ON SOME EARLY FORMS OF ELECTRIC FURNACES.

No. 8. WERDERMANN'S ELECTRIC FURNACES.

BY PROF. EDWIN J. HOUSTON.

Richard Werdermann, well-known to the scientific world in connection with his semi-incandescent electric lighting system, has made a number of ingenious applications of electrical currents to metallurgical purposes, some of which may properly be ranked under the general heading of electric furnaces.

The earliest of Werdermann's electric furnaces is described in Brit. Patent No. 474, of 1873, for an "Improved Method of Reducing and Purifying Metals," and dated February 10th, 1873.

Werdermann's process does not differ materially from that practiced by other inventors. The ore to be treated is first crushed and then raised by ordinary heat up to a red heat, when the metal is extracted by sending through it an electric current, led into and through the heated mass by terminal electrodes of carbon, platinum, or other refractory substances that are conductors of electricity. The electric source proposed by Werdermann was either a voltaic battery or a dynamo-electric machine.

Werdermann proposed to employ his process of electric reduction either in connection with or independently of the reducing action of carbonaceous matter.

The following description of his process is taken from the specification of the above mentioned British patent, viz :

"My invention relates to an improved mode of applying electric currents in order to reduce metals directly from their ores with or without the ordinary chemical action of carbonaceous matter, and in purifying and refining at the same time and by the same process the metal during its reduction from the ore.

"The ores, that is to say, oxides, sulphides, carbonates, or other combinations in which the metals exist in nature are first crushed, and then heated in a suitable furnace or retort.

"After the whole charge is raised to a red heat, two pieces of carbon or platinum or some other suitable material which conducts electricity, are plunged in the crushed ore. These two pieces are

connected by a platinum or other suitable wires or ribbons with the two poles of a galvanic battery or magneto-electric machine."

Werdermann mentions the necessity for properly regulating the electro-motive force and current employed. He describes the applicability of the current to the operation of *electric puddling*, and states the saving in time thereby effected.

"By regulating in a suitable manner the electro-motive force and the intensity of the electric current, and stopping it at the proper moment, cast iron, wrought iron, or steel can be produced directly from the furnace without any intermediate operations. This puddling by means of an electric current will occupy from ten to fifteen minutes only, instead of several hours as in the ordinary puddling by hand labor or machinery, and consequently a great saving of time will be effected."

The application of electricity to the puddling furnace would appear to possess great promise, and it is singular that the process has not as yet been carried into actual extended use. It is probable that a difficulty has been found to arise as regards the proper regulation of the current, and the quality of the wrought iron produced, should the process be stopped either too soon, or not soon enough.

In Brit. Patent No. 1933, of 1873, Werdermann describes a process for the production of aluminium in which, reversing the order of sequence, electricity is first employed, and heat afterwards. This process consists, briefly, in acting electrolytically on common salt and thus reducing it to a sub-chloride Na_2Cl , or Na_4Cl_2 (?) This chloride is then reduced to a powder and mixed with cryolite, or chloride of aluminium, or with double chloride of aluminium and sodium in sufficient quantity for the reduction of the aluminium. The mixture, with or without suitable fluxes, is then to be heated to redness in a reverberatory furnace, when, it is claimed, the reduction quickly takes place. The practicability of this process must be considered very doubtful.

In 1874, Werdermann invented a process for the cutting of rock by the heat of the voltaic arc. This process, though affording an excellent illustration of the application of powerful electric currents, can hardly be ranked under the head of electric furnaces, unless it may be regarded as a species of blast or reverberatory furnace for the fusion of refractory substances.

Werdermann applied his invention by causing the electric current to pass between two carbon sticks or electrodes placed parallel to each other. The arc was formed at their extremity by causing the current to pass up one of the carbons and down the other.

It will be noticed that Werdermann's invention of the electric blow-pipe in reality anticipates the invention of the Jablochkoff electric candle, in which two parallel carbon electrodes are used, as in Werdermann's apparatus, for the production of light instead of heat.

Werdermann patented his invention in England in patent No. 1,438, of 1874, under the title of "An improved method of cutting rock or stone and other hard substances, applicable for tunnelling, mining, quarrying, shaping, or dressing stone, and for other like operations." The patent is dated April 24, 1874.

The following description is taken from the specification of the other patent :

"The said invention consists mainly in the application of intense heat to the rock or other substances to be cut, crushed, or perforated, and is carried into practice in the following manner: On a rod or stem of cast iron or other suitable material is fixed a set of powerful air or steam blow-pipes at such distances apart as to cover when in operation the entire surface of the rock to be cut or penetrated. * * *

"When the rock is very hard, as porphyry, granite, gneiss, and the like, I prefer to use an electric blow-pipe in the following manner: The carbons of the electric light are fixed on a suitable handle provided with screws to regulate by hand the distance of the carbon points. At equal distances from the carbon points are arranged the two poles of a powerful electro-magnet. As soon as the light is produced, and the electro-magnet set in action, the voltaic arc is repelled and pointed like the flame of the blow-pipe. The same effect is obtained in blowing through the voltaic arc between the two carbon points a powerful current of air or steam or other suitable vapor or gas.

"The heat obtained by such an electric blow-pipe is so intense that the hardest granite not only calcines but fuses in a few seconds."

The ingenious application of an electro-magnet for the purpose of directing the arc against the surface to be acted on, is similar to the use of the coil placed around the electric crucible of Siemens

for preventing the arc from playing against the sides of the crucible, and directing it on the substance that is to be fused.

In Brit. Patent No. 4,805, of 1876, dated June 12, 1877, Werdermann patented the use of parallel carbons, suitably insulated from each other, for the production of the electric light.

CENTRAL HIGH SCHOOL,
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OBITUARY.

JAMES CURTIS BOOTH.

In preparing a minute of the death of Prof. JAMES CURTIS BOOTH, your committee feels that it is not inappropriate to quote the following concise and authentic biography from the illustrated history of the United States Mint, 1885 (published by G. G. Evans, Philadelphia):

"JAMES CURTIS BOOTH, melter and refiner, United States Mint, Philadelphia, was born in Philadelphia, 1810; educated in the same place and was graduated from the University of Pennsylvania, 1829, after-study and field practice in the Rensselaer School, at Troy, N. Y., in 1831 and '32, under the late Prof. A. Eaton.

"Mr. BOOTH derived his knowledge of practical chemistry in Germany in 1833, '34 and '35, in the laboratories of Profs. F. Wohler and G. Magnus, and in visiting accessible manufacturing establishments in Germany and England.

"The late Prof. J. F. Frazer and Mr. BOOTH were the two assistants on the Geological Survey of Pennsylvania in its first year, 1836. Mr. BOOTH next had charge of the Geological Survey of Delaware, in 1837 and '38 (being assisted by Prof. J. F. Frazer), and published his report of the Survey in 1839 and '40.

"Mr. BOOTH, observing the great necessity for a knowledge of applied chemistry in his native place, opened a laboratory for teaching the same by chemical analysis and by operative work in 1836, and the laboratory then established has been continued successfully to the present time by Mr. BOOTH, in association with Mr. T. H. Garrett and Mr. A. Blair. Having the same object in view, Mr. BOOTH lectured at the FRANKLIN INSTITUTE for nine (9) successive winters, there giving three full courses of lectures upon