theory of heat which treats it as an elastic fluid, is striking and eminently suggestive, though too recondite to be more than mentioned here. There is then a vast field of research, full of interest and promise, for whose exploration this thermometer is, we believe, the most reliable instrument, and we trust it will therefore be put into increasingly active requisition.

TYPE FOUNDING.

THE early printers in Germany made their letters in Gothic and semi-Gothic forms; and Caxton, in England, and Antoine Verard, in France, printed their works with a style of letter imitating the handwriting of that period. In Italy, under the influence of the beautiful manuscripts, more common there than elsewhere, and of the excellent taste of the early printers, the form of the letters was completely changed into the style which we use at the present day, under the name of Roman letters. In 1462, Louis XI., of France, sent Nicholas Jenson, an engraver in his service, to Mayence to learn the new art of printing. But Jenson, for political reasons, established himself in Venice, and engraved there the beautiful Roman characters, which Garamond afterwards took as models in engraving the types employed by the Elzevirs in their celebrated books. The Roman characters were also adopted by the Aldi and the Stephani, whose beautiful and finished works it is the glory of modern printers to imitate and rival. But little improvement has been made in the art of casting types since its invention, which goes back to the origin of printing itself. The types made by Baskerville and by Didot, are not more elegant and perfectly finished than the earlier masterpieces of the art which we have mentioned. The innumerable changes which have been introduced into the shapes and relative proportions of letters by the caprice of modern engravers, are retrograde changes, the fashion for a while, and then forgotten. The old letters of Garamond and Jenson have been again employed by Pickering and other eminent English publishers, and will probably always maintain their place with printers of taste.

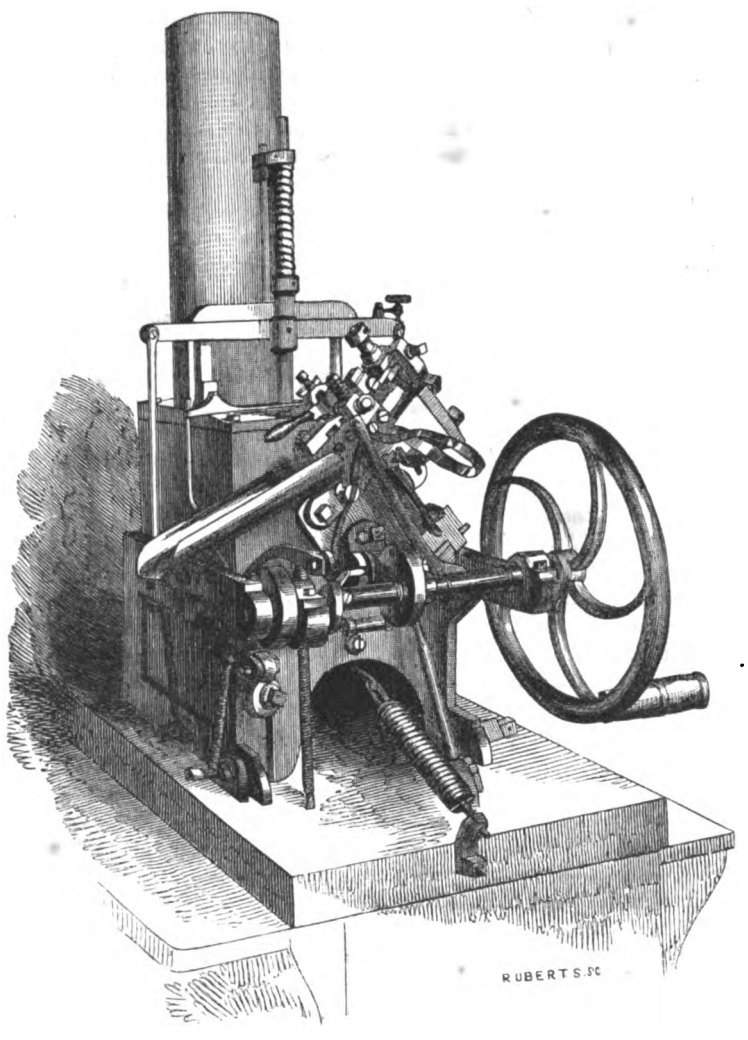
In the United States, types were first cast in 1735 by Christopher Sower, at Germantown. Unsuccessful attempts were made in 1768 to establish type-foundries, one in Boston, and another in Connecticut; but not long after the close of the War of Independence, the first regular type-foundry was set up in Philadelphia by Baine, who came there from Edinburgh. In 1790, Messrs. Binney & Ronaldson also commenced the business in Philadelphia, and met with great success from the growing number of newspaper and other job offices, which, in ten years, increased the amount of printing threefold, and caused a corresponding extension of the business of type-founding. These gentlemen are credited with the first improvement made in the art since its invention. It is a type-mould, which was introduced into Europe at the commencement of this century, and is known there as the American Mould. By this mould 6000 types are cast as easily as 4000 by the old process. The first extensive foundry in New-York was established in 1811, by Mr. White. He had before been a type-founder in Hartford, where he had invented and used a method of casting several letters together, but this device was dropped after his removal to New-York. Another type-foundry was erected in 1813 by Messrs. Bruce. The business has since been extended to keep pace with the increased number of newspapers and books published here, and each of the principal cities of the Northern and Western States now has one or more type-foundries. These give employment to about 800 persons, and produce daily between 4000 and 5000 pounds of type. They furnish nearly all the types used on this continent. Some of the finer book-work is still done, however, with English types, and the Oriental founts, and the beautiful Porsonian Greek type, employed at Mr. Trow's University Press in this city, are also imported.

The first and most important step in type-founding is to prepare the punches. They are pieces of soft steel, upon each of which the engraver cuts a single letter with all possible accuracy, and they are then carefully tempered. The face of the punch resembles the finished type. Its impression, made in soft copper, is called a matrix; it is the mould which forms the face of the type. The mould of the shank is made of two pieces of steel, which fit accurately to each other and the matrix, and are inclosed in wood for convenience of handling. The type metal is poured into a funnel-shaped orifice at the top, and by a peculiar movement of the caster's arm; is thrown into the cavities of the matrix. When the metal is set, the founder detaches the matrix from the face of the type, and the mould is then opened and the type removed. The overplus of metal which filled the funnel is next broken off, and the sides of the types are rubbed smooth, after which they are secured in frames, and have their ends cut smooth, and the lower one also ground. The process of *bearding*, which consists in bevelling the angle of the body below the letters, is performed at the same time. Types of the same fount are distinguished by one or more nicks upon the lower edge or end, which enables the compositor to set them correctly without looking at each. The composition of type metal is various. Lead forms about 75 per cent. of the alloy; it is united most commonly with antimony, but sometimes with copper, brass, tin, or bismuth. Within a few years, types have also been made by powerful steel punches from plates of cold copper; but we have not learned whether they have come into use.

The first successful machine for casting type was invented twenty-five years ago, by Mr. William M. Johnson. It did not come into general use, probably because the types manufactured by it were not as solid and durable as those made in hand-moulds. The latter continued to furnish the ordinary means of type-casting until six or eight years since, when the Type-Casting Machine, of which we give an engraving, was invented by David Bruce jr., of New-York. Its merits have been thoroughly tested by L. Johnson & Co., of Philadelphia, who exhibit the machine, and cast type with it in the Crystal Palace. These gentlemen have applied it in their extensive establishment to the manufacture of almost every variety of type, and have attained a degree of finish and accuracy entirely satisfactory. The peculiar merit of Bruce's Machine is, that it produces solid and substantial types with great rapidity—the limit being in the time required for the metal to solidify after entering the mould. The force with which the liquid metal is injected into the mould is so great, that the proportion of the defective letters is much smaller than in hand-casting. The fine lines of the matrix are brought out sharp and unbroken.

The space occupied by the machine is about 14 by 20 inches; including the wooden frame on which it rests, it is three feet high. A pot filled with type-metal occupies the back part, and a small furnace, fed with anthracite coal, is placed beneath it, or a gas-burner powerful enough to maintain the fluidity of the metal. A cylindrical tube or pump, stands vertically under the metal, and has a spout projecting from the front side of the pot. A piston rod, set in motion by a revolving crank, moves up and down in the cylinder, and at every revolution injects a small quantity of the metal into the mould, which, at the proper moment, comes closely up to the spout to receive it. After the metal has been received and hardened, which is done almost instantly, the mould recedes a few inches, its upper half rises, and the type is thrown out into a gutter leading to the receiving box. The type is then ready to be finished as we have already described. The power required for the various movements, is communicated by cams arranged along an axle, whose crank is turned by the right hand of the caster.

All, or nearly all, the types produced in American foundries are cast by machines; the only exceptions that we know of being large, ornamental type. Machines have been sent from the United States to Europe, and others have been invented there, but they have not been much used except in Germany. They are well known to type-founders in England, but have never been employed by them,



probably in deference to the prejudices of the workmen in their service. The use of machines for casting has contributed to reduce the price of type within a few years, but it is still an expensive article, not so much from the cost of the materials, as from the labor required to cast and finish it, each type having to pass through five separate operations; and they are also subject to rapid wear and deterioration, both when they are actually employed in printing and when stereotypes are cast from them.

Printers in the early days of the Art, and indeed until recent times, cut and cast the type themselves, as well as executed all other operations connected with their profession, which are now divided among many distinct trades. This division of labor, and the excessive competition consequent upon it, have had the effect to destroy the original and personal characteristics which belonged to the work of ancient typographers.

The art of type-founding has now been successfully applied to every variety of language and alphabetic form. The reduction of the intricate and complex characters of Chinese to type is a triumph of the art. In the truly magnificent display of the typographic art at the Exhibition of 1851, three methods of printing Chinese were exhibited, and all of them are now successfully employed in Europe and in Canton. The historical importance of saving from oblivion the languages and idioms of the human races, can be fully appreciated only by the philologist, and it would be foreign to our purpose to remark upon it here.

ASSIGNMENT OF SPACE.

THE following Official Report of the General Superintendent of the Crystal Palace, to the Board of Directors, shows the views and objects, which regulated the assignment of space in the Exhibition of the World's Industry:

Report on the assignment of space to home and foreign exhibitors, and to the several classes into which the Exhibition was distributed.

Three different methods of national assignment were considered.

One was geographical in its principle—the building being octagonal in its form, it was proposed to lay a plan of it upon a general map, and to place the nations as nearly as possible according to their relative geographical positions.

The second was to distribute the nations through the building by lot.

The third was to assign their situations arbitrarily, and with a special reference to the character of the exhibition of each nation.

The adoption of the latter method was rendered almost imperative by the situation of the Machine Arcade, and the necessity of placing England and America in juxtaposition with this part of the building.

By far the greater part of the machinery in motion will belong to this country. To the United States, therefore, is allotted the northeast quarter of the building which is nearest the seat of power, the boiler-house being on the opposite side of Forty-second street.

To Great Britain and Ireland is assigned the other division, (the southeast), adjoining the machine-room.

It fortunately so happens that this section with the galleries above, afford the amount of space demanded by the British portion of the Exhibition.

The two largest classes of exhibitors being thus disposed of under the rule of necessity, the distribution of remaining nations is less difficult. Even in this, however, circumstances supply a guide.

The whole of the northeastern section, with the corresponding galleries, are insufficient for the American part of the Exhibition—it is necessary to cross the north nave, and occupy some courts in the northwest section.

Again the contributions of France and the States of Germany are of themselves nearly enough to occupy one entire quarter of the building. The encroachment of the United States upon the northwest division, has not left them sufficient room there—it is most convenient therefore to divide between them the only remaining division—the southwest,—which, with the exception of two courts allowed to Belgium, they fill up entirely, their lighter productions occupying, as in other cases, the corresponding galleries.

The space now remaining to be assigned, is that part of the northwest division which is not filled up by the productions of this country.

This is capable of receiving the contributions of the other nations, and of the British Colonies. In this are placed Switzerland, Holland, Austria, Italy, the Canadas, Newfoundland, British Guiana, &c.

The form of the building might lead to the opinion that there was a greater choice of positions with reference to the sun, than is really the case. For those nations that suffer the disadvantage of a southern aspect on the walls bounding their space, have the advantage of north and west, or north and east lights on their nave fronts, and, on the other hand, the nations that are in the north divisions, encounter the sun on the line of their naves; consequently there is no great choice of positions on this account.

In the national assignment of space, two rules have in general been observed. One is to give to each nation the gallery above its floor space, another to give to each nation a front on some one of the naves.

The first of these rules could not be invariably followed. Switzerland, for example, required no floor but only gallery space, while Holland, Austria, and the British Colonies required only floor space. The particular cases are decided by the nature of the property exhibited.

After the general assignment of space to the nations comes the subdivision among the classes.

The machinery in the case of Great Britain and America is placed, of course, either in or adjoining the machine-room.

The sculpture and finer products of artistic skill, the paintings excluded (for which there is a distinct gallery), are exhibited with the best effect in or near the naves. It is my purpose, therefore, in the local distribution of the classes, to proceed in each division outward towards the naves, from the productions of nature to the works of art, and from machinery to its results.

This purpose has governed me in the arrangement of the classes in the American department of the Exhibition. The same general views have been applied, as far as is convenient or practicable, in the other national departments.

I have adopted the general classification of the materials of the Exhibition, made at the Great Industrial Exhibition of London, with slight exceptions, one of which is the subdivision of class ten, and the creation of a new class of musical instruments, which is numbered 30.

The analysis and further separation of the classes, I leave to the juries.

Very respectfully, your obt. serv't.

S. F. DU PONT, General Superintendent.

We add to the Official Report of the Superintendent the list of Classes under which the articles have been arranged.

LIST OF CLASSES INTO WHICH ARTICLES ARE DIVIDED.

Class 1. Minerals, Mining and Metallurgy, and Geological and Mining Plans and Sections.

2. Chemical and Pharmaceutical Products and Processes.

3. Substances used as Food.

4. Vegetable and Animal Substances employed in Manufactures.

5. Machines for direct use, including Steam, Hydraulic and Pneumatic Engines, and Railway and other Carriages.

6. Machinery and Tools for Manufacturing purposes.

7. Civil Engineering, Architectural and Building Contrivances.

8. Naval Architecture, Military Engineering, Ordnance, Armor, and Accoutrements.

9. Agricultural, Horticultural and Dairy Implements and Machines.

10. 10. Philosophical Instruments, and Products resulting from their use, *e. g.* Daguerreotypes, &c.,) Maps and Charts.
10A. Horology.
10B. Surgical Instruments and appliances.

11. Manufactures of Cotton.

12. " " Wool.

13. " " Silk.

14. " " Flax and Hemp.

15. Mixed Fabrics, Shawls, Vestings, &c.

16. Leather, Furs, and Hair, and their Manufactures.

17. Paper and Stationery, Types, Printing, and Bookbinding.

18. Dyed and Printed Fabrics, shown as such.

19. Tapestry, including Carpets and Floor Cloths, Lace, Embroidery. Trimmings, and Fancy Needlework.

20. Wearing Apparel.

21. Cutlery and Edge Tools.

22. Iron, Brass, Pewter, and General Hardware, including Lamps, Chandeliers, and Kitchen Furniture.

23. Work in Precious Metals, and their Imitations, Jewelry, and other Personal Ornaments, Bronzes, and articles of Vertu generally.

24. Glass Manufactures.

25. Porcelain and other Ceramic Manufactures.

26. Decorative Furniture and Upholstery, including Papier-Maché, Paper Hangings, and Japanned Goods.

27. Manufactures in Marble, Slate and other Ornamental Stones, Cement, &c., for Construction and Decoration.

28. Manufactures from Animal and Vegetable Substances, not woven or felted or otherwise specified.

29. Miscellaneous Manufactures and Small Wares, Perfumery, Confectionery, Toys, Taxidermy, &c.

30. Musical Instruments.

31. Fine Arts, Sculpture, Paintings, Engravings, &c.

THE WORLD

OF

SCIENCE, ART, AND INDUSTRY

ILLUSTRATED

FROM EXAMPLES

IN THE NEW-YORK EXHIBITION, 1853-54.

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