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Remarks on Parkes's Method for the Estimation of Copper by means of Cyanide of Potassium, together with a brief Review of the Modes usually adopted for the Determination of Copper, by FREDERICK FIELD.

[FIRST PART.]

IN one of the numbers of the *Mining Journal*, in the year 1851, Mr. Parkes published a method for the volumetric determination of copper, by means of a standard solution of cyanide of potassium. The process is so well known, and has been so generally adopted, that a detailed account of the *modus operandi* would be unnecessary. The substance containing copper is dissolved, ammonia added in excess, and solution of the cyanide dropped carefully into the dark blue liquid until the colour disappears.

Towards the latter stage of the process, however, the decolorisation is not very distinct, the solution assuming a delicate violet tint, which fades very gradually, leaving at length the liquid destitute of colour. Great caution and considerable practice are required to determine the necessary amount of cyanide. There can be no doubt that it is requisite to allow the liquid to stand for some time (a quarter of an hour or twenty minutes) towards the close of the operation; and if the colour is not expelled after that period a few drops more cyanide must be added, the flask well agitated, and the solution once more left at rest. Indeed, it is always safer to leave a very slight tint, as it disappears after the lapse of twelve or fourteen hours. Since the publication of Mr. Parkes's method, I have made considerably more than fifteen thousand estimations of copper by the cyanide process, comparing it with many other well-known modes of determination, in order to test its accuracy, and to observe the influence which solutions of other metallic oxides possess when in conjunction with that of oxide of copper.

In the case of copper ores, containing copper either combined with sulphur, as disulphide or protosulphide; with sulphuric acid, as *brochantite* or *cyanose*; with oxygen, as suboxide or protoxide; with carbonic acid, as the *blue and green basic carbonates*; with chlorine, as *atacamite*; with phosphoric acid, as *tagilite*, &c.; as arsenide in *Domeykite* or *algodonite*, and with arsenic or arsenious acid, provided no iron be present; in alloys of copper and tin or copper and antimony; double sulphides of copper and iron, either as yellow or blue pyrites, the copper can be estimated with exactness by cyanide of potassium.

Now, in all copper ores containing iron, it is far better to add the cyanide to the ammoniacal solution, *without filtering off the suspended peroxide of iron*. Every chemist knows with what tenacity this oxide holds an ammoniacal solution of copper. Even after several hours washing with warm liquid ammonia, the copper cannot be separated; and although the liquid may pass through colourless, on rewashing, after a day or two, the filtrate will have a decided blue tint. The test first proposed, I believe, by Mr. Warington (and which, decidedly, is the

most delicate one for the presence of copper which we possess), viz. ferro-cyanide of potassium, never fails to show the presence of copper in the peroxide of iron, even when hydro-sulphuric acid or ammonia are unable to detect it. If a small quantity of copper with a large excess of iron be dissolved in nitric acid, a considerable quantity of ammonia added, and the two metals separated by filtration, after washing for several days, on taking a small portion of the oxide of iron, dissolving in hydrochloric acid, adding ammonia and filtering, a drop of the ferrocyanide added to the filtrate in a white capsule, is sure to give a pink stain on the porcelain, when the excess of ammonia has been expelled by a gentle heat. There is no need whatever for filtering off the oxide of iron, and the estimation of copper can be effected in a very satisfactory manner without undergoing filtration.

In copper slags, for example, which generally contain from 0.2 to 0.8 per cent. of copper, and from 40 to 50 per cent. of iron, it is impossible to determine the former metal, with any degree of accuracy, by the addition of ammonia and subsequent filtration. Cyanide of potassium added to the liquid in which the oxide of iron remains suspended, is capable of estimating the amount of copper with considerable exactness. A rim of liquid, more or less blue, gradually appears above the precipitating oxide, a few drops of the standard decolorising solution are added, the whole well agitated, and allowed to rest, until the clear liquid reappears. If still strongly coloured, more cyanide is required, and this operation is continued until the liquid has a pale violet, or rather, rose-coloured tint. It is then left for some time, and if the shade do not seem to fade, a small quantity more is added. The result of numerous estimations prove, that small quantities of copper can be determined very successfully by this means; and when several slags or other metallurgic products have to be examined, the method is very convenient, as, while the oxide of iron is subsiding in one flask, another assay can be undergoing decolorisation from the burette, and so on.

In order to test the accuracy of the process, two or three experiments may be cited from among a great many which have been made. A mineral containing simply sulphur, iron, and copper, with a little quartz, gave in five determinations:—

31.4	per cent. Cu.
31.5	" "
31.3	" "
31.4	" "
31.4	" "

or a mean percentage of 31.4.

Four estimations were made by precipitating the copper from the solution of its oxide in hydrochloric acid, by means of metallic iron:—

31.38	per cent. Cu.
31.42	" "
31.47	" "
31.44	" "

Mean 31.427.

Two determinations were effected by the precipitation of the copper as sulphide by means of hydrosulphuric