

ART. II.—*Kehoeite, a new Phosphate from Galena, Lawrence Co., S. D.*; by WM. P. HEADDEN.

ABOUT three years ago I received a number of minerals, mostly from the Merritt mine located at Galena, S. D., among which was the material described in this note. The mineral forms seams and bunches in the ore at one point in the mine. The ore is an argentiferous galena carrying zinc blende and iron pyrites. Goslarite occurs at other points in the mine but was not found in the immediate vicinity of this occurrence. The nearest point at which the goslarite was observed was some 500 feet distant.

The material is white, amorphous and insoluble in water, but it yields a small amount of zincous oxide and phosphoric acid to concentrated hydric acetate upon continued boiling. Ammonic

hydrate extracts rather more zinc than the hydric acetate but does not dissolve it to any great extent. Concentrated potassic hydrate as well as the dilute hydric salts, i. e. HCl, HNO₃ and H₂SO₄ dissolve it readily and completely. The washed mineral forms an impalpable powder with a specific gravity of 2·34 at 15°; it is infusible, and in the closed tube yields an abundance of water. With soda on charcoal it gives an incrustation of zinc oxide, obtained with some difficulty—and reacts for alumina, when moistened with cobalt solution. Borax and phosphorus salt dissolve it readily; the beads are slightly yellow while hot and colorless when cold. The saturated beads become opaque upon flaming.

The strongly ignited mineral is not completely soluble in HCl, HNO₃ or in aqua regia; the residue insoluble in these acids contains alumina and zinc, but no phosphoric acid or only traces of it. The air-dried material loses when dried at 105–110°, 14·2 per cent and loses but 3·34 per cent additional between 115–120°. It required continued heating over a Kellogg burner to expel the last portion of water. The washed and air-dried material had the following composition:

	I.	II.	III.
Insoluble	1·76	1·78	1·74
H ₂ O	31·06	31·04	30·92
P ₂ O ₅	26·76	26·74	26·78
SO ₃	·50	·54	----
ZnO	11·64	11·54	11·58
CaO	2·70	2·90	----
Al ₂ O ₃	24·84	25·62	----
Fe ₂ O ₃	·78	----	----
MgO	·08	----	----
Cl	trace	trace	----
	100·02	100·16	

Analysis No. I gives after deducting the insoluble—

H ₂ O	31·60 =	0·2808	·2808	8·91	9	27
P ₂ O ₅	27·13	0·1529	} ·1560	4·96	5	15
SO ₃	·51	0·0031				
ZnO	11·74	0·0232	} ·0314	1	1	3
CaO	2·75	0·0079				
MgO ...	·08	0·0003				
Al ₂ O ₃ ...	25·29	0·1178	} ·1202	3·83	4	12
Fe ₂ O ₃ ...	·79	0·0024				
	99·94					

The oxygen ratios correspond to 3RO + 4R₂O₃ + 3P₂O₅ + 27H₂O, or R₃P₂O₈ + 2Al₂P₂O₈ + 2Al₂(OH)₆ + 21H₂O in which

$R = Zn_{\frac{3}{4}} + Ca_{\frac{1}{4}}$. The small amount of SO_3 present and the deportment of the material toward concentrated hydric acetate indicate the absence of any significant quantity of basic sulphate or hydrated oxide of zinc. The analyses show an excess of basic oxides over the quantity required by the P_2O_5 present in order to form neutral salts, and the fact that igniting the material rendered a part of it insoluble may be interpreted in the same sense, especially as the insoluble portion is quite free from phosphoric acid and consists largely of alumina. On the other hand the presence of zinc and phosphoric acid in the hydric acetate solution is suggestive of the presence of a zincous phosphate.

As a control on the water-determination, a portion of the unwashed mineral which had been kept for upwards of three years in a stoppered but unsealed bottle, and then exposed to the atmosphere of a warm room for three days, was ignited and showed a loss of 31.48 per cent. I could not detect any CO_2 in the mineral.

The formula suggested, when $R=Zn$, requires: P_2O_5 27.25, Al_2O_3 26.10, ZnO 15.67 and H_2O 31.09.

The relationship of this mineral is not evident. If, however, the analysis made by Hermann on material from Richmond, Mass., and given on p. 178, Dana's System of Min., 5th ed., is correct, then there is an aluminic phosphate having the formula $Al_2P_2O_8 + 9H_2O$ and the material presented in this note may be a molecular combination of the following character: $2(Al_2P_2O_8 + 9H_2O) + 2Al_2(OH)_6 + (Zn_3P_2O_8 + 3H_2O)$.

I propose *Kehoeite* as the name of this mineral, after Mr. Henry Kehoe, to whom I am indebted for the material and who was the first to observe its occurrence.

Note on Jarosite.—This mineral is found as a coating in and sometimes partly filling larger cavities in the auriferous quartzite which is the chief ore obtained in the Buxton mine, Lawrence Co., S. D. It also occurs in the smaller cavities of the rock and in distinct crystals associated with small quartz crystals which cover old fracture-planes in the rock. The jarosite where it is free from limonite has a golden yellow color and the mass is composed of scales which under the microscope appear as six-sided plates. The largest crystals observed were about 2^{mm} in breadth and have a light brown color; their form could be recognized with the aid of a good magnifier as a combination of a rhombohedron and the basal plane.

The purest material that I could select gave:

Quartz	6·10	Quartz deducted.	O.		
SO ₃	28·46	30·29	=	·1817	} ·1904 12
As ₂ O ₅	2·36	2·51		·0087	
Fe ₂ O ₃	46·27	49·28		·1478	} ·1478 9·35
CaO	·39	·42		·0012	
Na ₂ O	4·35	4·62		·0119	} ·0158 1
K ₂ O	1·47	1·57		·0027	
H ₂ O	10·55	11·24		·0999	} ·0999 6·3
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	99·95	99·93			

The excess in O ratios for the iron and water is to be attributed to the presence of some ferric hydrate and the O ratios for the sample is 1 : 9 : 12 : 6.

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