NOTE ON THE SOLUBILITY OF BISMUTH SULPHIDE IN SODIUM SULPHIDE, WITH SPECIAL REFERENCE TO THE ESTIMATION OF SMALL AMOUNTS OF BISMUTH IN ANTI-FRICTION ALLOYS.

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Received June 16, 1896.

THE method of separation of lead, copper and bismuth from antimony, arsenic and tin by the use of sodium sulphide is quite general. This is dependent upon the usually accepted statement that the sulphides of bismuth, lead and copper are insoluble, and the sulphides of arsenic, antimony and tin are soluble in sodium sulphide. This process of separation is employed in the analysis of various alloys, especially of anti-friction alloys, containing lead, tin, antimony, etc.

An alloy, used for similar purposes, but containing, in addition to lead, copper, antimony and tin, a very small amount of bismuth, was recently submitted to me for analysis.

After complete solution of the alloy in hydrochloric acid with a few drops of nitric acid, the acid was neutralized with sodium hydroxide, sodium sulphide solution (1.06 sp. gr.) added and the heat applied for twenty minutes. The solution was filtered and the filtrate examined for the antimony and tin with satisfactory results.

The precipitate of insoluble sulphides remaining upon the filter was found to contain lead and copper, but no bismuth. This indicated that the small amount of bismuth which was present in the alloy had gone into solution in the sodium sulphide.

To prove this theory, I weighed 0.128 gram of pure bismuth nitrate, dissolved it in twenty-five cc. of water with a few drops of nitric acid, the clear solution neutralized with sodium hydroxide, seventy-five cc. solution of sodium sulphide added, and warmed to a temperature near boiling for twenty minutes. The solution was filtered from the bismuth sulphide, remaining insoluble in the sodium sulphide. The clear filtrate was rendered faintly acid with hydrochloric acid, when a brownish-black precipitate immediately formed. This precipitate was filtered, dissolved in

hot nitric acid and evaporated to dryness and ignited in a weighed porcelain crucible. The residue obtained was 0.031 gram of bismuth trioxide, and strongly yellow in color. It was dissolved in a few drops of hydrochloric acid, and the three following confirmatory tests for bismuth were made :

1. A portion of the solution was poured into a large amount of water, forming immediately a white precipitate of bismuth oxychloride.

2. A portion was tested by Schneider's test, the most delicate test for bismuth, the reaction obtained being strong and characteristic.

3. A portion was diluted with water, not enough to cause precipitation, and the solution saturated with hydrogen sulphide. The precipitate formed was brownish-black in color.

These three tests are absolutely confirmative of the presence of bismuth, and also show the absence of the other metals. By thus using pure bismuth nitrate for this test, lead, copper, antimony and tin are not present.

If now an analyst should weigh twelve grams of an alloy, composed approximately of lead eighty per cent., antimony fifteen per cent., tin 4.75 per cent., and bismuth 0.25 per cent. ("magnolia metal,)" and sodium sulphide solution be used for the separation of the tin and antimony from the lead and bismuth, *all* of the bismuth present would pass into solution and escape determination by the analyst.

No analyst, however, would use as much as twelve grams of such an alloy for analysis, but rather one or two grams.

If one gram be taken and sodium sulphide used as above indicated, three per cent. of bismuth might be present and *all* of it pass into solution in the sodium sulphide instead of remaining as an insoluble sulphide with the lead sulphide.

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