hydroxide and add hydrochloric acid until the precipitate just dissolves as before and pour into a mixture of fifteen cc. ammonium acetate solution and five cc. acetic acid. Digest at 60° C. for one-half to one hour and filter, and wash once with the ten per cent. ammonium acetate solution. Redissolve and repeat the precipitation, being careful to again add one gram of ammonium phosphate to the solution, in order that there be a sufficient excess of phosphorus pentoxide to precipitate all the alumina as a neutral phosphate. Wash the precipitate three times with dilute ammonium acetate solution.

Take the filter, while wet, from the funnel and ignite in a tared platinum capsule, using a very low flame until the filter paper is thoroughly charred. The heat is increased gradually until the paper is completely consumed, and finally the blast lamp is used for a minute. Weigh as combined phosphates of iron and alumina. The iron is determined volumetrically in the solution of the weighed precipitates. The iron oxide present in the rock is also determined separately by volumetric process, preferably the bichromate method, in a solution of five grams of the rock in dilute hydrochloric acid (1–1), reducing all iron to protoxide and titrating with bichromate.

The ignited precipitate from one of the duplicate precipitations may, if desired, be dissolved and subjected to a fourth precipitation and the filtrate tested for lime by adding ammonium oxalate and heating. My thanks are due to our assistant, Thomas Brown, Jr., for valuable aid in the above analytical determinations.

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A NEW METHOD FOR THE ESTIMATION OF IRON OXIDE AND ALUMINA IN PHOSPHATE ROCK.

BY THOMAS S. GLADDING.

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THE method for the separation of alumina from phosphate of lime by three successive precipitations with ammonium acetate is tedious, though accurate if proper precautions be taken, as shown in the preceding paper on this subject.

The following modification suggested itself as saving both

time and labor. This modification consists of the separation of alumina from calcium phosphate and iron by means of its solubility in an excess of caustic potash. To demonstrate the accuracy of this method, a solution of ammonia alum, twenty grams in a liter, was used as in the previous experiments, ten cc. containing 0.0225 grams Al_2O_3. The caustic potash solution was made by dissolving 500 grams of caustic potash in distilled water and diluting to one liter. Chemically pure caustic potash, purified by barium, was used and was carefully tested for alumina, as much so-called chemically pure potash contains an appreciable amount of alumina.

To a solution of mixed phosphates of alumina, iron, and lime were added fifteen cc. of the C. P. potash solution. The mixture was digested for an hour at a temperature of 70° C., with occasional stirring. It was then filtered, the filtrate neutralized with hydrochloric acid, and the alumina was precipitated as a phosphate with ammonium acetate as described in my ammonium acetate method.

Ten cc. standard alumina solution + 0.030 gram iron oxide + 0.500 gram calcium phosphate gave

	$Al_2O_3.P_2O_5$ found. Grams.	Al_2O_3. Grams.
1	0.0538	0.0225
2	0.0542	0.0227
3	0.0543	0.0227
4	0.0543	0.0227

Comparative tests were made on phosphate rocks between this method by solution in C. P. potash and by three successive precipitations with ammonium acetate.

	By new potash method. Al_2O_3 found. Per cent.	By acetate method. Al_2O_3 found. Per cent.
1	1.05	1.03
2	1.19	1.16
3	1.86	1.61
4	1.07	0.99
5	1.88	1.98

These results show the accuracy of this method, both in obtaining a known amount of alumina and in showing close agreement with results by the acetate method.

This method has been in use in our laboratory for over a year. A reprint of an article by M. Henri Lasne[1] has just been received, giving a method for the separation of alumina from phosphates of iron and lime very similar to this. M. Lasne uses caustic soda instead of potash and precipitates his aluminum phosphate with ammonium hyposulphite instead of ammonium acetate. I have made a few comparative tests by my method and that of M. Lasne and find closely agreeing results.

Using ten cc. standard alumina solution + 0.500 grams calcium phosphate I found

	By my method.		By Lasne's method.	
	$Al_2O_3.P_2O_5$.	Al_2O_3.	$Al_2O_3.P_2O_5$.	Al_2O_3.
	Grams.	Grams.	Grams.	Grams.
1	0.0542	0.0220	0.0540	0.0226
2	0.0538	0.0225	0.0533	0.0223

In the analysis of a phosphate rock I found

By my method. Al_2O_3 found.	By Lasne's method. Al_2O_3 found.
Per cent.	Per cent.
1.75	1.73
1.80	...

The detailed method used in my work is as follows: Treat the finely ground rock phosphate with a magnet to remove any metallic iron derived from the iron mortar used in the preparation of the sample. Dissolve four grams of the rock in thirty cc. dilute hydrochloric acid (1–1), heating just below the boiling-point for half an hour. This prevents the solution of pyrites. Filter into a 200 cc. flask, add a few drops of nitric acid, and boil to oxidize the iron, cool and dilute to mark. Take fifty cc. containing one gram of rock and run into twenty cc. of the solution of C. P. caustic potash. Digest for an hour at 70° C., stirring occasionally. Let the precipitate settle and filter on a large paper, first decanting the supernatant liquid on the paper and finally washing on the precipitate. Wash two or three times with hot water.

To the filtrate add one gram of ammonium phosphate, acidify with hydrochloric acid, add ammonia until a permanent precipitate is formed and dilute hydrochloric acid, drop by drop, until it is just dissolved. Add a mixture of fifteen cc. neutral ammo-

[1] From the *Bulletin de la Société chimique de Paris*, [3] 15, 118, *1896*.

nium acetate solution and five cc. acetic acid (thirty per cent.) and digest for half an hour at 70° C., by which time the precipitation is complete.

Filter, washing five or six times with hot ammonium acetate solution (ten per cent.), stirring up the precipitate with the jet each time. Ignite with a low flame until the paper is charred, increase the heat, and, when the paper is completely consumed, blast for a minute. The precipitate is the normal aluminum phosphate and its weight multiplied by the factor 0.418 gives the Al_2O_3.

The iron oxide is determined volumetrically, preferably by the bichromate method, in a solution of the precipitate of iron oxide and calcium phosphate thrown down by the caustic potash. It is also determined separately, by the same method, in a solution of five grams of the rock in dilute hydrochloric acid (1–1).

My thanks are due to Mr. H. E. Cutts, A.M., for valuable assistance in the above investigation.

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SOME THOUGHTS ABOUT LIQUIDS.

BY CLARENCE L. SPEYERS.

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CONSIDER an empty closed space. Imagine a quantity of liquid put into it, enough to fill the space with vapor and leave some liquid over. A portion of the liquid changes into vapor and passes into the previously empty space above the liquid and continues doing so until the pressure of the vapor reaches a certain value, when the vaporization ceases.

The usual way of explaining this vaporization starts out by assuming that, with the exception of the surface, the liquid is perfectly homogeneous in a physical sense. That is, there is not a single particle of the liquid which for any appreciable length of time is different from any other particle, but of course, spaces between the particles of liquid are recognized. At the surface of the liquid, however, a distinction is to be made. For outside the surface, the activities are different from those within the surface, otherwise there would be no boundary. So that the