The single fact that it is now possible by means of simple petrographic microscope methods to ascertain the optical constants of minute crystal grains with sufficient accuracy for diagnostic purposes suggests a number of chemical problems in which the petrographic microscope may render useful service; a few such problems are noted above. In some instances, as in Portland cement clinker and in the set cement, the actual mineral composition and the physical-chemical phase relations can be ascertained only by means of petrographic microscope methods.[1]

Long experience with the petrographic microscope has convinced the writer that the field of its application is a large one and full of possibilities both from the viewpoint of pure research and of practical application in the technical world; in many instances information can be obtained by means of the petrographic microscope in a few moments which it would take several days to get by the usual methods; this means an appreciable amount of time and of money saved. To know at each step in a process or investigation just what is taking place is essential to effective work and such knowledge is obtainable in many problems only with the aid of the petrographic microscope.

WASHINGTON, D. C.

[CONTRIBUTION FROM THE WOLCOTT GIBBS MEMORIAL LABORATORY OF HARVARD UNIVERSITY.]

DENSITY OF RADIO-LEAD FROM PURE NORWEGIAN CLEVEITE.

BY T. W. RICHARDS AND C. WADSWORTH, 3D.

Received June 10, 1916.

Through the kindness of Professor Ellen Gleditsch of the University of Kristiania, we have been so fortunate as to receive a specimen of lead sulfide from carfully selected Norwegian cleveite. According to Dr. Gleditsch, "The Norwegian uraninites are very old and very unaltered. They are found in well developed crystals and occur in connection with the pegmatite dykes in southeastern Norway." The sample in question occurred in cubic crystals near Langesund.

As Hönigschmid has already pointed out,[2] the properties of radio-lead[3] obtained from pure minerals of this sort are far more interesting and significant than those of lead obtained from ordinary uranium ores, which doubtless contain some admixture of ordinary lead. Hönigschmid has shown that the lead from pure cleveite has an atomic weight as low as

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[1] G. A. Rankin and F. E. Wright, *Am. J. Sci.*, [4] 39, 1–79 (1915); A. A. Klein and A. J. Phillips, "The Hydration of Portland Cement," U. S. Bureau of Standards, *Bull.* 43 (1915).

[2] Hönigschmid, *Sitz. Wien. Akad.*, 123, IIa, 20 (1914).

[3] The name radio-lead is used provisionally to designate lead which appears to be the result of radioactive transformation.

206.06, and our own experience with the sample referred to above essentially confirms this result, as will be shown in another communication. So far as we know, however, the density of lead of this kind has not yet been determined, and accordingly the present paper recounts such a determination, which forms an interesting sequel to the recently published results on the density of Australian radio-lead.[1]

The purification of the sulfide, which doubtless contained traces of sulfides of other metals, was carried out as follows: The specimen was dissolved in nitric acid and crystallized three times with centrifuging as nitrate,—a process which Baxter's experience has shown to be an excellent one for the purification of lead from other metals.[2] From this purified nitrate the chloride was precipitated by pure hydrochloric acid, and this salt was crystallized three times. The final crystals, after draining on the centrifuge, were stored in a vacuum desiccator over caustic soda. The chloride thus prepared was used for the determination of the atomic weight, the density being determined in the material saved from the filtrates from that determination. These filtrates contained excess of silver, therefore enough hydrochloric acid was added to bring the concentration of the dissolved chloride ion to 0.01 normal, because at this concentration silver chloride is most nearly insoluble.[3] When the precipitated silver chloride had settled and had been removed by filtration through a Gooch-Munroe crucible with platinum mat, the resulting solution was concentrated and crystallized once more as nitrate. The pure crystals were electrolyzed, and the pure radio-lead treated exactly as in the case of the other samples previously described.[4]

The amount of substance at hand being rather small, the work could not be done quite as accurately as before. The density determinations were made in the same pycnometer as before, by the second method described on page 223,—the volume of the pycnometer having been redetermined because its tip had been broken in the meantime. Four identical determinations gave 5.7200 as the weight of water in the pycnometer at 19.94°, weighed in air. Therefore, the volume of the pycnometer was 5.7361 cc.

TABLE.—DENSITY OF LEAD FROM CLEVEITE.

Obs. wt.	Wt. in vac. (W).	Obs. wt. water not displaced.	Corres. volume.	Volume of pyc.	Volume (V) of water displaced.	Density W/V.
4.4252	4.4250	5.3287	5.3437	5.7361	0.3924	11.277
4.4252	4.4250	5.3286	5.3436	5.7361	0.3925	11.274
4.4252	4.4250	5.3285	5.3435	5.7361	0.3926	11.271
4.4252	4.4250	5.3285	5.3435	5.7361	0.3926	11.271
					Average,	11.273

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[1] Richards and Wadsworth, THIS JOURNAL, **38**, 221 (1916).

[2] Baxter and Grover, *Ibid.*, **37**, 5 (1915).

[3] G. S. Forbes, *Ibid.*, **33**, 1937 (1911).

[4] *Loc. cit.*, p. 224.

The density of this sample, presumably a nearly pure isotope, is thus 11.273, distinctly less than 11.289, the density of the Australian radio-lead, and still less than the density 11.337 found for ordinary lead. The decrease is almost exactly proportional to the decrease of the atomic weight in these samples, for the atomic weight of the Australian lead was about 206.35, and that of this sample 206.085. Thus the atomic volume of the isotope $((206.08)/(11.273) = 18.281)$, is almost identical with that of pure lead, as indicated by our previous experiments. 18.281 is essentially equal, within the limit of error of experiment, to the value 18.277, found for ordinary lead, and to the value 18.279, found for Australian radio-lead. It is interesting to note that Australian radio-lead would be essentially duplicated as to these properties by a mixture consisting of three parts of pure isotope to one of ordinary lead.

Summary.

This brief paper describes the determination of the density of lead from Norwegian cleveite kindly furnished by Professor Gleditsch. This lead, presumably a pure isotope, was found to have a density (11.273) decidedly lower than the mixture previously studied. The corresponding atomic volume of the pure isotope is essentially equal to that of ordinary lead, as indicated by the earlier results on radio-lead from Australia.

CAMBRIDGE, MASS.

[CONTRIBUTION FROM THE CHEMICAL LABORATORY OF THE UNIVERSITY OF TEXAS.]

AN ELECTRO-ANALYTICAL METHOD FOR THE DETERMINATION AND SEPARATION OF THE METALS OF THE COPPER-TIN GROUP.[1]

BY EUGENE P. SCHOCH AND DENTON J. BROWN.
Partly in collaboration with THOMAS E. PHIPPS.[2]

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Solutions containing chlorides have been considered unsuitable for the electro-analytical deposition of metals, probably on account of the oxidizing action of the liberated chlorine. Since the formation of chlorine can be prevented by the addition of reducing agents, and since such solutions present all the advantages of *simple acid electrolytes* while they are more serviceable than either the "sulfuric acid" or the "nitric acid" electrolytes advocated by Foerster[3] and by Sand,[4] respectively, it was decided to investigate their use with the more common metals, particularly with

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[1] This work was carried out at the University of Texas under the direction of Professor Schoch and presented to the University of Chicago by Mr. Brown as part of the dissertation in partial fulfillment of the requirements for the Ph.D. degree.

[2] Mr. Thomas E. Phipps worked out the methods given in Arts. 13, 14, 15, and 16.

[3] *Electrochemie Wässeriger Loesungen*, 23; *Z. angew. Chem.*, 19, 1842 (1906).

[4] *J. Chem. Soc.*, 91, 401 (1907).