

copper ore was made by Mr. A. H. Low, in the laboratory of the Boston and Colorado Smelting Co., at Argo, where the details of the process were worked out, in twenty-two minutes.

Technical Estimation of Copper, BY A. H. LOW.

The present paper is intended to outline the scheme for the technical estimation of copper as developed by the writer, now in use at the works of the Boston and Colorado Smelting Company at Argo, Colorado. This scheme is essentially that of Dr. Steinbeck, but so modified as to save considerable time, while ensuring equal if not greater accuracy. Omitting the discussion of the details, the method is as follows:—

Treat one gramme of the pulverized ore in a small, (250 c. c.) flat-bottomed glass flask with seven cubic centimetres of commercial nitric acid and five cubic centimetres of commercial sulphuric acid. Heat strongly till the nitric acid is all expelled and the sulphuric acid is boiling freely. Sulphur, if present, is usually partially, sometimes entirely volatilized, a portion recondensing on the neck of the flask. What remains in the bottom of the flask should be melted into globules which are yellow when cold, and free from copper. Allow the flask and contents to cool sufficiently and add 25 c. c. of water and six grammes of commercial sheet zinc cut into small slips. Shake the zinc about in the flask a little to break up any cake formed in the bottom, and allow to stand five minutes. Now add 50 c. c. of water and 20 c. c. of sulphuric acid to rapidly dissolve the excess of zinc, which usually takes about five minutes more. When solution is complete, fill the flask up to the neck with water, allow to settle, and decant the clear, supernatant liquid. This may be tested for copper if desired, with sulphuretted hydrogen water, bearing in mind that antimony, bismuth etc., may be present and give tints or discolorations likely to be mistaken for copper. As a rule, no discoloration whatever, or only an extremely faint one will be observed, and consequently the test is usually omitted. Fill up and decant twice more. The residue in the flask may consist of gangue and copper, besides various other constituents of the ore and the impure reagents used, such as silver, gold,

lead, arsenic, antimony etc., of which only silver is likely to interfere with the assay. Add five cubic centimetres, pretty exactly measured, of strong, pure nitric acid, and boil just long enough to expel the red fumes. Now add a single drop of strong chlorhydric acid, and if much silver (one per cent or more) is thus indicated, add a second drop of chlorhydric acid, which is usually quite sufficient, and, after diluting with a little water, filter. A simple cloudiness or very slight precipitate of chloride of silver may be disregarded. To the somewhat diluted acid solution add ten cubic centimetres of strong ammonia water (having previously determined that ten cubic centimetres will be a considerable excess over the amount necessary to neutralize the five cubic centimetres of nitric acid used), and then cool. One of two courses is now to be chosen. If the color of the solution indicates that but little copper is present, say not over two or three per cent, add about 125 c. c. of distilled water, and filter. One of the coarse, gray, French filters, about seven inches in diameter and folded in corrugations, is the best for the purpose. It filters rapidly and the small amount of dilute solution remaining in its pores need not, as a rule, be washed out. If a larger amount of copper be present, the titration with cyanide of potassium solution should be proceeded with until all but about two or three per cent. of the copper has been neutralized, and then the liquid should be diluted up to 125 or 150 c. c., if not already of that bulk, and filtered as before. The object of this filtration is to remove the gangue, hydrate of lead and small amounts of iron, etc., that may be present, and afford a clear solution on which to complete the titration. The cyanide solution is run into the filtered liquid, and when within a few cubic centimeters of the end the bulk of the solution should be noted and distilled water added if necessary, so that the final bulk shall be about 180 c. c. (This is about the bulk that would be attained without any dilution in the assay of a substance containing 80 per cent. copper, which is the maximum amount considered in the present scheme, starting with one gramme of substance.) The final addition of the cyanide should be made drop by drop, the flask being well shaken each time, until the blue or lilac tint can be scarcely discerned at the upper edges of the liquid when viewed against a white background.

The cyanide solution should be of such a strength that one cubic centimetre will correspond to about half of one per cent. of copper. Accordingly it will contain from 55 to 60 grammes of commercial cyanide of potassium to the litre. The solution should be kept in a shady place and protected from the air by a layer of coal oil. The supply bottle may be conveniently arranged on a high shelf, and the solution siphoned off directly into the burette for use. To standardize, dissolve 0.3—0.5 grammes of pure copper in five cubic centimetres of strong, pure nitric acid, boil off red fumes, dilute a little, add ten cubic centimetres of strong ammonia water, cool and titrate. When near the end add distilled water sufficient to bring the final bulk up to about 180 c. c., and finish as described above.

Although most ores yield to the above treatment with nitric and sulphuric acids, the addition of a little chlorhydric acid is sometimes necessary or advantageous.

When the amount of silver present is known, it need not be removed, but a correction applied to the final result instead. $2\text{Ag}=\text{Cu}$, or 1 per cent. $\text{Ag}=0.3$ per cent. Cu , about.

NOTE.

When large amounts of arsenic, etc., are present, they may be only partially precipitated by the treatment with zinc, and may subsequently, when the zinc has been dissolved, react upon the precipitated copper and cause the solution of a small portion. With such ores more time should be allowed for the zinc to act before dissolving the excess, and also the first decantation made as soon as possible after the zinc has been all dissolved.

Mr. Pearce presented an alloy of gold, silver and lead found recently at Argo beneath the hearth of an old furnace, while removing the bottom. The alloy is crystallized in very perfect, brilliant octahedra, which are grouped in the axial manner often seen in minerals of the regular system, silver, copper, magnetite, etc. The composition is gold 19.88, silver 39.08, lead (by diff.) 41.03: total, 99.99, corresponding nearly to the formula AuAg_3Pb_2 . In regard to its formation, Mr. Pearce suggested that the hearth bottom having been saturated with an alloy rich in lead, as the temperature fell the above described alloy crystallized out,

while the excess of lead flowed off, or was absorbed by the material of the hearth bottom. Evidence of this is found in the fact that the material of the bottom was saturated with lead oxide.

Mr. Pearce also presented specimens of the rare mineral wurtzite, from near Butte City, Montana, and of a gold sand from a tributary of the Snake River, Idaho Territory. The more precise locality of the latter is probably above and near the great waterfall. The gold of this sand is in curious grains which seem made up of lenticular particles, and are not worn.

MEETING OF MARCH 5TH, 1883.

Ore Deposits of Summit District, Rio Grande County, Colorado, By R. C. HILLS.

[WITH TWO PLATES.]

The object of this paper is a description of the phenomenal ore deposits of Summit District, Rio Grande County, Colorado. In what follows I will endeavor to explain that the vein-like masses of auriferous quartz constituting these deposits have resulted from the alteration and mineralization of an eruptive rock by solutions circulating along a contact plane. That subsequent folding and erosion gave rise to the existing series of parallel quartz-bands having much the appearance of true veins. In consideration of the peculiar features presented I shall also offer a few remarks respecting their origin.

Plate I shows the relative position and sinuous course of the outcroppings, and also a section along the dotted line A.B. illustrating the manner of folding and number of plications.

The deposits are confined to the neighborhood of South Mountain, principally to the northern and eastern slopes. The horizon of the metal bearing zone is near the middle of the Tertiary eruptive series of Southern and Western Colorado. Only a few of the rocks of this series bear any relation to the present subject, which may be better understood by a brief description of those exposed in the vicinity of the deposits. They occur in the following order, beginning with the oldest.