[Contribution from the Chemical Laboratory of New Hampshire College.]

THE QUANTITATIVE DETERMINATION OF YTTRIUM.

By C. F. Whittemore and C. James.

Received March 29, 1912.

Having encountered difficulties in the determination of yttrium in the presence of sodium, the authors made a systematic study of the quantitative determination of yttrium in the presence of this and certain other elements.

A neutral solution of yttrium chloride was first prepared and carefully standardized by precipitation with oxalic acid. Then the yttrium in 25 cc. portions of this solution was precipitated with various reagents in the presence of other elements.

In the Presence of Sodium.—For the purpose of studying the separation from sodium, 10 cc. of a saturated solution of sodium sulfate were added to each 25 cc. sample of the standard yttrium chloride solution. Sodium hydroxide, the first reagent employed, gave the following results:

No. of cc. standard YCl_3 solution.	No. of cc. of saturated solution of Na_2SO_4 present.	Y_2O_3 found. Gram.	Y_2O_3 in standard. Gram.
25	10	0.1642	....
25	10	0.1647	....
25	10	0.1640	....
25	10	0.1647	....
25	10	0.1638	....
25	10	0.1640	....
		Average, 0.1642	0.1575

Since these figures were considerably too high, 5 N ammonium hydroxide was tried but with equally unsatisfactory results.

Oxalic acid gave exceedingly high results due to the carrying down of sodium.

The next precipitants used were the ammonium salts of several organic compounds.

Ammonium anisate formed a precipitate which gave low results owing to its slight solubility.

Yttrium palmitate was investigated but was found unsatisfactory and no determination was made.

Ammonium phthalate and ammonium fumarate formed no precipitates with yttrium chloride in dilute solution, probably on account of the formation of soluble double compounds.

Ammonium benzoate precipitated yttrium from the neutral solution at first, but the compound dissolved in an excess of the reagent.

The next reagent, ammonium sebacate, gave a perfectly quantitative separation, and the precipitated yttrium sebacate was found to be comparatively easy to filter off and wash. The average of several determinations showed a good agreement with the standard:

No. of cc. of standard YCl_3 solution.	No. of cc. of saturated solution Na_2SO_4 present.	Y_2O_3 found. Gram.	Y_2O_3 in standard. Gram.
25	10	0.1582	....
25	10	0.1573	....
25	10	0.1581	....
25	10	0.1579	....
		Average, 0.1578	0.1575

In the Presence of Potassium.—Having eliminated the difficulty of the separation of yttrium from sodium, the separation from potassium was next taken under consideration. Ammonium hydroxide and ammonium sebacate were tried without success. Finally a double precipitation, as the sebacate, proved satisfactory. The following data were obtained.

AMMONIUM HYDROXIDE.

No. of cc. of standard YCl_3 solution.	No. of cc. of saturated solution of K_2SO_4 present.	Y_2O_3 found. Gram.	Y_2O_3 in standard. Gram.
25	5	0.1629	....
25	5	0.1625	....
		Average, 0.1627	0.1575
		AMMONIUM SEBACATE.	
25	5	0.1592	....
25	5	0.1599	....
25	5	0.1590	....
25	5	0.1596	....
		Average, 0.1594	0.1575
		AMMONIUM SEBACATE. Double Precipitation.	
25	5	0.1536	....
25	5	0.1542	....
		Average, 0.1539	0.1537

After finding a satisfactory separation from sodium and potassium it seemed advisable to study the separation from iron, aluminium, lithium and magnesium. As the result of several trials, it was found that yttrium could be quantitatively separated as the oxalate in the presence of ammonium chloride.

In the Presence of Iron.—10 cc. of a 10% ferric chloride solution were added to 25 cc. of the standard yttrium chloride solution and the whole diluted to approximately 100 cc. After heating to boiling, the yttrium was precipitated by means of oxalic acid. This oxalate was first slightly reddish brown but became white on standing. The ignited oxide, however, was slightly colored. Other determinations were made in which the oxalate was precipitated from a cold solution with ammonium chloride present. In this case, a white oxide was obtained. The average of these determinations agreed well with the standard:

Average Y_2O_3 in presence of $FeCl_3$, 0.1536 gm.; Y_2O_3 in standard, 0.1537 gm.

In the Presence of Aluminium.—In order to study the determination of yttrium in the presence of aluminium, 10 cc. of a 10% aluminium chloride solution were added to the 25 cc. sample of the standard solution. Yttrium oxalate was precipitated from the cold solution in the presence of ammonium chloride. The result of this determination was also in close agreement with the standard:

Average Y_2O_3 in presence of $AlCl_3$, 0.1539 gm.; Y_2O_3 in standard, 0.1537 gm.

In the Presence of Lithium.—To the 25 cc. of the standard solution of yttrium chloride, 10 cc. of a 10% lithium chloride solution were added. Yttrium was precipitated as in the previous case and with equally satisfactory results:

Average Y_2O_3 in the presence of LiCl, 0.1536 gm.; Y_2O_3 in standard 0.1537 gm.

In the Presence of Magnesium.—Yttrium oxalate was precipitated from 25 cc. samples of the standard yttrium chloride solution to which 10 cc. of a 10% magnesium chloride solution had been added. As in the preceding cases, there was a complete separation:

Average Y_2O_3 in presence of $MgCl_2$, 0.1537 gm.; Y_2O_3 in standard, 0.1537 gm.

Summary.

1. Ammonium sebacate affords a quantitative separation of yttrium from sodium.
2. A double precipitation with the same reagent gives a complete separation from potassium.
3. Oxalic acid in the presence of ammonium chloride effects a perfectly satisfactory separation from iron, aluminium, lithium and magnesium.

DURHAM, NEW HAMPSHIRE.

[CONTRIBUTION FROM THE BIOCHEMICAL LABORATORY OF HARVARD MEDICAL SCHOOL.]

IS IONIZATION, AS INDICATED BY CONDUCTIVITY, A NECESSARY PREREQUISITE FOR THE COMBINATION OF ACIDS WITH BASES?

BY OTTO FOLIN AND FRED F. FLANDERS.

Received March 11, 1912.

Sometime ago a method was described by Folin and Wentworth, based on the titration of acids by means of sodium ethylate, using as solvents