

VII.—*Observations on the processes for making the different Preparations of Arsenic, which are practised in Saxony, and on those for preparing Smalt or Cobalt, as pursued in Bohemia.*

Communicated in a letter to JOHN AYRTON PARIS, M. D.

By JOHN HENRY VIVIAN, Esq.

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**Y**OU have frequently done me the favour to ask me for some information on the subject of the mines and smelting works which I had an opportunity of examining during my travels on the continent. It was fully my intention to have furnished you, before this, with a memoir on the Saxon and Hungarian mines, and I regret that other business has hitherto prevented me; anxious, however, to shew the interest I take in the success of the Society of which you have shone so conspicuously as the founder, I am unwilling to leave the county without complying with your request, although

I fear the communication is little worthy of your consideration.

Having heard, a few days since, that an establishment in Cornwall had to contend with considerable difficulties in making the different preparations of arsenic, it occurred to me that it might be advantageous to give publicity to some remarks I had an opportunity of making during my last visit to Saxony, on the methods practised in that country; having had the good fortune to be admitted to examine in *detail*, all the works carried on for that purpose. To these I shall add some remarks on the method of preparing *smalt* or *cobalt*, which it is well known is imported into England from Saxony, at the very time that cobalt ores have of late been found in considerable quantities in this county.

I should state that, in Saxony, the cobalt works belong to the sovereign, and that strangers are not admitted to see them; having received great civilities from the managers of all the other establishments, I did not attempt it; it is from those of Bohemia that the information is derived which I shall communicate, and the processes, I understood, were the same as those of Saxony.

The preparations of arsenic are of four sorts, distinguished in commerce by their colours; viz.

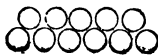
1. *The Grey or Black*, which is arsenic in the *metallic* state.

2. *The Red*, a compound of the metal and sulphur.

3. *The White*, an oxyd of arsenic.

4. *The Yellow*, a compound of the oxyd with sulphur.

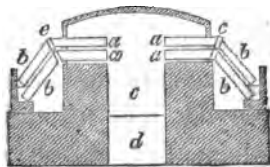
The two first are made entirely from the *arsenical pyrites*, or *white mundic* of the Cornish miner. The oxyd and its compound may be prepared from the sublimated arsenic from the tin burning-houses; indeed I doubt not but the metal itself might be obtained from the burning-house sublimate, which is chiefly an impure oxyd, by reducing it with charcoal powder or iron; and in case of its containing much sulphur, a little potash might possibly be added with effect, or it might be subjected to a second roasting, during which a great part of the sulphur would burn off. The method by which in Saxony they prepare the *red*, or sulphuret of arsenic, is by mixing equal quantities of the common pyrites, or *mundic*, and of the arsenical, or *white mundic*, in a cylindrical earthen retort about two feet in length, and six inches in diameter at the mouth, tapering a little towards the end. Twenty-two of these retorts, containing about four cwt. of pyrites, are placed in a reverberatory furnace, eleven on each side, in two tiers, thus,



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the lower tier of six resting on the sides of the furnace or fire place, and the upper tier of five lying on them.

The retorts are so placed that the closed ends do not project into the fire beyond the sides of the furnace ; the whole are under an arch. The following sketch will represent a section of the furnace and retorts :

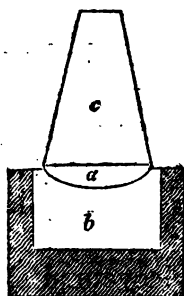


To the mouths of these retorts, which lie horizontally (*a*), and project through holes in the sides of the upper part of the furnace (*c*), below which is the fire place (*d*), others precisely similar are luted with clay (*bb*); and as they form an angle with those in the furnace, a small ring of baked clay is placed on the inside of each at the point of junction to assist the luting (*ee*). It may be observed that the *pyrites* in the retort should not be too fine, or it will be liable to bake together. The furnace being thus prepared, a tolerably strong fire is given for eight or ten hours, and a *sublimate* comes over and forms a *glass* in the receiver, which is taken out, when sufficiently cool, and

afterwards purified. This is done by melting it in a cylinder formed of sheet iron six or eight inches in diameter, burning wood being kept around it. The slags which collect on the surface are skimmed off, and when the mass is sufficiently cleansed, which is ascertained by taking occasionally an assay with an iron rod, it is cast into a semicircular iron pan; it is then of a fine red colour, has a glassy fracture, and a smooth shining surface.

*The grey, or metal of arsenic,* is prepared in a similar manner, except that *arsenical pyrites* alone are employed, and instead of a ring of baked clay, a piece of sheet iron is placed round the inside of the receiver, where it is connected with the retort to which the sublimated metal attaches itself. When thus prepared, it has a dark grey sparkling appearance. Some impure metal of a dead earthy aspect is likewise obtained in the burning-houses over the mouth of the furnace, being a portion of the sublimated oxide reduced.

*The yellow arsenic* is a compound of the oxide of arsenic, with a small quantity of sulphur. It is prepared by mixing in a shallow circular cast-iron pan, two cwt. of the impure oxide of arsenic from the burning-house, and a quarter of cwt. of sulphur.



The pans (*a*) used for this purpose are shallow, about two feet in diameter, and are laid in masonry over the fire place (*b*); when the mixture is formed, it is covered with a cap (*c*) of sheet iron, of a pyramidal form, and about four feet in height, and carefully luted at the point of connection. The fire is then kept up for twelve or sixteen hours, and the sublimate, of a fine yellow colour, is found adhering to the sides of the iron cap, from which, when cool, it is easily separated.

*The White*, or oxide of arsenic, is prepared precisely in the same manner, but without the addition of the sulphur. The sublimate obtained, not being quite pure, undergoes a second and similar operation; it is then quite clear and transparent.

These products are pounded, sifted, and packed in cases for exportation; I was informed that considerable quantities were sent to Eng-

land. The *red* and the *grey* bear the highest price.

The *white* is particularly dangerous to handle, being of the most poisonous nature. I observed running water throughout the works, and the frequent use made of it by the workmen was evident from the lady-like whiteness of their hands.

Having thus endeavoured shortly to explain the method of preparing the different kinds of arsenic, I shall proceed to give such observations as I had the means of making on

#### THE PREPARATION OF SMALT, OR COBALT.

The ores used in the cobalt works of Bohemia, on the frontiers of Saxony, near Johann-Georgenstadt, to which I gained admittance, are chiefly from the mines at Joachimsthal, and are inferior in quality to those used in the Saxon works from the Schneeberg mines.

The cobalt ores at Schneeberg occur frequently so blended with ores of silver, that as one or the other metal must be sacrificed, it is often a matter of calculation to which works it will be most advantageous to deliver them. The first point to be ascertained is, the precise quality of the ore to be acted on; this may be done by roasting, or calcining a small quantity, and then melting it with sand or potash, so as to form a glass: it should be observed, that for trials in the crucible, a larger proportion of

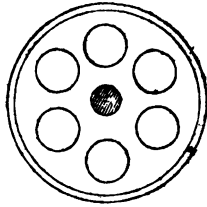
potash is required than is used in the mixture for the pots.

Much depends on giving the ore a proper degree of calcination. If it be overcalcined, the glass from it has a red appearance, and on the other hand, if it be not sufficiently calcined, the glass has a greenish or blackish cast. Calcining too high is to be particularly avoided. Some ores require only one hour's calcination, others two, and some even eight or nine hours; this operation is performed in a common reverberatory furnace, in quantities of three or four cwt. As all cobalt ores contain *arsenic*, some sublimate is obtained from the flues of the calciner, which is occasionally used in small portions as a flux in preparing the glass when the potash is not good.

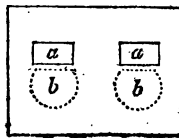
The ore when roasted is dry-stamped, and sifted; it is then mixed, in the proportion of one to three, with a fine white sand prepared from stamped quartz, and to this mixture about one-third of potash is added; the quantity of potash employed must depend, however, in a great measure, on the purity of the article and on the fusibility of the ores. These ingredients, well mixed, are then put into a circular pot, made of fine clay, about eighteen inches in diameter, and somewhat less in depth. The furnaces in which the fusion is performed, vary in their construction; in one work I observed the furnace was circular, and



contained six pots, in the midst of which is a circular aperture to admit the flame.



In another it was square, and contained only four pots, but the circular furnace appeared to me most advantageous; the fire in each case was below the bottom of the furnace in which the pots stood, and had a circular hole in the centre through which the flame ascended, a strong arch covering the whole. Each pot contains about half a hundred weight of this mixture; when it has been properly fused, which may be after eight or nine hours strong firing, the vitrified mass is laded out through a door in the side of the furnace (*aa*) just above the mouth of each pot (*bb*), and cast into a cistern of water.



Although the usual proportion of sand to the roasted cobalt ore is as three to one, this must

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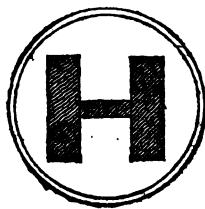
depend materially on the quality of the ore, and on the density of colour required for the glass. For the light coloured glasses, the inferior ores, however, are generally employed.

I should observe, that in the bottom of each pot is a small hole, for letting off the metals which occasionally collect there, and which were contained in the cobalt ore. When not in use, this tap-hole is stopped with clay.

The glass thus obtained is dry-stamped to about the size of common sand, and sifted. It is then ground with water in a stone mill. Two long square stones of a fine grained granite, with grooves in the lower side,



and fastened together by iron bars, are moved round in a large fixed circular trough.



After the mass is well worked about for six hours, it is let off and diluted with water in a tub, where it is allowed to stand for five or six hours more, until the coarser part is deposited; the liquid containing the fine

is then taken out in buckets, put into another and a larger tub, further diluted, and allowed to remain for twenty-four hours. As the fine becomes deposited, the water above is let off by degrees, by means of plugs in the side of the tub, and is passed through a range of pits, in which it deposits any it may still contain. The fine deposit obtained in the tubs is again stamped and washed in the same manner; it is then dried on a hearth, sifted, and prepared for sale.

The assortments of smalt or cobalt are distinguished in Saxony by letters; thus of the *fine*, there are the FFFE, FFE, FE, ME, MES, and OES.

Of the *coarse*, FFFC, FFC, FC.

The coarse sorts feel a little rough between the fingers; the fine are quite a powder. The three F's are the deepest, and finest coloured. The sorts MES and OES are quite pale, scarcely tinged; they are obtained from the pits through which the waste water passes. The coarse sorts appear of a deeper colour than the *fine*, although obtained from the same glass.

I shall be most happy if the information I have thus attempted to give should prove of any advantage to the manufacturers of our county, and I hope I shall shortly be enabled to send you a memoir on some other subject.