



VI. Description of an assay-furnace, with an apparatus for measuring the degree of heat employed

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greater part of metals, but not with lead, iron, or bismuth; and it may be amalgamated with quicksilver. This amalgam of zinc is very proper for strengthening the power of an electric machine, and Higgins has given a prescription for preparing it. In the dry way it has the greatest affinity with copper, and produces with it a more or less yellow composition, which can be obtained by no other metal. In this respect, then, it is essentially different from all other metals, and becomes itself a very useful one, as it is used for brass, pinchbeck, prince's metal, bronze, Manheim gold, and in fire-works, &c.

It is very remarkable, in regard to zinc, that neither sulphur nor liver of sulphur * produces on it any effect; whereas gold, which sulphur cannot overcome, is dissolved by liver of sulphur.

On this occasion I cannot omit making mention of the celebrated alkahest of Respur, who believed, that when he alcalified zinc and rendered it caustic, and had obtained from it a purple-coloured mass, volatile in the open air, he had found out a menstruum, by which he could radically dissolve all metals. A paradoxical position, which was long adopted by the gold-making alchemists, but which has never been realized.

[To be concluded in next Number.]

VI. *Description of an Assay-furnace, with an Apparatus for measuring the Degree of Heat employed.* By Mr. DAVID MUSHET of the Clyde Iron Works. Communicated by the Author.

IN my last paper I mentioned, that, in order to facilitate the operations of the assay-furnace, and to compare the various degrees of heat in which different experiments are

* It has been ascertained that zinc and sulphur can be united; but the process is difficult, on account of the easy oxidation and volatility of the zinc. See *Mem. de Dijon*, 1783.

effected,

effected, I had constructed the pyrometer which I am now about to describe. It can in no point of view be considered as an universal instrument, as its scale will be entirely local, and vary according to the construction and exigencies of the furnace: it possesses, however, this advantage, that after a scale of comparison is formed betwixt it and Wedgewood's, in the manner described in the explanation, the assayer can at any time mark, with considerable accuracy, the degree at which an experiment is effected, and compare it with the degrees of that scale; and if the furnace and apparatus are kept in proper repair, the results will be consistent with former ones.

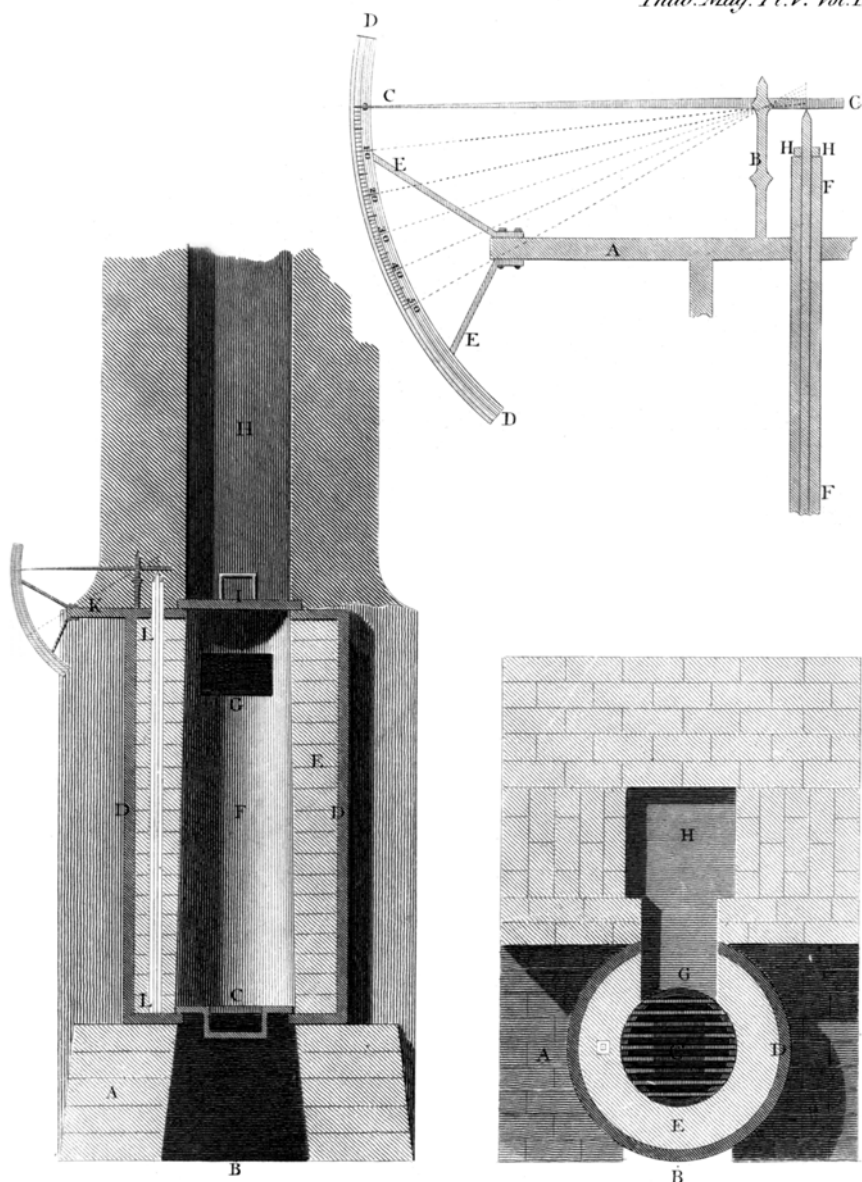
DESCRIPTION of the FURNACE.

AA (Plate V.) the pedestal of brick-work on which the furnace is reared. B, the ash-pit. C, a view of the central parts of the grate, with a knee two inches deep and four inches square, for the purpose of receiving a pedestal of fire-clay for supporting the crucible. DD, the section of an iron cylinder, which contains the brick-work, with flanges projecting inwards both at top and bottom: the upper flange contains two grooves for sliding the cover I, (made of cast iron;) and the under one projects so far as to form a support for the bars of the grate. EE, the lining of the furnace, composed of fire bricks. F, the fire-place, three feet deep, ten inches diameter at the grate, and diminishing to nine inches at the top. G, the flue or draught-hole, which communicates with the chimney. H, the chimney (the top broken off to make it come into the plate), which should never be less than 30 feet high, and nine inches square in the passage. K, an oblong rectangular plate, which projects from the top of the cylinder for the purpose of supporting the pyrometer. LL, an iron box with a square bar of steel, which, in expanding, acts upon the lever at the distance of one inch from the fulcrum.

The letters of the horizontal and vertical section refer to the same parts of the furnace.

DESCRIP-

Philos. Mag. Pl. V. Vol. IV.



Lowry, sculp.

DESCRIPTION of the PYROMETER.

The principle upon which this instrument is constructed is the expansion of metal by heat. After several experiments with copper, iron, and steel, I was induced to give the preference to the latter. Copper was found to be too easily fused, and the scale by that means less extensive than was wished. Malleable iron, by being heated in this manner, frequently acquired permanent additional length, and passed into the state of semi-steel. This principle it derived from the contact of the surrounding charcoal, introduced for the purpose of preventing oxydation from taking place upon the surface of the bar. Highly cemented steel, when exposed in this manner to the greatest heat, acquired no sensible increase of length: a bar of polished steel was therefore adopted.

A corresponds with the plate of iron K in the drawing of the furnace, on which the pyrometer is supported. B an upright, on which is suspended the lever. CC the lever, ten inches long from the fulcrum to the extremity, which acts upon the scale, and one inch on the other end from the same point to a line drawn through the centre of the expanding bar. From this it is obvious, that if the short end of the lever be elevated half an inch by the expansion of the bar of steel, the other end will suffer a depression ten times as much, or equal to five inches. These I have divided into 50 degrees, (equal to each other on a tangent of the arch that forms the scale DD,) so that the most minute expansion in the bar will be visibly indicated. Should the ratio of ten to one be thought too small, the power of the lever can easily be increased to 13 or 20, and the scale thus greatly enlarged. When the pyrometer is at rest, the index points at 0° , and its other extremity rests lightly upon the sharp point of the steel bar. It is therefore requisite to make the lever nearly an exact balance, by forming its short end sufficiently weighty to overcome the great length of the other. The scale being carried the length of 50 degrees, allows the bar to expand

5-10ths. This, however, will not be the case, though exposed to a degree of heat approaching to fusion. EE are two supports for the scale, attached to the extremity of the plate by means of bolts. FF is a box of wrought iron which contains the bar of steel exactly fitted, with a small allowance for expanding in the thickness. This box is introduced into the lining of the furnace by means of square notches formed in the bricks about two inches from the contact of the fire. The bottom of the box rests upon the under-flange of the cylinder, and its other end rises through the building and iron-cover about two inches. When at first introduced into its place, the space which may remain betwixt the outside of the box and the building is carefully filled with fine charcoal dust, to prevent oxydation by the chance contact of atmospheric air. G is a polished bar of steel 3 feet 2 3-4th inches long and 1-4th of an inch square, the sharp extremity of which acts upon that part of the lever which, when at 0°, measures one inch from the fulcrum. HH, a small box or cover, which sits upon the top of the iron box by means of pins. This is always kept full of charcoal-dust, to prevent the approach of external air, and the transmission of heat from within.

This instrument may be used in conjunction with Mr. Wedgewood's scale. Any given substance may be melted, and the degree marked upon the scale: let this be compared with the degree of heat at which the same substance melts by Wedgewood's scale; then let the greatest degree of heat of the furnace be measured by one of Wedgewood's rolls, and compared with that pointed out by the index, the one difference divided by the other will give a scale of comparison.

It will hardly escape the notice of men of science, that circumstances may be so varied, by the modes of charging the furnace, as to endanger an erroneous result: but, if proper attention be paid, the assayer will soon understand the trim of his furnace so thoroughly as to be sure of always obtaining such an accurate indication of the heat as cannot
fail

fail to be of essential service to him. This fact I can attest from experience.

If absolute precision be wanted, it may be obtained by employing three or more pyrometers, distributed at regular distances round the furnace, instead of using only one. The mean of the whole will be the true degree of heat in the furnace.

VII. *Agenda, or a Collection of Observations and Researches the Results of which may serve as the Foundation for a Theory of the Earth.* By M. DE SAUSSURE.

[Continued from page 190.]

CHAP. XVIII.

A. *Observations to be made on Volcanoes at the Time of an Eruption.*

1. **T**HE form, dimensions, and elevation of the crater.
2. The colour, elevation, and other sensible qualities of the flames and the smoke.
3. Phenomena which preceded the eruption, subterranean noise, earthquakes, extraordinary movements of the sea.
4. Phenomena which accompany the eruption; as thunder, lightning, positive or negative electricity, subterranean noise, earthquakes: scoræ, ashes, and stones thrown up; to what height and distance.
5. Smell of the smoke. In general it indicates the sulphureous acid; but it may indicate also bitumen and coal.
6. Nature of the gases which escape during the eruption.
7. Velocity of the lava. Its degree of fluidity compared with the inclination of the ground over which it flows.
8. To measure, if possible, the degree of its heat when it issues from the volcano.
9. Whether the lava appears to be in a state of combustion, or only incandescence.