existence of carnotite. Under such conditions and in view of the fact that the extent of carnotite deposits is frequently quite large, a "transposition" of radium might be expected rather than a complete removal.

The high degree to which carnotite gives up its emanation by diffusion as shown in Table IV and discussed in Section IV, appears rather remarkable. This property does not seem to be connected with any other known properties of the ores and we are not able at present to do more than call attention to it, as well as to note that carnotite appears to furnish, in the solid state, a more abundant source of radium emanation than any other mineral with the same radium content.

X. Summary.

1. Samples of carnotite representing large quantities of ore (a few hundred pounds to several tons) show a Ra/U ratio identical with that of pitchblende, 3.33×10^{-7}.
2. Samples from small quantities (a few pounds) tend to exhibit abnormal Ra/U ratios. One instance as low as 2.48×10^{-7} and one as high as 4.6×10^{-7} have been found.
3. The most plausible explanation for these ratios seems to be one of "transposition" of radium within an ore bed, producing local differences which are equalized in mixing large quantities of ore.
4. The "emanating power" of carnotite is high and varies from 16 to 50%.
5. In order to obtain concordant results by the Boltwood emanation method, it was found desirable to determine the emanation liberated by solution in the same sample from which the emanating power had just been determined, thus making the two determinations strictly "complementary."
6. Radium may be more easily determined by the emanation method in one operation either by solution or by ignition from tubes in which it has been sealed for one month to reach equilibrium.
7. In contrast with the successful solution or ignition method for de-emanating carnotite, fusion with carbonate, and also the fusion and solution methods both gave low results and were abandoned.

It gives us great pleasure to acknowledge our indebtedness to Professor R. B. Moore for his helpful advice during this investigation.

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CESIUM ALUM AND ITS PROPERTIES.

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Received August 10, 1914.

Since the discovery of cesium by Bunsen, in 1860, its compounds have been investigated at various times, but a broad field for research still exists. The alum is one of the many compounds of cesium that offer an opportunity for original work.

Cesium alum was studied by Redtenbacher[1] in 1865, by Carl Setterberg[2] in 1881, and by Locke[3] in 1901. Setterberg compared the solubility of rubidium and cesium alums at eight different temperatures. Locke, in his work on an examination of all possible alums, gives the solubility of cesium alum at four temperatures and two of these differ from the results obtained by Setterberg. His other values were found at temperatures not given by Setterberg and, therefore, must be compared with interpolated figures. They are not the same.

The alum used was prepared from pollucite by treatment with sulfuric and hydrofluoric acids, followed by solution in water and recrystallization. The pollucite used appeared to contain zirconium. A considerable amount of jelly-like material separated, probably a zirconium compound, which was not further examined. This renders filtration difficult and tedious. The crude alum had a slight yellow color, due to ferric iron, which was removed by recrystallization from water containing sulfur dioxide.

The crystals finally obtained were examined spectroscopically and found to be free from rubidium and potassium. These crystals were used in the following:

TABLE I.—SOLUBILITY DETERMINATIONS.

No.	Temp.	Residue per 100 g. H_2O. Gram.	No.	Temp.	Residue per 100 g. H_2O. Grams.
1	7°	0.255	10	47°	1.173
2	19	0.422	11	49.25	1.387
3	22	0.426	12	50	1.417
4	22.5	0.435	13	56	1.86
5	24	0.474	14	60	2.06
6	29.5	0.571	15	66	2.798
7	31.5	0.607	16	66	2.85
8	40	0.865	17	68	3.13
9	41	0.879	18	80	5.78

The first five values of Setterberg coincide almost exactly with ours. Above 40° his values are less. In Table II, the values from 0–7° were obtained by interpolation using Setterberg's values for 0°. From 80–100° they were calculated by extrapolation and are only approximately correct.

Specific Gravity.—The specific gravity of the hydrated alum was obtained by weighing in 95% ethyl alcohol in which it is insoluble. Two determinations were made giving 1.96 and 1.93, average 1.945.

Melting Point.—The hydrated crystals in powder were enclosed in the usual capillary tube, which was heated in sulfuric acid. After the alum had

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[1] Redtenbacher, *J. prakt. Chem.*, **94**, 442 (1865).

[2] Setterberg, *Ann.*, **211**, 100 (1882).

[3] Locke, *Am. Chem. J.*, 36, 166 (1901).

Table II.—The Solubility of Anhydrous Cesium Alum, $AlCs(SO_4)_2$ in Water.

Temp.	Grams per 100 g. H_2O.	Temp.	Grams per 100 g. H_2O.	Temp.	Grams per 100 g. H_2O.	Temp.	Grams per 100 g. H_2O.
0°	0.19	22°	0.43	48°	1.21	70°	3.50
1	0.20	23	0.45	49	1.27	71	3.67
2	0.21	24	0.47	50	1.30	72	3.85
3	0.22	25	0.49[1]	51	1.39	73	4.07
4	0.23	26	0.50	52	1.45	74	4.30
5	0.24	27	0.51	53	1.51	75	4.50
6	0.25	28	0.52	54	1.58	76	4.72
7	0.26	29	0.55	55	1.65	77	4.95
8	0.27	30	0.57	56	1.71	78	5.15
9	0.28	31	0.59	57	1.77	79	5.40
10	0.29[1]	32	0.60	58	1.86	80	5.78
11	0.30	33	0.62	59	1.92	81	6.05
12	0.31	34	0.65	60	2.06	82	6.4
13	0.32	35	0.69[1]	61	2.14	83	6.7
14	0.34	36	0.72	62	2.25	84	7.0
15	0.35	37	0.75	63	2.37	85	7.4
16	0.36	38	0.77	64	2.50	86	7.7
17	0.38[1]	39	0.80	65	2.65	87	8.0
18	0.39	40	0.85	88	8.3	95	10.1
19	0.40	41	0.87	89	8.6	96	10.4
20	0.41	42	0.91	90	8.8	97	10.8
21	0.42	43	0.96	..	..	..	..
44	1.01	66	2.78	91	9.0	98	11.1
45	1.06	67	2.96	92	9.2	99	11.5
46	1.10	68	3.13	93	9.5	100	12.0
47	1.17	69	3.34	94	9.9		

Note.—0° to 40°, accurate as given. 40° to 80°, first decimal correct. 80° to 100°, extrapolated; approximately correct.

melted, a fine capillary was inserted and the solidifying point determined by drawing on the capillary until it broke. The following determinations show that the alum melts at 117°:

	Beginning.	End.	Solid.	Average.
	118°	118°	115°	116.5°
	116	118	117	117
	117	118	116	117
Average,	117	118	116	117

The melting point of cesium alum has been determined as follows: Tilden,[2] 106°; Erdman,[3] 120.5°; Locke,[4] 122°.

Easton, Pa.

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[1] Given by Setterberg.

[2] Tilden, *J. Chem. Soc.*, **45**, 266 (1884).

[3] Erdman, *Arch. Pharm.*, **232**, 3.

[4] Locke, *Am. Chem. J.*, 26, 183 (1901).