by boiling (after removing the excess of bromine with thio-sulfate and drying), dissolved in petroleum ether, and the linolic tetrabromides allowed to crystallize in the ice box. The next day these were filtered, washed, and dried. The filtrate was dried and weighed, and the percentage of bromine was determined. From these results the amounts of linolic and oleic acid were calculated.

	Grams	Per cent
Weight of unsaturated acids.....	5.000	7.66
Linolenic hexabromide, m. p. 181°.....	0.3830	2.81
Linolenic acid.....	1.7560	35.12
Insoluble tetrabromide, m. p. 112°.....	7.7350	47.96
Residue (tetrabromide and dibromide).....	5.3139	49.60
Bromine content of residue.....	2.4211	16.39
Tetrabromide in residue.....	2.4800	65.99
Dibromide in residue.....	1.5411	30.90
Linolic acid in residue.....		
Linolic acid in insoluble tetrabromide.....		
Total linolic acid.....		
Oleic acid.....		

These figures show the following composition of the unsaturated acids and the original oil:

	Unsaturated Acids Per cent	Original Oil as Found Per cent	Original Oil Corrected Per cent
Linolenic acid.....	2.81	2.4	2.4
Linolic acid.....	65.99	56.4	56.6
Oleic acid.....	30.90	26.4	26.5
Solid acids.....	...	9.7	9.3
TOTAL.....	99.70	94.9	94.8

The figures in the last column were obtained by deducting 0.36 per cent of unsaturated acids from the solid acids as found, and correcting the percentages of unsaturated acids accordingly. The iodine value of the above mixture is theoretically 155 for the unsaturated acids, and 133.0 for the original oil, while 153 and 134.0 are values found on experiment (the value 153 is the average of two other samples).

From the data obtained it is believed that the composition of soy-bean oil having an iodine number of 134 is approximately as follows: 2 to 3 per cent linolenic, 55 to 57 per cent linolic, 26 to 27 per cent oleic, and 9 to 10 per cent saturated acids.

Glacial Acetic Acid Method for Determining Uranium in Carnotite¹

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THE growing demand for radium has been an incentive to an increased interest in certain radium bearing minerals, the most important of which is carnotite.³ Since there appears to be a definite ratio of radium to uranium in the ore, the uranium content is an approximate measure of the amount of radium present,⁴ so that a rapid method for the determination of uranium is much to be desired.

The usual accompanying substances in carnotite are silica, iron, aluminium, and vanadium, and the method should provide for the separation of uranium from these elements.

Carnotite is easily decomposed by mineral acids. The procedure commonly employed is to treat the ore with nitric acid at boiling temperature (adding sulfuric acid if decomposition by the nitric acid is incomplete), filter off the silica, precipitate iron and alumina as carbonates with an excess of ammonium carbonate, precipitate vanadium from a slightly acetic acid solution as lead vanadate, remove the excess of lead either as a carbonate and sulfide, or as sulfate, and determine uranium by precipitation with ammonia, ignition to U_3O_8 and weighing as impure oxide. The residue is extracted with nitric acid, and the weight of insoluble residue is subtracted from the weight obtained, to arrive at the true U_3O_8 . The method is long and requires some experience for accurate results.

W. F. Hillebrand suggests separating vanadium from uranium by volatilization of the former as the oxychloride with hydrochloric acid gas. The method is not popular in the industrial laboratory on account of the apparatus required.

C. E. Scholl⁵ has outlined a rapid method which in part follows the procedure recommended by the Bureau of Mines⁶ for the commercial separation of the constituents of carnotite.

Scholl, however, separates the vanadium in the initial carbonate treatment to remove iron and aluminium by adding sufficient iron in excess of that present to carry out the vanadium. Unfortunately the vanadium is not completely removed and may often be found in the final residue U_3O_8 ; furthermore some uranium is invariably carried down by the iron and aluminium.

C. A. Pierlé⁷ has shown that vanadium may be quantitatively separated from uranium by extracting the nitrates with glacial acetic acid containing nitric acid in the proportion of 100:5. The uranium dissolves while the vanadium remains in the residue. After investigating the reaction the writer conceived the idea of using this principle in a quantitative method for the determination of uranium in carnotite.

Attempts were first made to extract the ore directly, with unsatisfactory results; roasting the ore before treating with the glacial acetic nitric mix proved more effective and indicated a commercial possibility. The best results were obtained by decomposing the ore with dilute nitric acid, filtering off the soluble constituents containing all of the uranium and evaporating to dryness, or treating the ore with nitric acid and evaporating to dryness without separating the silica, thus saving a filtration. The residue thus obtained was extracted with the glacial acetic-nitric reagent.

It was found necessary to evaporate the extract to dryness and reextract the uranium to effect a complete separation of uranium from vanadium (see experimental data). A final evaporation to dryness and ignition to destroy organic matter appears necessary for a complete precipitation of uranium. Pyrex glass has been found to be satisfactory.

PROCEDURE

Half a gram (100 mesh) of high-grade carnotite, or a larger amount of low-grade, is placed in a 300- to 400-cc. beaker and treated with 20 to 40 cc. dilute HNO_3 (1:1) and the mixture boiled gently and placed on a steam bath or hot plate

¹ Received January 12, 1922.

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³ *Am. J. Sci.*, [4] 10 (1900), 120; *U. S. Geol. Surv., Bulls.* 70, 104, 625.

⁴ 2.6 times per cent of U_3O_8 gives mg. radium per ton. Ratio U : Ra = 1 : 3.4×10^{-7} . S. C. Lind and L. D. Roberts, *J. Am. Chem. Soc.*, 42 (1920), 1170.

⁵ *THIS JOURNAL*, 11 (1919), 842.

⁶ *Bur. Mines, Bull.* 104.

⁷ *THIS JOURNAL*, 12 (1920), 61.