consider it as my improvement or invention, and on the principles I have here adopted.

In witness whereof, &c.

Specification of the Patent granted to ROBERT BOWMAN, *of Leith, in Scotland, Manufacturer; for the Means of making Hats, Caps, and Bonnets, for Men and Women, of Whalebone; Harps, for harping or cleansing Corn or Grain; and also the Bottoms of Sieves and Riddles; and Girths for Horses; and also Cloth for webbing, fit for making into Hats, Caps, &c.; and for the Backs and Seats of Chairs, Sofas, Gigs, and other similar Carriages and Things; and for the Bottoms of Beds; and also Whalebone Reeds for Weavers, &c.*

Dated October 30, 1807.

TO all to whom these presents shall come, &c. Now KNOW YE, that in compliance with the said proviso, I the said Robert Bowman do hereby declare, that my said invention is described as follows; that is to say: the process of making hats, caps, and bonnets of whalebone, for men and women, consists of making the whalebone soft and flexible, by means of heat, which may be produced either by steam, furnace, immersion in boiling water, or in any way the workman may find most convenient. And whilst the whalebone is in that state it is to be cut into such breadths as may be necessary and

 proper

proper for the purposes for which it is to be used. For example; in making hats for military men, or other persons, the breadth of the whalebone should be such, that one breadth may answer for the sides, one for the crown, and one or more pieces for the brim. These, after being rasped, filed and scraped, are brought into the form required, while the whalebone is in a soft and flexible state, by working them on a block of the exact shape or form wanted; and observe, either the block or the whalebone must be warm before it be attempted to put the hat or other thing into the form wanted. When the whalebone becomes cold it will retain the shape it received from the block; which last may either consist of wood, metal, or any other proper material. The joinings of the pieces of whalebone are to be fastened either by sewing, or by applying an adhesive gum or cement, or by soldering with parts of itself, as is done in manufacturing articles of tortoiseshell. The adhesive gum or gluten is made by immersing picked isinglass into strong ardent spirits, and applying heat until it is dissolved, and rendered into a proper consistency fit for use, when it is afterwards applied to the joinings while warm; and which gum or gluten, when in a cold state, is not soluble in cold water. Indeed, any other strong adhesive quality may be used and applied as above. The soldering the joints of whalebone, like the joinings of tortoiseshell, is performed by having the edges fresh rasped, and placing between the joints part of these raspings, and afterwards applying a hot iron to both the inside and outside of the joints; but the heat of the iron must be such as will cause the raspings to run or melt into a pulp. When that takes place the joinings must be pressed together, and kept in that position till the whole is completely cold.

The

The work may after this be polished and finished off with sand-paper, powdered charcoal, burnt cork, &c. by means of a woollen or flannel cloth, and varnished with copal, or any other elastic varnish, fine or coarse, as the quality of the article may require. Hats for military men, or other persons, manufactured as above, will prove to be very light and durable, and, besides, will be found to be incapable of being penetrated by the cut of a sword, or other weapon. They will also be impervious to water, be thereby comfortable to the soldier, and will free him from much labour and attention he was formerly obliged to bestow. The hats may be made of such a quality as to suit persons in the highest rank of life.

The process of manufacturing hats, caps, and bonnets, similar to those made of straw and of chip, commonly called Leghorn hats, &c. consists in separating the whalebone, while in its soft and flexible state, produced by heat as before described, into such breadths as may be wished to have the plaiting in fineness. The splits are varied accordingly, as may be judged necessary to suit a fine or coarse plaiting or webbing; previous to which the splits are to be reduced to a certain thinness and breadth, either by means of a knife by the hand, or by the aid of machinery, as may be deemed most prudent and convenient. They are then to be plaited into a plaiting or webbing (as straw or chip are plaited or woven while either in a cold or hot state), which plaiting or webbing is to be stitched or sewed up into the form of hats, caps or bonnets for men or women; to accomplish which, the same process is to be pursued as is usual in the manufacturing straw, chip or Leghorn hats, caps, bonnets, &c. by sewing, or otherwise forming it; after which they may be dyed, stained, or varnished, so as as to make them water-proof. They also may be lined with silk, leather, or other material, as fancy may direct.

The process of manufacturing harps or riddles for cleansing corn or other grain, &c. consists in forming the whalebone into splits (while in a soft and flexible state, produced by heat as before described) of such grist or size as may be deemed sufficient to resist the action or pressure which may come in contact with it in the operation of riddling or cleansing corn, grain, or other things. The same method is applied in fixing the splits into harps as is usually practised in fixing those which are made wholly of wood, and filled either with splits of wood or wire.

The process of manufacturing bottoms and sides of sieves and riddles of whalebone consists in reducing the whalebone, while soft and flexible, into similar splits, as wood or wire is for making sieves and riddles; after which these splits are to be worked by plaiting, cross-plaiting, intertwining, or weaving, close or open mashes or openings, so as to clean or riddle corn, grain, or other things requiring to be sifted. They may be formed or sifted like the wood or wire ones, or in any other way that may answer the purposes intended. Harps, riddles, and sieves, thus made of whalebone, will be free from every dangerous and pernicious quality, and are therefore far preferable to those made of iron, brass, or other metallic substances, the oxyds of which are very poisonous, and particles thereof may fall off, be mixed and ground along with the grain, which, when taken into the stomach, produce debility, and often death.

The process of manufacturing whalebone into girths is as follows: when the whalebone has been made soft and flexible by the means before described, while hot it is to be be immersed in oil, for some days, when it will be more pliant and strong than it formerly was; after which it must be cut into such breadths (while warm and pliant) as may be found necessary to render it fit for breeching or traces for horses, or other animals that draw in carriages. Whalebone prepared in this manner is less liable to rot, and is more durable than leather. A plaiting or narrow webbing may also be made of the pliant slips to be used as reins or straps of leather, for harnessing horses, &c.

The process of manufacturing whalebone into backs and seats of chairs, sofas, gigs, coaches, and other carriages and things, consists in preparing the whalebone as is done for plaiting, webbing for hats, &c. and with the splits of whalebone to work a webbing according to the fancy, in like manner as has been formerly done with cane, by plaiting, twisting, intertwining, warping, weaving, and tweeling, by which various figures may be thrown upon the surface of the same, such as names, crests, coats of arms, &c. and which may be varied according to the experience and genius of the workmen employed.

The process of manufacturing whalebone for bottoms of beds consists in warping and weaving, with splits or straps of whalebone, either in separate frames or in the original bed, stock, or frame, a webbing or cloth of whalebone, which may be varied according to fancy, and which, it is imagined, will be more elastic, more durable, and less liable to harbour vermin, or any contagious matter, than the materials hitherto used for that purpose.

The process of manufacturing whalebone into reeds for weavers, and fit for weaving linen, cotton, silks, or woollen

woollen cloth, consists in preparing the whalebone while in a pliant state to that size which will suit the coarsest or finest reed, when they are rasped, filed, and polished, so as to answer for fineness or coarseness to suit such fabric of cloth as the weaver may require. The frame of the reed is also made of whalebone; and when all these are brought to their proper size, they are then made, formed, or fashioned, as is usually performed in making weavers' reeds of wooden frames and Spanish reed splits, according to the experience and genius of the workmen employed. The frames and splits of reeds thus made of whalebone will be more durable, and less liable to rot or decay, than those hitherto made of wood, iron, steel, or other materials.

In witness whereof, &c.

Specification of the Patent granted to SAMUEL WILLIAMSON, *of Knutsford, in the County of Chester, Weaver; for a Discovery of a certain Improvement in weaving Cotton, Linen, Silk, Woollen, Worsted, and Mohair, and each of them, and every two or more of them, by Looms.*

Dated December 4, 1806.

With a Plate.

TO all to whom these presents shall come, &c. Now KNOW YE, that in pursuance of, and in compliance with, the said recited proviso, I the said Samuel Williamson, do hereby declare that the nature of my said invention, and the manner in which the same is to be performed, is as hereinafter mentioned. My invention or discovery is applicable to the lathe of a loom, which is constructed for weaving two pieces of cloth (made of cotton, linen, silk, woollen, worsted, or mohair, or any two or more of them) at the same time, and consists of the new-invented machinery which I use for impelling the shuttles from the shuttle-box, in the middle of the lathe, to the shuttle-boxes at each end of the lathe.

The drawing made in these presents contains the outlines of a common lathe, constructed for the weaving of two pieces of cloth at the same time.

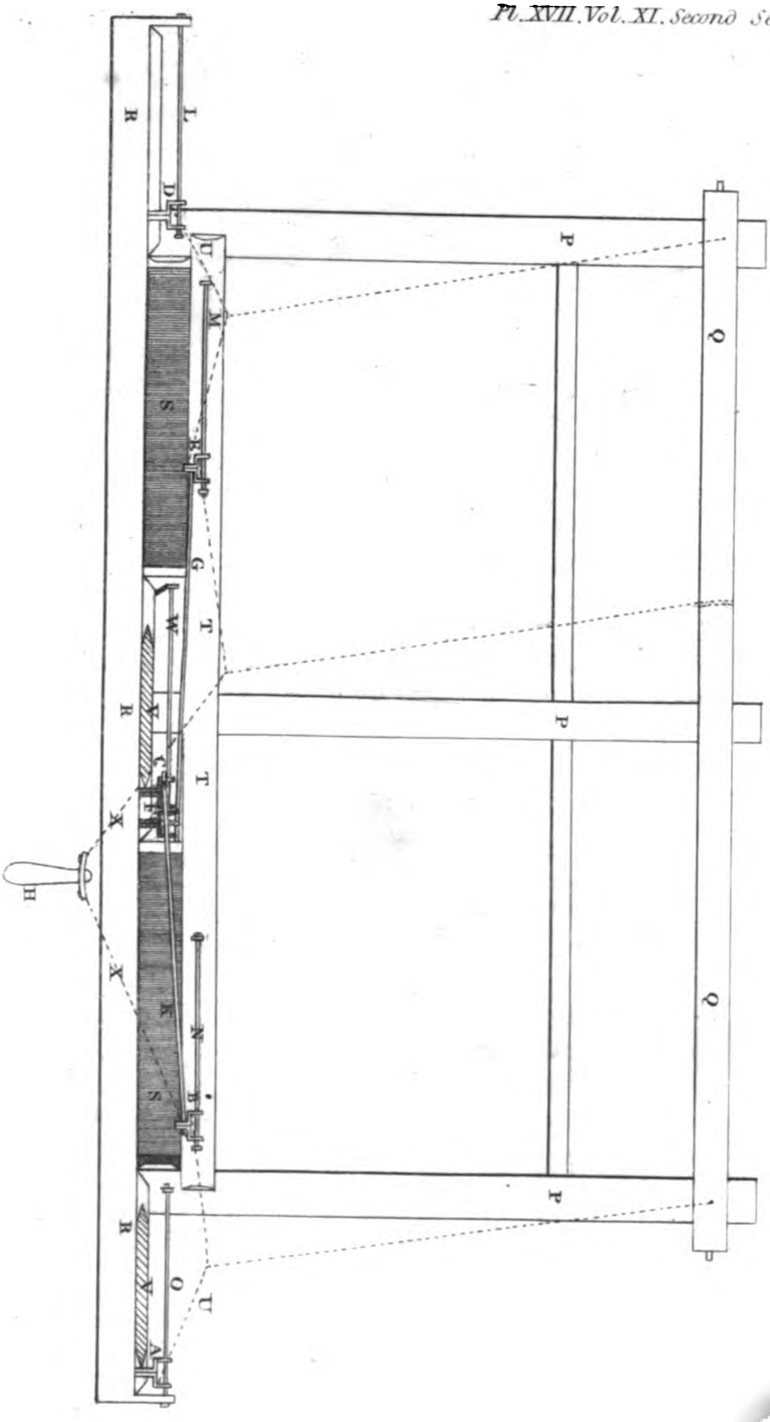
Description of the particular Parts of the Drawing.

Q Q, Fig. 1, (Plate XVII.) the axis upon which the lathe moves. P P P, the uprights or perpendicular parts of the lathe connecting the top of the lathe with its bottom. R R R, the bottom of the lathe. S S, the two reeds contained in the lathe. T T, the lathe-hood on that part of the lathe which holds the upper sides of the reeds in their proper position. V V, the two shuttles, one in the middle box, and the other in the end box on the right-hand side of the lathe. D C F A, are the four pickers used for picking the shuttle. L W O, are the picking-rods, upon which the above pickers respectively move, *viz.* the picker D moves upon the rod L, the pickers C and F move upon the rod W, and the picker A moves upon the rod O. M and N are two picking-rods, which I usually make of iron, but which may be made of any other metal which will answer the same purpose, and which I make about two inches (or the breadth of one picker) shorter than the picking-rod W. I fix the rods M and N at each end to the lathe-hood, as shewn in the drawing, leaving the rods between the points at which they are fixed at such a distance from the lathe-hood as to permit the runners E and B to move freely thereon: these rods may also be fixed to an additional cross bar, or any substance to hold them in a position near to the lathe-hood, and parallel, or nearly parallel, to the picking-rod W. E and B are two runners, which I make to slide on the two rods M and N respectively; and which I usually make of the same materials with and in the like form to the tops of common shuttle-pickers, but which may be made of other materials, and in other forms, to answer the same purpose. G K are two rods, which I usually make of wood, about three-eighth parts of an inch in diameter, but which may be made of other materials, and of other shapes, to answer the same purpose. I use the rod G for the purpose of connecting the runner E with the top of the picker F; and I use the rod K for the purpose of connecting the runner B with the side of the picker C, as shewn in the plan. The rods G K may be fastened to the pickers and runners either with strings or wire, or in any other practicable manner. The dotted lines marked U U represent strings used to connect the picker D with the runner E, and the picker A with the runner B. The dotted lines X X represent strings used to connect the runners E and B respectively with the handle H, which the weaver holds in one of his hands, and with which he is enabled to pick both the shuttles at the same time.

I confine my invention to the rods M and N, fixed, or to be fixed, as before stated, and the runners thereon, and the rods G and K, connected with such runners at one end thereof respectively, and with the pickers C and F respectively, at the other ends thereof respectively, as before described.

In witness whereof, &c.

On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On the Subject of Weeding; or Improvements to be effected in Agriculture by the Extirpation of Weeds.

By Mr. WILLIAM PITT, *of Wolverhampton.*

(Concluded from Page 363.)

On destroying Weeds on Corn Lands.

DR. Anderson observes, that "there is only one mode of extirpating annual weeds, whose seeds are indestructible; that is, to put the ground into such a state as to induce them to germinate, and then to destroy the plants" by harrowing up or ploughing under. This is strictly true, but I do not exactly agree with him in the process; the ground for this purpose should be ploughed before winter, but not harrowed, it being better to lay rough through that season, so as to have the greatest extent of surface possible exposed to the mellowing of frosts; as soon as it becomes dry in March, it should be cross-ploughed and harrowed down; many of the seeds and roots will then vegetate, which should in due time be ploughed under and harrowed again, and this process repeated as often as necessary: this is the true use of summer fallow, which, to have its proper effect, should always be attended to early in the season, when the powers of vegetation are greatest, and the heat of the sun is powerful.

The great defect in the management of summer fallows, seems to be the neglect of working them early in the season, by which omission the vigorous annual seedling weeds are not brought into vegetation in due time, after which they will not grow till the spring following, when they appear in such abundance amongst the wheat as sometimes to choke the crop; this is the reason why the poppy, the corn crowfoot, the tare, and many other annual weeds, make such havock amongst wheat, when by a judicious early working the fallow, they might have been brought to exhaust themselves in the fallow summer: this appears very clear from the effect, for if no wheat were sown, the seeds of these plants would often fill the ground with a full crop; but seeds can vegetate but once, consequently, had this vegetation been brought on in the fallow, and the plants afterwards been ploughed under in due time, none could have appeared in the wheat crop.

The turnip culture is peculiarly adapted to the destruction of weeds, as for this crop the ground must of necessity be in early preparation, by which weeds of early growth are brought into vegetation and destroyed, and those which remain alive in the soil may be exterminated by hoeing. I have observed, that wet weather is as necessary as dry to give a summer fallow its whole effect; for without a soaking of rain after the land is pretty well pulverized, numbers of the seeds will not vegetate, but remain and grow amongst the crop; the root-weeds are therefore to be destroyed in dry weather, and the seedlings after rain; and though the land should after a dry season be apparently in excellent order for sowing, it is better to wait the effect of rain, and even give time for seedlings to vegetate before you actually sow for the crop.

Some years ago, in a dry season, I remember a ten-acre piece prepared for turnips, and apparently in excellent order for sowing; the one half of it was sown without waiting for rain, and the other half left; plentiful rain soon came, and on the sown part the turnips and chadlock started together, and the crop was very full of the latter, which required great trouble to clean out by hoeing and hand-weeding: about a fortnight after the other part was again ploughed, and then sown with turnips; on this part scarce a single plant of chadlock ap-

peared,

peared; the seed having vegetated in consequence of the rain, was destroyed by the after-tillage.

The summer of 1795 was very dry, and free from soaking rain in this neighbourhood; in that summer I had a wheat fallow of nine acres manured with lime; harvest being finished, and it appearing in excellent order for sowing early in September, it was sown with wheat accordingly; soon after plentiful rain came on. By some accident one butt of land, about four yards wide, the whole length of the piece, was left unsown, having been harrowed without sowing: the wheat appearing in due time elsewhere, the omission was discovered; it was now sown and ploughed in. The other part of the field abounded with chadlock; on this butt there was scarcely a single plant.

The early-sown wheat fallows of the summer of 1795 were very generally full of chadlock; whilst the later-sown were not at all, or much less, infested with that plant: the reason is very clear from what has been said above.

Hence it appears that the destruction of root-weeds and seedlings, on corn land, must be effected upon different principles; the former by working them out of the soil in dry weather only, the latter by pulverizing the soil, so as to induce the seed to germinate after rain, and afterwards ploughing under the young plants; also, that frequent ploughings and harrowings are necessary, to expose all the seedlings contained in the soil to the powers of vegetation.

The ploughings and harrowings of fallow ground should not, however, immediately succeed each other; time should be given for the consolidation of the soil, which, after well harrowing, will undergo a slight fermentation, and settle, as it were, into a mass, after which it will turn up mellow, and the destruction of weeds will go on apace. The frequent ploughings, that have been recommended by some, are not only unnecessary but injurious, insomuch that, if any person would plough your fallow weekly for nothing, I believe it would be wrong to accept it. I have always observed that one ploughing of a fallow too soon succeeding another has no other effect than that of rooting about the clods, and prevents the general effect of consolidation and fermentation. The suffering of weeds to spread their leaves a little between the several ploughings of a fallow is not injurious; care, however, must be taken not to carry this idea too far, particularly in the case of squitch grasses, or so as to suffer any of the quick-growing weeds to ripen their seed, or the luxuriant ones to become too large for burying with the plough.

If a fallow for turnips be cross ploughed and harrowed down in March, it will generally lie very well to the beginning of May; and in general no fallow will want ploughing oftener than once in six weeks, if sufficient harrowings be given between the ploughings; the particular time most proper for these operations must, however, be determined not by any general rule, but by local circumstances, experience and observation.

The list here given of arable weeds may perhaps appear long, and the evils attending them, as well as the pains and labour necessary in their extirpation, may appear formidable to those who have not experienced or considered the subject: there is, however, no exaggeration in the account, and in the case of unimproved or ill-managed land the statement here made will apply in its whole extent; where lands are already improved, and have been for some length of time under good systematic management, the business is in part performed, and the evil

evil much lessened; in such land, and in all other, every rotation and course of cropping ought to render the land cleaner and freer from weeds, which it will certainly do in a judicious system with due attention: the means to be used are generally, 1. Complete and well-managed fallows, when fallows are necessary or proper: 2. Manures free from the seeds or quick roots of weeds: 3. A careful choice of clean seed: 4. Short tillages, *i. e.* not taking too many crops in rotation: 5. Attentive weeding and a spirited use of the hoe, in which view the drill-husbandry doubtless affords superior advantages to broadcast, in keeping land clean from weeds; but land must be well cleaned before the drill-husbandry is applicable: 6. A plentiful use of the clean seeds of the best grasses and trefoils at the end of the tillage: 7. Weeding the land when at grass, so as not to suffer the seeds of any injurious plants to spread themselves: 8. Upon again breaking up the land, to pursue such a system of cropping as will not increase or encourage weeds.

Upon these subjects much might be said, but I think it unnecessary, as the intelligent farmer will easily supply himself with every precaution necessary from his own observations; I shall, therefore, only slightly touch upon the several particulars: upon fallows some observations are made above; respecting fold-yard manure, it should always undergo a fermentation before laying on the land, sufficient to prevent the future vegetation of any seeds that may be contained therein; but it should also be kept as free as possible from the seeds of weeds, and perhaps it is best laid on grass land, applying only lime, or other manures certain on being clean, to fallows; or if dung not certainly clean from seeds be laid on fallows, it should be laid on early enough to give time to the seeds to vegetate and spend themselves before sowing for the crop.

crop. Every one knows the necessity of clean seed to producing a clean crop, but sometimes neglect to apply such knowledge; and indeed clean seed is not always to be procured. Short tillages are universally approved in theory, but sometimes the idea of present advantage tempts a deviation in practice. Weeding of crops is generally imperfectly performed, and likely to continue so in many places, from the difficulty of procuring hands enough for work only temporary; thistles are generally only cut off, but they should always be drawn up by tongs, and other weeds by hand: the hoe has yet been only of general use in turnips, nor is it likely to extend farther, unless the drill-husbandry should be more established, nor even in its present application can hands enough be always procured at reasonable rates. In the laying down of land to grass, the importance of clean seed is well understood, yet the seeds of docks are often sown with clover, and those of other pernicious plants with ray-grass: in the weeding of grass land, docks and thistles are often mown, or only cut off, but they should always be rooted up; for which purpose docking irons are formed upon a construction proper enough; they are, I suppose, every where understood, consisting of a forked or clefted spike of iron, jagged within the cleft, and fixed to the end of a wooden lever; this being forced down by the hand or foot, so as to inclose the root of a dock, or large thistle, will easily bring it up, particularly after rain; but mowing them off, being done with more expedition, is often practised, and they are sometimes left undisturbed, and suffered to scatter their seeds without any effort being made to prevent it.

Upon breaking up a turf, it is understood here, that unless a wheat fallow or a turnip crop compose a part of the tillage, the land will be injured and rendered fouler, and

and more addicted to produce weeds; this notion is, I believe, a just one, though often deviated from in practice for the sake of present profit, and under the idea of cleaning the land again next tillage; it is, however, well ascertained, that land well cleaned by former good management will best bear this deviation, for the fewer weeds it contains at breaking up, the less will be the increase of weeds during the tillage.

There is another cause of the increase and propagation of weeds, which may be termed a public cause, which it is not in the power of any individual to prevent: which a slovenly, neglectful, or ill-disposed individual may promote and increase, and which can only be prevented by a political regulation, and for which, I believe, no provision has yet been made in our political code: this is the number of vigorous and luxuriant weeds which are suffered to ripen their seeds in our hedges, pastures, woods, and other lands, and whose seeds being furnished with feathers, fly over the whole country, and propagate themselves far and near, growing wherever they alight and settle, and producing a plentiful crop; the most common and pernicious of which are the following:

1. Sowthistles *(Sonchus's)*, several sorts.
2. Saw-worts *(Serratula's)*, sorts.
3. Thistles *(Carduus's)*, sorts.
4. Coltsfoot *(Tussilago farfara)*.
5. Groundsels *(Senecio's)*, sorts.
6. Knap weeds *(Centaurea's)*, sorts.

As the seeding and scattering the seeds of these plants is clearly a public nuisance, as they are liable to be carried to a great distance by currents of air, and to injure the lands of all persons indiscriminately, I think they ought to be within the reach of our political regulations. It is very justly observed by the President of the Board, "that

"that some regulation of police for fining those who harbour weeds, the seeds of which might be blown into their neighbours' ground, has no injustice in the principle." Dr. Withering observes, that in Denmark there is a law to oblige the farmers to root up from their corn-fields the corn marigold (*Chrysanthemum segetum*); but this plant is not so publicly injurious as those above specified, the seeds having no feather, are much less liable to be blown elsewhere. It might, perhaps, be worth while to enquire the nature of this law in Denmark, though probably the despotism of the laws of that country might be unsuitable to our freer constitution; the following regulation is what strikes me in the first instance as practicable, and which may, probably, be better modelled upon farther consideration.

Suppose then the petty constable were required, by precept from the high constable, to give, in their presentments to the quarter sessions, a list of all persons who suffered the above plants to run to seeds in their hedges or lands, such presentments to be particularly specified to the court; those referring to the coltsfoot to be given in at the Lady-day sessions; and those referring to thistles of all kinds, sowthistles, groundsel, including ragwort and other *Senecio's*, and knapweeds, to be given in at the Midsummer sessions; an order of court might be made for the removal of such nuisances within one month, and a view appointed at the expiration of that time by two of the neighbouring justices, who should be empowered to fine the offenders not complying with such order, in any sum not exceeding five pounds, to be applied to the relief of the poor of the parish where such offence existed. If the present laws respecting nuisances do not give sufficient power for the above to the magistrates, I think a special act for that purpose is not beneath the notice of our legislature.

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The above-proposed regulations, generally adopted and applied in practice, it is presumed, may render the British empire as free from noxious weeds as those of China and Japan; particularly if united with the several precautions before proposed for preventing or exterminating these intruders: and it is hoped this public notice of an evil from a public body may tend to draw the attention of farmers and land occupiers more decidedly to this subject, as it is much more desirable to excite a voluntary spirit of national industry, than to enforce it by coercive measures, though I believe in the instance here alluded to little coercion would be necessary; as the extirpation of the weeds here specified would be unanimously agreed upon whenever the subject came under the cognizance of the public eye, and the interference of the police, by publicly exposing such as neglected their duty in this particular, might probably be productive of a good effect.

III. *Weeds in Grass Land.*

As it is not exactly agreed, even by attentive observers, what may be deemed useful plants, and what injurious ones, in the herbage of our meadows and pastures, the writer hereof has first given a list of what he believes noxious plants in grass land; and has afterwards added a list of what he calls neutral plants, with a few observations on them, in hopes of inducing a fuller investigation of this subject; in which it may perhaps be found, that some of this last class are useful herbage, and others noxious, though their particular qualities are not yet fully discovered. The plants here particularized are such as the writer has observed himself, or the authorities are given.

1. Cotton grass, hares-tail, moss crops; (*Eriophorum vaginatum* and *polystachion*), growing in bogs or meadows; poor

poor people stuff their pillows with the down, and make wicks of candles with it. This plant is a certain token that drainage has been neglected.

2. Hog weed, low parsnip *(Heracleum angustifolium)*, often found in meadows, but too coarse and weed-like to be suffered to abound on well-managed land, though I believe cattle will eat it either green or in hay: may probably be weakened or destroyed by annually cutting up.

3. Wild cicely, cow weed *(Chærophyllum sylvestre)*, common in orchards, hedges, meadows, and pastures: cattle are fond of it in the spring, but I think it too coarse to be encouraged amongst grass. This plant and the last may probably be worthy of trial in cultivation by themselves, being of luxuriant growth, would yield a large produce, but their value has not yet been fully ascertained.

4. Ramson *(Allium ursinum)*, in some meadows, but commonly in hedges; other plants will not flourish near it; cows eat it, but it gives their milk and its produce a garlic flavour, and should therefore be weeded out.

5. Rushes of sorts *(Juncus's)*, often found in meadows and pastures, and are a sure indication that the land wants draining; which, when effected, they always give way to better herbage, though their extirpation after draining will be accelerated by top-dressings of ashes.

6. Docks *(Rumex crispus, acutus, obtusifolius, &c.)* should be rooted up after rain from meadows and pasture land, being refused by cattle, and eaten only by fallow-deer, who prevent their flourishing in parks.

7. Bistort *(Polygonum bistorta)*, in some places occupying large patches in meadows, to the injury of better herbage; it is a perennial plant, but might doubtless be weakened by repeatedly rooting up; the root is one of the strongest vegetable astringents. Withering.

8. Wild

8. Wild campion *(Lychnis dioica)*, often found abundantly in arable pastures, where care should be taken to exterminate them, by well fallowing the land: there are two sorts, with white and red flowers.

9. Goose tansy, silverweed, or feathered cinquefoil *(Potentilla anserina)*, common in many arable pastures, but generally untouched by cattle; should therefore be destroyed in the tillage, and by keeping the land free of stagnant water.

10. Pilewort *(Ficaria verna)*. Withering. *(Ranunculus ficaria.) Flora Rustica.* Flowers very early in the spring, and abounds in shady or moist ground; it occupies much room in some meadows, and chokes other plants which grow near it, and not being eaten by cattle, should certainly be extirpated; nothing discourages its increase more than coal or wood ashes. *Flora Rustica.*

11. Lousewort, red-rattle *(Pedicularis sylvatica)*, in moist meadows and pastures, and, I believe, rarely found but where the land is in want of draining; said to be very disagreeable to cattle, and injurious to sheep; but I believe the injury is principally occasioned by the unwholesome nature of the land on which it grows: may be destroyed by draining and top-dressing.

12. Dyer's broom *(Genista tinctoria)*: I have seen it very abundant in some pastures, on strong or moist land, whence it ought to be grubbed up.

13. Rest harrow, cammock *(Ononis spinosa* and *arvensis)*, often found in pastures, where it is eaten by cattle, particularly the younger shoots: but it is too coarse and rubbishy to be suffered to increase, and should therefore be rooted out, or grubbed up.

14. Common or way thistle *(Serratula arvensis)*, should be cut off within the ground, or rooted up.

15. Rough,

15. Rough, or large thistles, boar thistles *(Carduus's)*, are generally mown, or otherwise cut off, but are much better rooted up.

16. Cudweed, chafeweed *(Gnaphalium germanicum)*, not uncommon in arable pastures. I have seen it abundant in an upland pasture after barley, where the clover has failed of success; cattle refuse it, but it is said to be successful in the bloody flux of cattle, and of the human species; it seldom appears much in a crop, or when the artificial grasses well succeed.

17. Ox-eye, white marigold *(Chrysanthemum leucanthemum)*, common in some pastures, and not grateful to cattle; but seldom abounding so as to be much injurious, and easily drawn out by hand.

18. Black knapweed *(Centaurea nigra)*, very common and abundant in some moist meadows and pastures, where it is a bad weed, being a harsh stubborn plant, seldom touched by cattle either green or dry, and not extirpated without much difficulty; it is a perennial plant, and increases much by the root *(Flora Rustica)*. It might, however, very probably be much weakened, and by degrees extirpated, by drawing up after rain. "Goldfinches are fond of the seeds." Withering.

19. Sedge grasses, various sorts *(Carex's)*, provincially hard grass, iron grass, carnation grass, most common in old sour moist land, undrained and unimproved, where in some places it occupies the whole surface; extremely hardy, and flourishing where scarcely any thing else will grow; seems produced by Nature from this principle in her economy, that a bad plant is better than none, for this plant is not eaten by cattle who can get any thing better; yet, upon draining and top-dressing the land, it will generally give way to a finer and more valuable herbage.

20. Nettle

20. Nettle *(Urtica dioica)*: sometimes growing in tufts on pasture land, where it should be rooted up, as it will prevent the growth of better herbage; asses are said to be fond of it, and cows eat it in hay.

21. Mosses *(Musci)*, various sorts: sometimes spreading on pasture-land, and I believe indicating that the herbage is starving and torpid, and wants a stimulus to quicken its growth: top-dressing should be used, and draining, if necessary; and if the land be arable, a pulverization by tillage with liming, and the seeds of fresh herbage, after a crop or two, may be applied.

The above I consider as plants to be extirpated from meadow and pasture land; besides which, there are many others of less import, whose characters are doubtful, or uses not ascertained, and to which little attention is commonly paid but what they command from the beauty and variety of their flowers; the most common of which, that have come under the observation of the writer hereof, are as follows:

1. Speedwell *(Veronica's)*, two or three sorts; little attention is paid to them by farmers; they are common in pastures, and I believe eaten by cattle.

2. Valerian *(Valeriana officinalis)*, common in moist land.

3. Spurwort *(Sherardia arvensis)*, in arable pastures after tillage.

4. Ladies mantle *(Alchemilla vulgaris)*, not uncommon in meadows.

5. Primrose, cowslip, &c. *(Primula's)*, considered as of no consequence to the hay or herbage.

6. Centory *(Chironia centaureum)*, extremely bitter; a diminutive plant with a pale red flower, common in pastures.

7. Pignut

7. Pignut *(Bunium flexuosum)*, common in old pastures, but not supposed of any consequence.

8. Purging flax *(Linum catharticum)*, common in pastures, but little attended to.

9. Harebell, English hyacinth *(Hyacinthus non scriptus)*, very abundant in some meadows, which I believe are not supposed better or worse on that account.

10. Daffodill *(Narcissus pseudo Narcissus)*, very numerous in some meadows, particularly near villages or houses, and much admired for beauty and early appearance, but not otherwise attended to.

11. Fritillary *(Fritillaria meleagris)*; this very curious and rare flower adorns, in great profusion, some meadows in the parish of Wheatenaston, Staffordshire. (Rev. Mr. Dickenson.)

12. Meadow sorrel *(Rumex acetosa)*, common in meadows, and, I believe, not at all injurious, but probably good herbage.

13. White saxifrage *(Saxifraga granulata)*, in meadows in the moor lands of Staffordshire.

14. Cuckoo flower *(Lychnis flos cuculi)*, common in meadows, but not attended to.

15. Meadow sweet *(Spircea ulmaria)*, coarse, but not disesteemed by some; cows and horses are said to refuse it, but probably eat it in hay; the farina or dust of the ripe blossoms is said to be an excellent styptic.

16. Cinquefoils *(Potentillas verna* and *reptans)*, common in pasture, and, I believe, eaten by cattle, but of little account as a pasture plant.

17. Tormentill *(Tormentilla reptans)*, similar to the last; growing in cold moist meadows.

18. Dwarf sun flower *(Cistus helianthemum)*, found in mountainous pastures, of much the same value with the two last.

19. Wood

19. Wood or meadow anemone (*Anemone nemorosa*); common in meadows, but disregarded by farmers; the whole plant is acrid: when sheep that are unaccustomed to it eat it, it brings on a bloody flux. Withering.

20. Meadow rue (*Thalictrum flavum*), abounds in patches in a meadow on my farm, where it is mown with the grass for hay, without any attention being paid to it, and without any known effect.

21. Crowfoots, butter flower, butter cup, gold cup (*Ranunculus bulbosus, repens*, and *acris*), common in meadows and pastures in every part of the island that I am acquainted with, so much so as to give a yellow tinge to the whole surface in the month of June; very abundant in the hay grounds near London, and indeed every where else: these plants are so prevalent in our meadows and pastures, and their good qualities have been so often questioned, that it seems highly proper their effects should be precisely ascertained. It is said in Withering's Botany, of the *bulbosus*, "cows and horses have a great aversion to it; and of the *acris*, "cows and horses leave this plant untouched, though their pasture be never so bare; it is very acrid, and easily blisters the skin." The *Flora Rustica* has given very elegant figures of these three plants, with remarks on the *bulbosus*, that "it inflames and blisters the skin; and beggars are said to use it for that purpose, to excite compassion by artificial sores; and on the *acris*, that "if cattle chance to eat it, their mouths become sore and blistered:" the three species are all occasionally found wild, with double flowers; in this state we frequently see the first and third cultivated in our flower gardens, especially the third; but we should derive more satisfaction from informing the farmer how he might effectually root them out of his pastures than how he might cultivate them successfully in his garden,

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for they propagate themselves with great facility, and occupy considerable space in good meadows. *Flora Rustica.*

Notwithstanding these authorities, I am inclined to think more favourably of these plants. I have never known a practical farmer name them as in the least degree injurious; and it is very certain of the *Ranunculus repens*, that cattle eat the foliage greedily with other herbage; and if they refuse the other species in bare pastures, it is probably because they have been deprived of most of their foliage with the adjoining herbage, and the remaining part of the plant is too acrid to be eaten alone; and indeed cattle refuse the flowering stems even of grasses, when deprived of their leaves: these plants may therefore be considered as seasoners and correctors, and adapted to uses in the animal economy, similar to that of salt, mustard, pepper, and vinegar at our tables, to correct the flatulent or putrid qualities of the more palatable and luxuriant dishes on the great table of nature; and though not eaten alone, are an agreeable aud useful stimulant with other more simple food. If these plants have any injurious qualities they have hitherto escaped the notice of farmers, all of whom cannot reasonably be supposed devoid of due attention.

22. Meadow bout *(Caltha palustris)*. This plant, though I believe useless to cattle, and occupying a good deal of room in some meadows, is of welcome appearance, its early showy flowers announcing the approaching spring; it declines time enough to give room for the growth of the later luxuriant grasses.

23. Bugle *(Ajuga reptans)*; common in some places on moist land.

24. Wild mint *(Mentha arvensis)*; in moist pastures; it prevents the coagulation of milk, and when cows have

eaten

eaten it, as they will do largely at the end of summer when the pastures are bare, their milk can hardly be made to yield cheese; a circumstance which sometimes puzzles the dairy-maids. This plant may be weakened by effectually draining the land.

25. Self-heal *(Prunella vulgaris)*; common in pastures; cows and sheep eat it, horses refuse it. Withering. It is little attended to.

26. Eyebright *(Euphrasia officinalis* and *odontites)*; common in pastures, and I think generally refused by cattle.

27. Lady's smock *(Cardamine pratensis)*. The leaves probably wholesome food green, and good in hay.

28. Crane's-bill *(Geraniums)*, several sorts; very common in upland pastures; but little known or regarded.

29. Milkwort *(Polygala vulgaris)*. I have found it often on uncultivated land, but have not seen it in meadows or improved pastures: cows, goats, and sheep eat it. Withering.

30. Goat's-beard *(Tragopogon pratense)*; often to be found in meadows and pastures.

31. Dandelion *(Leontodon taraxacum)*; very common, considerably diuretic; has probably a good effect on cattle from that quality at first going to grass; this and the last have similar qualities, and are good in hay with grasses.

32. Daisy *(Bellis perennis)*; growing almost every where; no attention is paid to it, but what it claims from the beauty of its flowers.

33. Yarrow *(Achillea millefolium)* and sneezewort *(Achillea ptarmica)*, both common and indifferent to cattle; the former is recommended for cultivation on poor land, by Anderson.

34. *Orchis's*, several sorts, common in meadows, having generally broad, entire, spotted leaves, and beautiful pale-coloured, or purple flowers in spikes, flowering through the early part of the summer; no attention is paid to them, as either useful or injurious, though I believe they are generally untouched by most, or all sorts of cattle.

Many of these plants deserve farther examination respecting their utility for cattle, or the contrary; green or in hay, as being hardy natives, their increase may be encouraged; or if injurious, means should be used towards their extirpation, or at least to weaken them, and reduce their numbers.

IV. *Weeds in Waste Lands.*

The weeds growing in waste land, considered as particularly injurious to such land, are not very numerous; for though many species of plants, useless for the food of domestic animals, grow there, yet, as there is no chance of introducing any thing better till such lands are appropriated and improved by cultivation, they can hardly be considered as noxious, so long as nothing better can be introduced in their stead.

As waste lands in their present state are useful only as sheep-walk, or for producing fuel, the improvement of them for sheep-walk is an object deserving attention, particularly as such improvement would render them of greater value in case of inclosure, and would much shorten the business of bringing them into cultivation.

The weeds that encumber waste lands, and reduce their value as sheep-walk, are of two kinds; the common upland rubbish, and the bog weeds; the former smothers the land, so as to prevent the growth of better herbage, and the latter are generally injurious to animals that feed on on them, either from their own nature, or because the land on which they grow is uncomfortable for, and unwholesome to, the health of animals, especially to sheep.

The upland rubbish is principally, 1. Heath *(Erica's)* of sorts. 2. Furze or gorse *(Ulex europæus)*. 3. Petty whin, or hen gorse *(Genista anglica)*. 4. Broom *(Spartium scoparium)*, but more commonly found in neglected dry arable land; these, where the land is of tolerable staple, should be burnt off, or grubbed up early in the spring; and if the land was afterwards sown with hay seeds in moist weather, it might much mend the herbage; also, 5. Fern *(Pteris aquilina)*, should be mown and carried off in summer, the value of it as litter being well worth the labour.

The bog weeds, or those occasioned by stagnant wa-water, are principally, 1. Cotton grass *(Eriophorum polystachion* and *vaginatum)*. 2. Matt grass *(Nardus stricta)*. 3. Rushes *(Juncus's)*, several sorts. 4. Red rattle or louse wort *(Pedicularis sylvatica)*. 5. Marsh St. Peter's wort *(Hypericum elodes)*. 6. Kingspear *Narthecium ossifragum)*: these two last are of little consequence in themselves, but indicate boggy land; in their company is often found, 7. Purple-flowered money-wort *(Anagallis tenella)*. 8. Sedge grasses *(Carex's)*, several sorts; these plants would give way to better herbage upon draining their native bogs, which ought to be done by a rate, levied upon the inhabitants of the neighbourhood having right of common.

If the country be not yet ripe for inclosing all the commons and waste lands, the improvement of their staple by measures of this kind, by destroying weeds and introducing better herbage; by draining the bogs, and destroying the aquatic weeds growing therein, would mend their present state, and improve their value to the public;

lic; would render them capable of maintaining a greater number of sheep, and preserve such stock in better health, as well as render the land more susceptible of a rapid and easy improvement by cultivation, whenever the time shall arrive for their inclosure, and for such improvements.

V. *Weeds in Hedges.*

All kinds of weeds are injurious to young hedges, which require to be well cleaned from them for three years after planting, otherwise the young quick would be choked and destroyed; and there are some kinds of plants which very much injure old full grown fences. Many kinds of weeds growing in hedges are a great nuisance if the seeds are suffered to ripen, because such seeds are liable to be carried into cultivated land by the wind; there are also some kinds of hedge weeds which bear the character of being injurious to stock; these, if the observation be well founded, should be cleared from the hedges that such stock frequent; and, lastly, improper species of the vegetable kingdom, composing or growing in hedges, may be termed hedge weeds, because they prevent the main object of such hedges, that of dividing and fencing out the land.

1. The catchweed, or cleavers *(Galium aparine)*, has a tendency to choke young hedges, by means of its numerous creeping rough branches; it should, therefore, be cleaned out in due time.

2. The great bindweed *(Convolvulus sepium)*, is, I think, injurious to some hedges, by twining round the growing quick; the roots of this plant must be well worth gathering for medical uses, the inspissated juice of them composing scammony, a powerful drastic purge. Dr. Withering observes, " Can it then be worth while to import

port scammony from Aleppo, at a considerable annual expense, when a medicine, with the very same properties, grows spontaneously in our hedges? though an acrid purgative to the human race, it is eaten by hogs in large quantities, without any detriment."

3. The great wild climber *(Clematis vitalba)*, common in hedges in the chalk countries, called there provincially old man's beard, from the hoary appearance of the plant after flowering, the seeds being furnished with numerous grey hoary tails. This plant is very injurious to fences, for the leafstalks twine about any thing they can lay hold of, and thus support the plant, which is large, luxuriant, and heavy, without any strength to support itself, and by its weight hauling down and deforming the fences. "The fine hairs which give the cottony appearance are, I apprehend, too short to be employed in manufacture, though it is probable they may be used to advantage for the stuffing of chairs." Withering.

The hop *(Humulus lupulus)*, the ladies seal, or black bryony *(Tamus communis)*, and the wild vine or bryony *(Bryonia dioica)*, are all common in hedges, where I think them somewhat injurious to the fences.

Sow thistles, the large rough thistles, knapweeds, and ragwort, as named before, are a great nuisance, if their seeds be suffered to ripen in hedges: in addition to which may be added the following, whose seeds are also furnished with feathers, and capable of flying to a great distance, and which are also often to be found in hedges:

Yellow devil's bit *(Leontodon atumnale)*.
Wild lettuce *(Lactuca virosa)*.
Yellow hawkweed *(Hieracium murorum)*.
Bushy hawkweed *(Hieracium umbellatum)*.
Smooth hawksbeard *(Crepis tectorum)*.

Burdock

Burdock *(Aretium lappa)*, a well-known plant, which should not be suffered to perfect its seed in hedges, being very luxuriant of growth. "Before the flowers appear, the stems, stripped of their rind, may be boiled and eat like asparagus; and when raw, they are good with oil and vinegar." Withering.

These, and other plants of a similar nature, as well as all luxuriant weeds, and shoots of brambles, and whatever else grows beyond the bounds of the fence, ought to be brushed out of hedges about Midsummer, as is very often done in Staffordshire for the sake of their ashes, which are worth all the labour.

The dog's mercury *(Mercurialis perennis)*, is said to be noxious to sheep; it is very common and abundant in some hedges, and appears very early in the spring, when sheep-food is very scarce; on which account it is still more dangerous, if it be so at all.

Most kinds of smooth wood make but an inferior fence, and therefore, upon plashing down a hedge, they are to be rejected and cut out, wherever there is enough of the hawthorn, crab or blackthorn, to supply their place; but the hawthorn is much to be preferred: the blackthorn *(Prunus spinosa)* makes a good impervious fence, but is apt to grow out of bounds, from its roots spreading and sending out shoots; the shrubs of the rose kind *(Rosa's)*, are objectionable on the same account, as well as because their branches grow irregular also; and the bramble is still more objectionable on these accounts: even the hazle *(Corylus avellana)*, may be termed a hedge weed in some populous neighbourhoods, because it tempts trespassers to break the fences in seeking for the nuts. Timber trees should be planted sparingly, or with a proper selection, in hedges, for they certainly must injure the fences, which never grow so vigorously under the shade of trees

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as elsewhere; the elm is the least objectionable on this account, from its lofty growth; the ash may certainly be termed a hedge-weed on many accounts, though so valuable in its proper place, which should be in clumps, coppices or plantations; the alder is often planted in hedges on low land, where it is of quick growth, but should always be rejected on upland; where, indeed, for fence, every thing must yield to the hawthorn, whose superiority is established and well known.

VI. *Weeds in Woods and Plantations.*

The cultivation of timber may be considered as a branch of Agriculture, and as that part of it peculiarly the province of the gentlemen, and owner of the soil, since the length of time required to bring the crop to perfection must necessarily preclude all others, and little expectation can reasonably be formed of personal profit; yet it often happens, that the individual amusing himself with this employment, has at the same time the pleasure of reaping the crop raised by the labour of his ancestors, and may have the satisfaction of reflecting that he, in his turn, is preparing the same pleasure for posterity.

As the cultivation of timber is generally undertaken as a matter of pleasure and amusement, it must heighten that pleasure to unite with it the greatest utility and future profit; which is to be done by a preference of the most valuable species, and by less attention to those of inferior consequence.

The oak is the true staple of our woods, and of by far the first consequence on many accounts, in comparison of which, many other sorts may be termed mere weeds of the forest: even its bark is a leading article in one of our most staple manufactures; the wood is necessary for the defence of our country, and applicable to numberless domestic uses: this can never want price, so long as any article brings it. The ash and the elm too have their manifold uses; and whenever firs and evergreens are planted, if the soil be suitable to English forest trees, they should be at such distances, as that the oak and the ash may be introduced between them; and as the latter grow and require more room, some of the former should be cut away.

I consider large plantations of Scotch and other firs, on land proper for our best English forest trees, as mere weeds in comparison of what might have been raised on the same ground; and have sometimes looked upon the large forests of beech, in some of the counties near London, in but little better light; particularly when I have by chance met with a very fine oak here and there, in the proportion perhaps of one to an hundred beech trees; when, had the major part of the trees been oaks, the value of the whole would have been many times doubled.

I therefore cannot but consider the inferior kinds of wood as coppice weeds, when they occupy the ground that might and should have been planted with the more valuable kinds; but, as every kind has its value and use, if it be but for fuel, the planter upon a large scale will of course cultivate a variety of kinds, but his attention should be principally directed to those of superior quality, which should certainly have the preference in point of number.

As no live stock can with propriety be introduced into a plantation, at least not till the trees are well grown, there seems no particular room for choice of the under herbage: the smooth underwoods should be encouraged, and briers and brambles, if they appear, should be grubbed up, as making the plantation inaccessible even to its owner. I think ivy injurious to the growth of timber trees;

trees; as clipping, confining, and fretting its supporting plants, and therefore that some attention should be given to clearing it away before it has too long established itself, otherwise, becoming a kind of garment, the stripping it off may starve, and in that way injure the main plant. When timber trees in a plantation increase in size, they should be gradually thinned, by weeding out the underlings and inferior species, and that annually, or by degrees; as the making too large an opening at once may let in too much cold air, and starve the plantation. I shall conclude the whole with a short list of herbs, or plants peculiar to, or commonly found spontaneous in woods, so far as I have observed them, and growing there without the aid of the owner or planter.

1. Enchanter's nightshade (*Circæ lutetiana*), woods in Bedfordshire and elsewhere; not uncommon.

2. Wood reed (*Arundo arenaria*).

3. Woodreoffe (*Asperula odorata*), common in many woods; in Enfield pleasure-grounds, Staffordshire, very plentiful.

4. Wild angelica (*Angelica sylvestris*), common in woods and hedges, and having the same properties in an inferior degree with the garden angelica.

5. Solomon's seal, or wood lily (*Convallaria*), woods in various parts of the kingdom.

6. English hyacinth, harebell (*Hyacinthus non scriptus*).

7. Willow herbs (*Epilobiums*).

8. Bilberry (*Vaccinium myrtillus*), in moist woods.

9. Wintergreen (*Pyrola*), woods in the moorlands of Staffordshire.

10. Wood sorrel (*Oxalis acetosella*), very common.

11. Wood spurge (*Euphorbia amygdaloides*), wood, in a clayey soil frequent; Needwood forest, Staffordshire, plentifully.

12. Raspberry, dewberry, and common bramble (*Rubus's*), common in most woods, one or more of the species.

13. Strawberry (*Fragaria vesca*), common in woods.

14. Tormentill (*Tormentilla reptans*), very common.

15. Herb bennett (*Geum urbanum*), common.

16. Wood anemone (*Anemone nemorosa*).

17. Wood crowfoot (*Ranunculus auriconus*), common in woods on a clayey soil.

18. Stinking hellebore (*Hellebore fœtidus*), in woods in many parts of the kingdom.

19. Wood sage (*Teucrium scorodonia*).

20. Betony (*Betonica officinalis*).

21. Hedge nettle (*Stachys sylvatica*).

22. Bastard baum (*Melittus melissophyllum*).

23. Cow grass, or cow wheat (*Melampyrum pratense*), very common in many woods, and said to be an excellent cow herbage, but not much found in pastures.

24. Figwort (*Scrophularia nodosa*).

25. Coral wort (*Dentaria bulbifera*).

26. Pea everlasting (*Lathyrus sylvestris*), a luxuriant plant. I observed it in Lord Winchilsea's woods in Rutlandshire, stem five or six feet long.

27. Wood vetch (*Vicia sylvatica*).

28. Wood peaseling (*Orobus sylvatica*).

29. St. John's wort (*Hypericum perforatum*).

30. Shrubry hawkeweed (*Hieracium sabaudam*).

31. Saw wort (*Serratula tinctoria*).

32. Hoary groundsel (*Senecio erucifolius*).

33. Golden rod (*Solidago virgaurea*).

34. Butterfly orchis (*Orchis bifolia*).

35. Twayblade (*Ophrys ovata*).

36. Sedge grasses (*Carex's*), several sorts.

37. Spurge olive and spurge laurel (*Daphna mezereum* and *laureola*).

These

These are the most common plants, spontaneously produced in our woods, without reckoning the timber or underwood species; many other sorts are to be found there, which are either less common, or have not come under the writer's observation; also many plants commonly deemed weeds, are omitted in various parts of this paper, as not being, to the writer's knowledge, particularly injurious in any kind of cultivation.

Description of a Machine for splitting Sheep-Skins.

Invented by Mr. BENJAMIN STOTT, *of Bermondsey-street.*

With a Plate.

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

Twenty Guineas were voted by the Society to Mr. STOTT *for this Machine.*

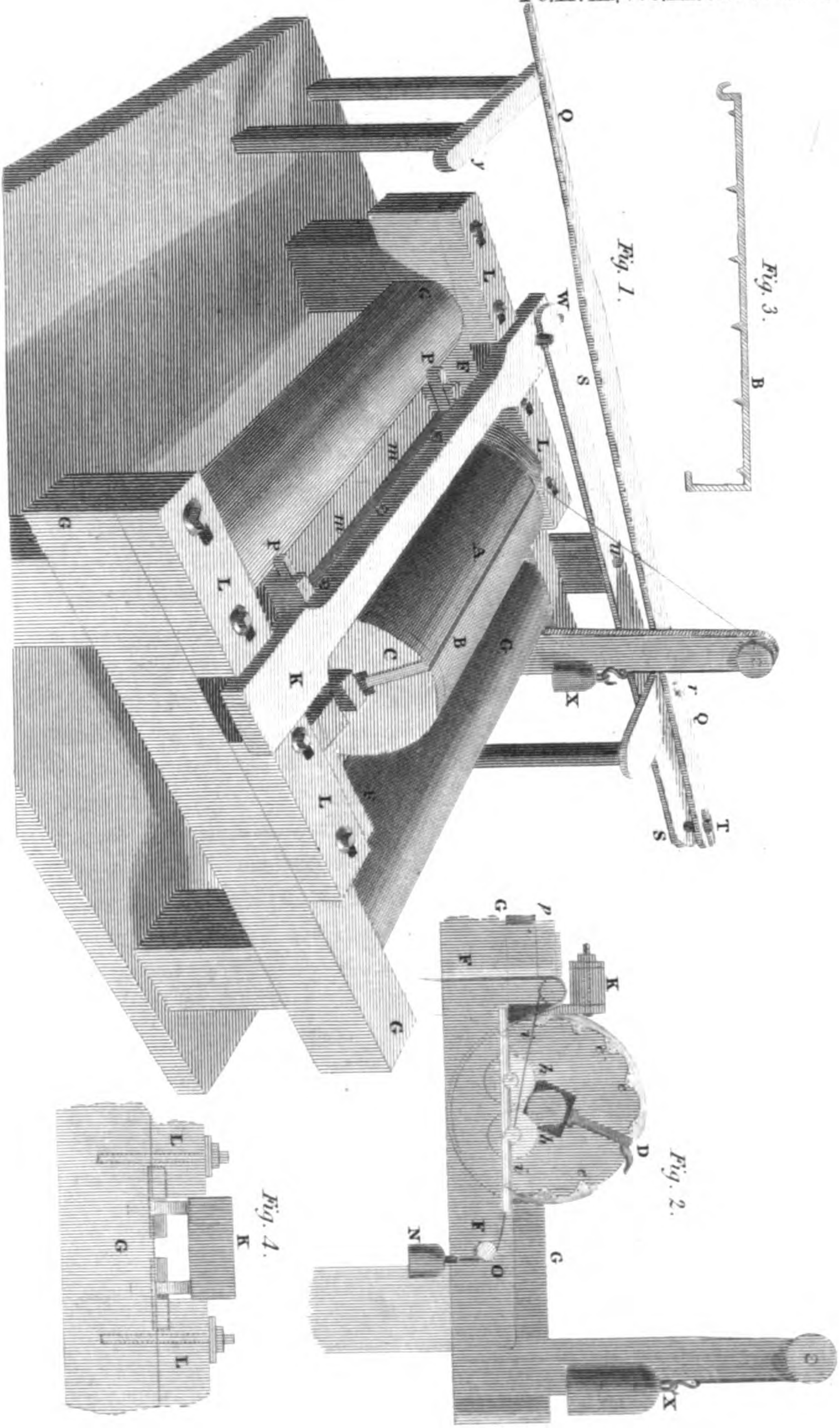
THIS engine is for the purpose of splitting sheep-skins, that is, of making two good skins out of one. The former and common mode of dressing skins is to shave one side off, reserving the shavings for glue-pieces; whereas by my method these shavings are all taken off in one piece, forming a good skin of leather; and thus, independently of the advantages arising to the proprietor, an additional revenue will be caused to the nation in proportion to the increase of leather made.

REFERENCE to Plate XVIII.

Fig. 1, A, the barrel of cast-iron (having wooden ends) round which barrel the skin is wrapped, and kept close by means of pins run through the edges into the wood, as at at *e e*, Fig. 2. B (Fig. 1) an iron running in a groove along the barrel, catching in a hole at C, and fastened down at the other end by a hook fixed in the end of the barrel, the bar having points in it (as shewn at B, Fig. 3), under which the edges of the skin are fastened (as seen at D, Fig. 2). F F (Figs. 1 and 2) bars fixed across each end of the strong wooden frame G G G G, over which the barrel is supported on friction-rollers, as at *h h* (Fig. 2), which run on a slip of brass, moveable under the screws *i i*, to adjust the barrel to the knife. K K (Figs. 1 and 2) a strong bar of cast-iron, to which the knife is screwed, moving lengthwise on friction-rollers between the pieces of wood L L L L, on the frame G, as at K (Fig. 4). The pieces of wood L L L L are each moveable under two screws, by which they are adjusted to steady the motion of the knife-bar. *m m* (Figs. 1 and 2) is a roller at the back of the knife, to which it is kept close by a weight N, at each end, acting over pullies, as at O (Fig. 2), suspended from the slider *p*, between which the roller is placed; by drawing the spare skin over this roller, as it is cut off, it keeps both sides of the skin equally up to the knife, and makes it cut more uniform. Q Q is a lever acting on a pin *r*, and moving another lever S S, by means of a pin and a notch T, which acts on another pin at *u*; and by means of the two pins at W it moves the knife lengthwise to and fro: as fast as the skin is cut the barrel is drawn round by the weight X. *y* is a guide to the lever, from which end it is worked.

Account

Pl. XVIII. Vol. XI. Second Series.



Account of an Experiment on the comparative Culture of Turnips.

By CHARLES LAYTON, *Esq. of Reedham Hall, Norfolk.*

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

The Silver Medal was presented to Mr. LAYTON *for this Communication.*

BEING desirous of ascertaining by experiment the best mode of cultivating turnips, I prepared, in 1805, twenty statute acres of land, well calculated for such trial. The whole spot was level, and the soil similar in every part. By manuring it equally with ten cart loads *per* acre of rotten farm-yard dung, after it had been properly summer tilled, it was fit, by the 24th of June, for the reception of the seed. In order to make the experiment perfectly accurate, I divided the field, which is square, into ten equal parts, and sowed the whole of them alternately by drill and broadcast at the same time. The drills were twelve inches asunder. The seed was of the white-loaf stock, and I had the satisfaction to find that no part failed. The divisions were all of them hoed at the same time, and care was taken to set the plants, as well the broadcast as the drilled, twelve inches apart. The expense for the whole was seven shillings *per* acre; but from the drilled plants requiring an extra man and horse *per* acre beyond the broadcast, I estimate the relative expense as eight to seven. Sixteen perches of each were set out and weighed by three respectable farmers and graziers, who reside in the parish of Reedham, where the experiment was made; and who have set their names to the certificate sent herewith.

A certificate

A certificate in proof of the above account was received by the Society, signed by John Baker, Daniel Cockerill, and Robert Long.

The certificate also states, that

	T.	Ct.	St.
16 perches of the drilled crop weighed -	1	19	0
Ditto - of the broadcast - - - - - -	1	14	4
	0	4	4

Difference in favour of the drill, 4 cwt. 4 stone.

Observations and Experiments on the Method of preserving Corn from Insects and from Heating.

By M. Lavocat Dominique Capriata.

From Sonnini's Journal.

I HAVE several times mentioned to the Academy a method of defending corn from insects, or, I should rather say, of mixing the seed with quick lime, reduced to a powder merely by being exposed to the night damps for at least forty nights, which is practised with success by many individuals in my country (Frugarolo). The necessity of this practice cannot be too much enforced, since those who neglect it are each year punished by the damage of their corn.

Having observed, that the corn thus prepared with lime was free from every species of insect, I was not surprised at it, because the lime in which the grain had been steeped defended it from the eggs of these little animals; but, to say the truth, I was rather surprised that the limed corn was not more liable to heat, since that not so prepared is much subject to it.

It

It is known that wheat in particular, in certain years, is subject to a sensible heating; which is discoverable by putting the hand in the bin, where it cannot be kept without pain: this is usually attributed to premature cutting of the corn, to negligence, or to an unfavourable season having prevented the grain from being sufficiently dried after being threshed and separated from the ear. This is the common opinion: but, I must say, I think it unsatisfactory, because, if it were the case, the corn prepared with lime for sowing, which is gathered at the same time as the other, is of the same quality, and very often taken from the same bin, and would naturally be equally subject to heat.

The lime when reduced to powder, and mixed with the grain, does not at all, or at least very little, augment the heap, because it fills up the interstices between the grain; the heating therefore cannot be attributed to its increased bulk.

It cannot be believed neither, that the lime absorbs the moisture of the grain, and by adhering to it prevents it from fermenting; for three or four pounds, or thereabouts, of lime to a sack of corn, could not absorb all the moisture; even if it absorbed a part, the lime would remain humid; but I never perceived it. On the contrary, I have observed that when the grain is stirred, which is frequently practised, lime-dust always rises, and does not remain attached to the grain; a double proof that it remains dry. In short, I could discover no cause why the limed grain did not become heated as well as the other.

What added to my uncertainty on this subject was the idea which prevails, that when the corn heats through dampness (for example, when it has become accidentally

 moist-

moistened on the barn-floor or in the granary, or when it has been washed without the precaution of making it sufficiently dry) the dampness causes it to lose its natural colour, approaching to yellow, and to contract a darker, which is very different from the heated corn. Indeed this latter, when separated by a sieve from the dirt and the grain attacked by insects, and afterwards cooled, loses none of its colour, nor of its intrinsic value. The meal of the wetted corn does not heat, and produces a bread that the country people call *pain a cendre;* whereas the heated corn being cleaned and freed from its heated state, makes very good bread; and probably we should hardly find one family out of a hundred in all the dismembered provinces of the duchy of Milan (where this heating is more common) who are not fed with bread made with this grain.

Now, it is a known fact, that this heating always produces worms; however it sometimes happens, that when the grains that have been attacked by worms are separated, the remainder begins to heat afresh, and so on till the whole bin is spoiled: I have seen this accident frequently happen, notwithstanding every possible precaution.

I have already said that the lime defends the corn from heating; but as the grain that is destined for seed is never taken from any that has been heated, I was desirous of observing, during some weeks, whether the lime would restore what had been already heated, and separated by sifting from the corn which the insects had attacked. I mixed eight pounds of powdered lime with two *emines* of corn, so that the lime was well divided; I made it into a small heap, and left it; I could not perceive that it heated, and I certainly should if I had not made this mixture;

mixture; for it is well known that corn taken from a heap that has been attacked by insects, although passed through a sieve, is re-attacked, and becomes heated afresh, especially if it be not often disturbed. Hence I conclude, that the lime will undoubtedly prevent the grain that has already suffered from heating again.

I was farther desirous of trying if the lime would not put a stop to the heating when already begun, and also arrest the ravages of the insects; and, almost contrary to my expectations, I finally succeeded: I took a sack of corn, the hottest part of a heap, and where it was most damaged by the insect, and without sifting it, or using any other precaution, I mixed it with eight pounds and a half of lime, and stirred the mixture two or three times, that the lime might be well dispersed. I afterwards left it to itself, and by degrees the heat diminished, and ceased entirely on the third day. If I had set apart this same grain without any lime, it is beyond a doubt that in less than three days nothing but chaff would have remained; so that it is certain that the lime puts a stop to, and even destroys, the heat, and prevents the progress of the insect.

The results from these very simple experiments lead one to think that the heating of the grain has its source, not only in the too great moisture of the corn, or some other internal defect, but also in the prodigious number of insects' eggs.

As it appears to me of the highest importance to ascertain the cause, I am desirous that the above experiments should be repeated, and especially that of preparing the grain with lime whilst the fermentation is at its height, and the ravages of the insects most powerful, because the infection is so speedy that the least delay is dangerous;

ous; and if new and reiterated experiments confirm, as I have no doubt they will, the fact, that the lime puts an immediate stop to both, it is certain that by this means a great quantity of corn would be preserved, which otherwise in certain years would be inevitably lost.

I am satisfied, from my own experience, that bread made from corn that has been prepared with lime is very wholesome; for in my father's house, when a larger quantity of grain was prepared than could be used, which was frequently the case, because when the season was unfavourable it was necessary to sow it thicker than usual, the overplus of prepared grain was sometimes reserved to sow in the following year, and sometimes ground for the use of the family, or sold.

When it was destined to be ground, it was spread upon a floor, and afterwards sifted, in order to cleanse it better: if it was to be sold, it was only exposed to the air. Heat separated it as soon, and even, when a little lime still adhered to it, on account of the dampness, it was only necessary to expose it to the sun for a short time. Many people think that the heat renders the corn cleaner and better than the other method; so that there need be no scruples about selling it, and it may be ground without the least fear.

An

An economical Process for obtaining in the large way pure Caustic Alkali and common Caustic.

By Bouillon la Grange.

With a Plate.

From the Annales de Chimie.

THE processes for preparing caustic alkali and melted potash, called in pharmacy *common caustic*, being either defective or of long duration, M. Welter and myself sought to abridge this operation by employing a process less tedious and expensive, and at the same time more certain and useful, for preparing in the large way caustic alkali, so necessary in the arts, and in chemical experiments.

We hope, therefore, to be serviceable to practitioners by acquainting them with a method by which they will not lose an atom of potash, and which yields it pure and caustic, without much expense or a great apparatus. Our method consists in having several troughs of white wood, or rather of calcareous stone, the dimensions of which may be varied according to the quantity to be prepared. Those that we had made for the Polytechnic School were of stone, and of the capacity of a cubic foot, (see Fig. 1, Plate XIX.); the bottom cut in channels, each about an inch in depth and width, and so placed as to allow of five or six, running parallel with each other, and one on the side, crossing the others, and serving to collect the whole of the water. A hole is pierced through the middle of the last-mentioned channel, to contain a glass tube, which should project obliquely at an angle of 45 degrees to the horizon.

The channels are covered over with glass tubes ranged transversely, on which is placed a cloth, which covers them completely; the cloth is then sprinkled with wood-ashes, and

and afterwards the mixture is placed on it, which we shall presently describe.

If stone troughs cannot be had, small tubs of white wood may be used (see Fig. 2), and for the channels at the bottom, river-sand, well washed, may be substituted; another bed of finer sand must be laid upon it, and the whole covered over by a cloth sprinkled with ashes. There must also be a tube added to it like the others, by which the filtered liquor may run out.

We need scarcely observe here, that the first method is to be preferred; for the caustic alkali always absorbs from the wood a portion of its colour; it will even, according to its degree of concentration, carry with it a small quantity of silex, which it dissolves; but these inconveniences are immaterial, if the object be only to obtain caustic alkali or common caustic.

For the arts, and for nice chemical experiments, troughs of calcareous stone should be preferred; then the liquor obtained is perfectly limpid.

The things being thus disposed, take equal parts of quick lime and potash when the lime is very caustic; when otherwise, 20 parts of lime may be taken and 15 of potash: put some water into an iron vessel, heat it until it nearly boils; then add the lime, which by its quenching brings it to this state: when it is quenched mix the potash with it, which forms of the whole a thickish paste; and leave it thus to cool.

Afterwards pour the mixture into the troughs, and cover it with water immediately; to prevent the water from washing holes in the matter as it is poured on it, place thereon a small wooden plate, which will rise with the water.

Care must be taken to place pitchers, or some other vessels, to receive the liquor that runs through the tube; and that the lessive may not absorb the carbonic acid contained in the atmosphere, the vessel should be almost closed, so as to prevent the circulation of the external air.

It is also necessary to keep the mixture always covered with water, and to collect it only until it comes insipid from the tube.

The liquors obtained are nearly of the same strength to the end, when they suddenly become so weak as to be useless.

To evaporate the waters, an iron kettle may be used. Begin with those last obtained, which are rather the weakest, in order to avoid keeping the strongest for a long time in contact with the air; and employ a strong ebullition.

When it is concentrated to a certain point, the sulphate of potash crystallizes and precipitates: it may be easily collected, by placing at the bottom of the vessel an iron skimmer, into which the salt will fall. The strongest ebullition is necessary to keep out the atmospheric air, and it assists the precipitation of the sulphate of potash into the skimmer.

If the object be to obtain common caustic, the concentrated liquor is to be poured into a smaller iron vessel, and afterwards evaporated to such a point, that when poured upon a plate of iron or marble it congeals *.

If, for nice chemical experiments it be desirable to obtain this alkali more pure, instead of using potash, supertartarite of potash, or cream of tartar calcined, may be

* We think it necessary to observe, that melted potash, thus prepared, is much more caustic than that which is prepared in pharmacy under the name of common caustic; and we caution those who may use it to be very prudent in employing this medicament.

employed;

employed; or the melted potash of which we have been speaking may be still farther purified by alcohol, according to Berthollet's method. Experiment has satisfied us that it is possible by this means to obtain a very pure alkali *. In this case the ley is evaporated to the consistence of a thick syrup in a silver basin, and it is best for the vessels to be closed: then the matter is dissolved in alcohol; the potash alone combines with it; the sulphate and muriate of potash, the portions of earth, and even the carbonic acid which it obstinately retains, or imbibes from the air during the evaporation, remain at the bottom of the solution. If alcohol be poured on this matter while warm, and if this re-agent be not employed in greater quantity than is necessary to dissolve the potash, it crystallizes as it cools in white plates, which are sometimes several inches long. If you wish to separate the potash from the alcohol, and to obtain it in a state of dryness, the solution must be evaporated in a silver basin, and not in a glass vessel; for the potash frequently dissolves a portion of the silex, which injures its purity.

By this operation, the details of which should be seen in Berthollet's memoir, caustic potash is deprived of silex, of carbonic acid, of all the foreign salts, and of the small quantity of iron which it may have taken from the vessel in which the liquor has been evaporated.

* What we here relate is extracted from a memoir of the celebrated Berthollet; and may save some trouble to those who have not his work at hand.

On

Fig. 1.

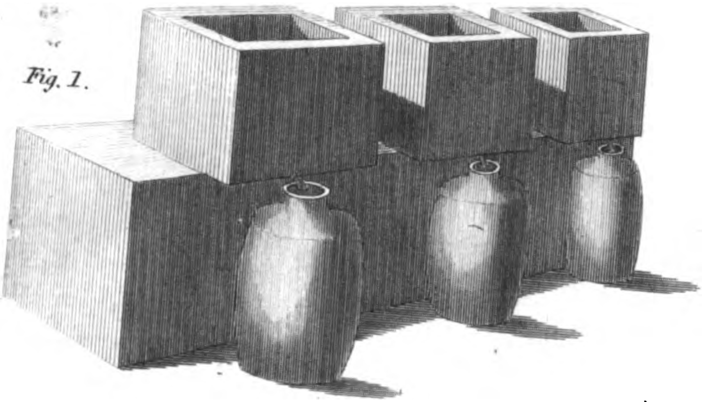
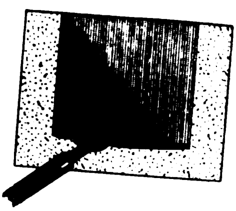
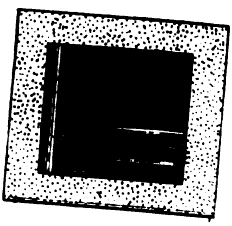


Fig. 2.





On a fulminating Combination of Silver of a White Colour and crystalline Appearance. By M. Descotils.

From the Annales de Chimie.

THERE has been lately sold at Paris, as an object of amusement, a detonating powder inclosed between the folds of cards cut in two lengthways. This powder is placed at one end of the card, and the other end is marked to distinguish it with facility. If they are held by the marked end, and the other is applied to the flame of a candle, the detonation soon takes place, with a sharp explosion, and a violet-coloured flame; the card is torn and reddened, and the part which touched the composition is covered with a slight metallic coat, of a greyish-white.

Having been consulted on the nature of this material, which is sent ready prepared to Paris, I am convinced, from various experiments, which it would be useless to relate, that it is a combination of oxyd of silver, ammoniac, and a vegetable matter; a combination analogous, as we see, to that which constitutes the fulminating mercury of M. Howard.

We may obtain this combination, which I shall call *detonating silver*, to distinguish it from the *fulminating silver* of M. Berthollet, by dissolving some silver in pure nitric acid, and by pouring into it, while the solution is taking place, a sufficient quantity of rectified alcohol, or by pouring alcohol into a nitric solution of silver with considerable excess of acid.

In the first case, the nitric acid in which the silver is put must be slightly heated until the solution begins to take

take effect, that is to say, until the first bubbles begin to appear. It is then removed from the fire, and enough alcohol is immediately added to prevent the disengagement of nitrous vapours. The mixture of the two liquors is made with the disengagement of heat; the effervescence soon recommences without the separation of nitrous gas; it increases by degrees, and exhales at the same time a strong smell of nitrous ether. The liquor soon becomes turbid, and deposits a crystalline and very heavy white powder, which must be separated when it ceases to fall, and washed several times with small quantities of water.

In employing the solution of silver already made and very acid, it must be slightly heated, and alcohol afterwards added to it; the heat excited by the mixture gradually but quickly produces a considerable ebullition, and the powder is soon deposited *.

This powder has the following properties. It is white and crystalline, but the latter appearance varies according to the size and lustre of the crystals.

It changes a little in the light.

Heat, a sudden shock, or long continued friction, will cause it to inflame with a quick detonation. Mere pressure alone (provided it be not very strong) will effect no change in it.

It detonates by the shock of an electrical spark.

It is slightly soluble in water.

It has an extremely strong metallic taste.

* It is needless to observe, that the mixture of alcohol and nitric acid, warm, is liable to accidents, and consequently it is prudent to operate on small quantities.

Concentrated

Concentrated sulphuric acid determines its inflammation; it spirts to a great distance; diluted sulphuric acid appears to decompose it slowly.

Weak or concentrated muriatic acid decomposes it immediately, forming muriate of silver. The quantity of muriate obtained indicates about 71 *per cent.* of metallic silver in the detonating silver; it disengages in the first moment a tolerably decided smell of prussic acid, but I never could collect any sensible traces of it.

Nitric acid decomposes it by the aid of ebullition, and nitrate of silver and nitrate of ammoniac only are obtained, if it be sufficiently prolonged.

It is decomposed by sulphuretted hydrogen; the ammoniac and vegetable matter remain in the liquor.

Caustic potash decomposes it; black oxyd of silver is separated, and ammoniac is disengaged.

It dissolves in ammoniac; but by a slow evaporation it separates with its colour and other properties, and particularly that of detonating by heat and not by simple contact.

Lastly, the most important property to be considered, on account of the use it is put to, is its action on the animal economy. M. Pajot la Foret, who has made a great number of experiments on this subject, is convinced that very small doses of it will destroy very strong animals (cats for example); all have expired in the most horrible convulsions. It is certainly one of the most violent poisons that metallic combinations produce.

On the dangerous Effects of Clover on Cattle; Method of preventing Accidents; and approved Remedies when they do occur. By M. De Vincens.

From Sonnini's Journal.

CLOVER is a very substantial food, and cattle will eat of it till they burst of indigestion, if not prevented by care and attention.

We must not confound this indigestion with those sudden swellings, called *tympanites*, *meteorisations*, which are followed by immediate death if the animal be not speedily relieved from the air that swells and suffocates it.

It is not the quality of the herb that is hurtful, but simply the quantity of air and water with which it is surcharged, and from which it should be freed before it is given to the cattle.

I have suffered several losses from this cause; but I am certain they have always happened through the inattention of my servants in my absence, and that of my superintendant.

The means of preventing this disorder are;

First. Never to give this herb in the beginning of the spring before it has acquired a certain degree of strength. When very young it abounds more in air and water, the principal causes of the disorder; besides, if too young, it affords but little nourishment to the cattle, and they of course consume a much greater quantity.

Secondly. Always to give it cut the evening before, a little at a time, with management, vigilantly observing whether the animal appears incommoded by it, or begins to swell; never to give it damp or heated, from heaping

heaping it in too great a quantity in the barn where it is spread to day.

Thirdly. The deceased Mr. Gilbert, Veterinary Professor, known by many excellent works in agriculture, in his work, *Sur les Prairies Artificielles*, has published the method by which the post-master at Lauterbourg fed his cattle with clover, without their suffering any inconvenience from it. This was, to make them drink before they eat of the clover, and never to suffer them to drink again until a long time after. I have adopted this method, because I have experienced its success, and have never suffered from any accidents when my servants have conformed to it. I have hay given to my cattle before they are led to drink, or I send them to pasture for a short time first.

When it happens that notwithstanding these precautions, or owing to some inattention, the beasts begin to swell, the following approved remedies must be employed.

First. To gag the animal, in order to keep its mouth open, and in this state to make it walk about at a quick rate.

Secondly. To throw pails-full of cold water all over its body, in abundance, and with force.

Thirdly. To make him swallow a glass of brandy, in which a large tea-spoonful of salt of nitre has been dissolved. This remedy has always succeeded. I give this quantity to a large beast; to a sheep I give a spoonful of brandy and a pinch of salt of nitre, proportioning the dose to the animal.

Fourthly. M. Sonnini, the editor of the *Bibliotheque Physico-Economique*, affirms in that journal, that one remedy, which he has never known to fail, is to make the animal swallow about a quart of milk. If this remedy is is infallible it ought to be known, and it is in the hands of the public.

Fifthly. If it be found that these remedies do not speedily relieve the animal, there is one that is certainly infallible, but it should only be resorted to in the last extremity, and then there must be no hesitation. This is to stab the stomach of the beast with the first instrument that is to be met with; then to introduce into the aperture a hollow tube, a piece of elder deprived of its pith will do, and to force the animal to move a little.

In support of this operation I shall relate a fact that occurred on my own farm. A fine bull, three years old, began to swell in the stable. I was absent, but they tried all the remedies directed: the animal could not walk, and they supported him to prevent him from falling and expiring. My superintendant, in despair, recollecting what I had told him of stabbing the animal in this case, but not knowing how to perform the operation, thrust a kitchen knife, up to the handle, through the loins of the animal's back, near the spine, and introduced a long piece of elder, &c.: immediately the air and a green froth burst through the aperture in the form of the tunnel of a chimney, and the beast exhibited signs of convalescence.

When I arrived, I was much troubled at his condition, and sent him to M. Gaud, a veterinary surgeon at Chermont, who removed my fears, and pointed out to the servant where he should have pierced the skin.

I have related this fact to shew how little danger attends this operation even when unskilfully performed. Yet it may do mischief if an essential part is wounded. It is therefore important for all farmers to be acquainted with so simple and easy an operation, which is instantaneous

taneous in its effects, will not bear delay, and may be also employed to relieve swellings that are not caused by clover, although the effect is the same. This effect is nothing more than the too great quantity of air and water contained in the herbs given to the cattle, or in their pasture: for instance, it is known that they should never be sent to pasture, especially in the spring, before the dew is fallen, if we would preserve them from this accident.

Roots also cause these swellings, the turnip and the potatoe more than the red and white beet-root and the parsnip.

M. Gaud informed me that the stomach of a horse not having the capacity of that of an ox, it cannot be relieved in this manner.

List of Patents for Inventions, &c.

(Continued from Page 400.)

William Pedder, of Norfolk-street, Strand, in the county of Middlesex, Esquire; for an addition and improvement to the cattle-mills and water-mills for grinding sugar-canes, or any other mill or machine requiring additional velocity and power.
Dated October 19, 1807.

Tebaldo Monzani, of Old Bond-street, in the county of Middlesex, and of Cheapside, in the city of London, Music-seller; for certain improvements in the musical-instrument called the German Flute.
Dated October 19, 1807.

Edward Shorter, of the parish of St. Giles, Cripplegate, in the city of London, Mechanic; for certain improvements

improvements in the machine or instrument, called or known by the name of a Jack for roasting meat. Dated October 21, 1807.

Louis Carou, of the city of Paris, now residing in the city of London, Manufacturer; for certain new methods of weaving or manufacturing hair along with silk or thread, or other materials, and of making the same into perukes or wigs, and various other articles, so as to imitate Nature, and of taking the measure or section, or profile, of the head, by an instrument applicable to that and other useful purposes. Dated October 21, 1807.

William Chapman, of the town and county of Newcastle-upon-Tyne, Civil Engineer, and Edward Walton Chapman, of the same place, Rope-maker; for a method or methods of making a belt, or flat-band, for the purpose of drawing coals and other minerals up the pits or shafts of mines, and for raising of heavy articles, in any situation whatever. Dated October 30, 1807.

Henry Thompson, of Tottenham, in the county of Middlesex, Merchant; for an invention which consists in the impregnating Cheltenham or other natural medicinal waters, or such as are usually denominated "Mineral Waters," with one or more of the different gases or aëriform fluids, and in adding other substances to, or combining the same with, such waters. Dated October 30, 1807.

George Hawks, of Gateshead, in the county of Durham, Iron-manufacturer; for a method of making, and likewise of keeping in repair, cast-iron wheels for coal-waggons, and other carriages, where such wheels are applicable. Dated October 30, 1807.

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