[CONTRIBUTION FROM THE JOHN HARRISON LABORATORY OF CHEMISTRY, No. 18.]

THE SEPARATION OF BISMUTH FROM LEAD.

BY ARTHUR L. BENKERT AND EDGAR F. SMITH.

Received October 2, 1896.

MANY methods have been suggested to effect this separation. In a recent issue of the *Zeitschrift fur angewandte Chemie* (1895, p. 530), Olav Steen reviews thirteen of these methods and concludes that an early proposal of Rose,[1] in which the lead is thrown out as chloride and weighed as sulphate, another by Löwe,[2] in which the bismuth is removed as basic nitrate, and a late suggestion made by Jannasch,[3] *viz.*, the expulsion of the bismuth as bromide from a mixture of lead and bismuth sulphides by an air current carrying bromine are the most satisfactory. At least these methods gave Steen the best results. The separation of bismuth from lead frequently confronts the analyst, and any novelty in this direction cannot be absolutely devoid of interest, hence the present communication, which brings data that may perhaps prove of service in the hands of others who are interested in the solution of this analytical problem.

It will be recalled that Herzog[4] proposed to separate bismuth from lead by precipitating the former as basic acetate. The method required considerable time for execution, and in other hands than those of its author apparently has not yielded entirely satisfactory results.

An idea closely related to that of Herzog would be the substitution of a formate solution for that of the acetate. This was done with results that are very interesting.

Solutions of lead nitrate and bismuth nitrate in nitric acid were made up of such strength that twenty cc. of the first contained 0.2076 gram of lead oxide, and twenty cc. of the second 0.1800 gram of bismuth trioxide. The lead and bismuth were accurately determined after dilution to a liter. Twenty cc. of these two nitrate solutions were then introduced into a beaker

---

[1] *Ann. chem. phys. Pogg.*, 110, 425.

[2] *J. prakt. Chem.*, 74, 348.

[3] *Ber. d. chem. Ges.*, 25, 124.

[4] *Ztschr. anal. Chem.*, 27, 650.

glass, carefully diluted and almost neutralized with sodium carbonate, or until the incipient precipitate dissolved slowly, when considerable sodium formate solution of sp. gr. 1.084 and a few drops of aqueous formic acid were added. The total dilution of the liquid was 250 cc. It was gradually heated to boiling and held at that point for *five* minutes. The precipitate was then allowed to subside, but was filtered while yet hot. The basic formate separates rapidly and is easily washed if not boiled too long. It was washed with hot water, then dissolved in dilute nitric acid and precipitated with ammonium carbonate. The ignited bismuth trioxide weighed too much ; it contained lead. However, the impure oxide was dissolved in nitric acid, diluted to 250 cc., and after the addition of sodium carbonate to almost complete neutralization, sodium formate and free formic acid were added as before, and *the precipitation of basic formate repeated*. This precipitate after solution and the bismuth thrown out by ammonium carbonate gave 0.1804 gram of bismuth oxide instead of 0.1800 gram as required by theory. Seven additional separations, in which the quantities of bismuth and lead were the same as indicated above, gave :

0.1806 gram of Bi_2O_3.
0.1806 " " "
0.1803 " " "
0.1804 " " "
0.1804 " " "
0.1805 " " "
0.1796 " " "

The conditions in these determinations were similar to those previously outlined.

With a solution containing 0.3600 gram of bismuth oxide and 0.2076 gram of lead oxide, operating in an analogous manner, two results were obtained :

0.3595 gram of Bi_2O_3.
0.3605 " " "

instead of the required 0.3600 gram.

The residual bismuth trioxide was examined for lead, but none was found.