

XXVIII. *On Palladium—Its Extraction, Alloys, &c.* By
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THIS metal was discovered by Dr. Wollaston in the year 1803, as one of the alloys of native platinum, which for some time after this discovery appears to have been considered the only source of palladium; and as the quantity of the latter metal so alloying the native platinum is very small, it was then considered as a very rare metal: of late years, however, the importation into this country from Brazil of gold dust, alloyed with palladium, has occasioned a much more extensive supply of this metal, as it exists in some specimens of gold dust to the extent of 5 or 6 per cent., and in one instance (that of the gold from the Candonga mine) it constitutes the only alloy of the gold.

The operation of refining is conducted in the following

manner:—The gold dust is fused in charges of about 7 lbs. troy, with its own weight of silver and a certain quantity of nitrate of potash; the effect of this fusion is to remove all earthy matter, and the greater part of the base-metals contained in the gold dust and in the silver melted with it. The fused mixture is cast into ingot moulds, and when cooled, the flux or scoria (containing the oxides of the base metals and the earthy matter, combined with the potash of the nitre) is detached. Two of the bars thus obtained are then remelted in a plumbago crucible, with such an addition of silver as will afford an alloy containing one-fourth its weight of pure gold, and which being first well stirred to insure a complete mixture, is poured through a perforated iron ladle into cold water, and thus very finely granulated; it is then ready for the process of parting. For this purpose about 25 lbs. of the granulated alloy is placed in a porcelain jar, upon a heated sand-bath, and subjected to the action of about 25 lbs. of pure nitric acid, diluted with its own bulk of water: after the action of this quantity of acid, the parting of the gold is very nearly effected; but to remove the last portions of silver, &c., about 9 or 10 lbs. of strong nitric acid is boiled upon the gold for two hours. It is then completely refined, and after being washed with hot water is dried and melted into bars containing 15 lbs. each.

The nitrous acid gas, and the vapour of nitric acid arising during the above process, are conducted by glass pipes (connected with the covers of the jars) into a long stone-ware pipe, one end of which slopes downwards into a receiver for the condensed acid, the other end being inserted into the flue for the purpose of carrying off the uncondensed gas.

The nitrate of silver and palladium obtained as above is carefully decanted into large pans, containing a sufficient quantity of solution of common salt to effect the precipitation (as a chloride) of the whole of the silver, the palladium and copper remaining in solution in the mother liquor, which is drawn off, and when clear is run off, together with the subsequent washings from the chloride of silver, into wooden vessels, and the metallic contents are then separated in the form of a black powder, by precipitation with sheet zinc, assisted by sulphuric acid.

The chloride of silver, when washed clean, is reduced by the addition of granulated zinc washed on the filter with boiling water, dried and melted in plumbago crucibles, without the addition of any flux.

From the black powder obtained as above, the palladium is extracted by resolution in nitric acid and super-saturation with ammonia, by which the oxides of palladium and copper

are first precipitated and then redissolved, while those of iron, lead, &c., remain insoluble. To the clear ammoniacal solution, muriatic acid is then added in excess, which occasions a copious precipitation of the yellow ammonio-chloride of palladium, from which, after sufficiently washing it with cold water and ignition, pure metallic palladium is obtained. The mother liquor and washings contain all the copper and some palladium, which are recovered by precipitation with iron.

Pure palladium is of a greyish-white colour, rather darker than that of platinum; it is both malleable and ductile, though inferior in those qualities to pure platinum; its specific gravity is 11·3, which may be raised by hammering or rolling to 11·8. When perfectly pure it cannot be fused even in small quantities in an ordinary blast furnace, but may be brought into such a state of agglutination as to bear laminating or drawing into wire.

It may be completely fused by means of oxygen gas, and being kept some time fused, is said to burn with the production of brilliant sparks; it is not tarnished by exposure to sulphuretted hydrogen, nor oxidated by the air at the ordinary temperature, or at a bright red heat; but it has the singular property of becoming oxidated by exposure to air at a dull red heat, the surface becoming coloured in the same manner as iron or steel; and by continuing the process cautiously for some time, the metal becomes coated with a brittle crust of oxide of a brown colour; this oxide is, however, reduced by a temperature very little higher than that necessary for its formation; and the surface of the metal regains its original colour upon being heated to a bright red, and cooled out of contact with the air.

It is with difficulty soluble in nitric acid when pure and fused, or in a state of aggregation, but is readily so when alloyed to some extent with silver or copper, and still more so when in the form of the black powder above referred to, in which state it is also soluble with the aid of heat in sulphuric and muriatic acids; but its proper solvent is nitro-muriatic acid, which, if it be not very much alloyed with silver, dissolves it readily.

It is of all the metals that which has the greatest affinity for cyanogen; and by means of cyanide of mercury, it may be separated from all its solutions.

It may be alloyed so as to be malleable with gold, silver and copper, several of its alloys with the two latter metals being of great use in the arts from their hardness and elasticity, and non-liability to rust or tarnish. When added to

gold or copper, it whitens both those metals in a very great degree, about 20 per cent. being sufficient in either case to destroy the colour of those metals.

The uses to which the alloys of palladium have been applied, are for the points of pencil-cases, for lancets for vaccination, for the graduated scales of instruments, as a substitute for gold in dental surgery, or for any purpose where strength and elasticity, or the property of not tarnishing, is required.

