THE SYSTEM OF

MINERALOGY

of James Dwight Dana and Edward Salisbury Dana
Yale University 1837–1892

SEVENTH EDITION
Entirely Rewritten and Greatly Enlarged

By

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VOLUME II

HALIDES, NITRATES, BORATES, CARBONATES, SULFATES, PHOSPHATES, ARSENATES, TUNGSTATES, MOLYBDATES, ETC.

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Anal.

	1	2
Al_2O_3	32.26	32.40
P_2O_5	44.93	44.73
H_2O	22.81	22.68
Rem.		0.56
Total	100.00	100.37
G.	2.53	2.54

1. $Al(PO_4)\cdot 2H_2O$. 2. Lucin.[6] Rem. is V_2O_3 0.32, Cr_2O_3 0.18, Fe_2O_3 0.06.

Tests. As with variscite.

Occur. As tiny crystals associated with crystals of variscite in cavities in massive variscite nodules on Utahlite Hill, five miles northeast of Lucin, Box Elder County, Utah. Also found massive with variscite at Candelaria, Nevada. In phosphatized andesite on Malpelo Island, Colombia, in the Pacific Ocean.[7]

Alter. To variscite (?).

Name. In allusion to the dimorphous relation to variscite.

Ref.

1. Originally described as orthorhombic (under the name variscite) by Schaller (1912, 1916) but shown by x-ray study, McConnell, *Am. Min.*, **25,** 719 (1940), to be isostructural with metastrengite and monoclinic as earlier suggested by Strunz and Sztrókay, *Zbl. Min.*, 272 (1939), and Ulrich, *Rozpr. České Ak., Cl. 2,* **39,** no. 17 (1930). Elements of Schaller with the unit and orientation changed to conform to the structure cell. Transformation: Schaller to new, $00\frac{1}{2}/010/\bar{1}00$.
2. Schaller (1916); it is uncertain whether certain forms given in orthorhombic position by Schaller are positive or negative forms in the monoclinic interpretation.
3. Frondel, priv. comm. (1948).
4. Larsen and Schaller (1925).
5. McConnell, *Am. Min.*, **25,** 719 (1940).
6. Schaller (p. 65, 1916).
7. McConnell, *Geol. Soc. Am., Bull.*, **54,** 707 (1943).

40.3.2.2 **METASTRENGITE** [$FePO_4\cdot 2H_2O$]. Phosphosiderite *Bruhns* and *Busz* (*Zs. Kr.*, **17,** 555, 1890). Clinobarrandite *McConnell* (*Am. Min.*, **25,** 719, 1940). Vilateite (?) *Lacroix* (**4,** 477, 1910).

Cryst.[1] Monoclinic; prismatic—$2/m$.

$a:b:c = 0.5449:1:0.8968$; β 90°36′; $p_0:q_0:r_0 = 1.6458:0.8968:1$

$r_2:p_2:q_2 = 1.1151:1.8353:1$; μ 89°24′; p_0' 1.6459, q_0' 0.8968, x_0' 0.0105

Forms:[2]

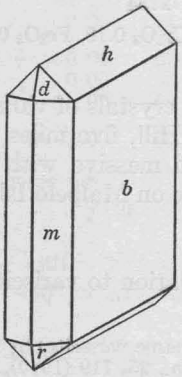
	ϕ	ρ	ϕ_2	$\rho_2 = B$	C	A
c 001	90°00′	0°36′	89°24′	90°00′	.....	89°24′
b 010	0 00	90 00	.....	0 00	90°00′	90 00
a 100	90 00	90 00	0 00	90 00	89 24	.....
m 110	61 25	90 00	0 00	61 25	89 28½	28 35
n 210	74 45½	90 00	0 00	74 45½	89 25½	15 14½
o 410	82 14½	90 00	0 00	82 14½	89 24½	7 45½
h 011	6 40½	42 05	89 24	48 16	41 44	85 32
f 103	90 00	29 12½	60 47½	90 00	28 36½	60 47½
e 101	90 00	58 53	31 07	90 00	58 17	31 07
d 111	61 34	62 02	31 07	65 08	61 30½	39 02½
r $\bar{1}11$	−61 15½	61 48	148 33½	64 55½	61 16½	140 36

Rare or doubtful:

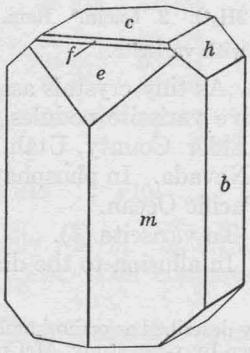
p 710	g 034	t 041	$\bar{5}04$	117	i 771	$\bar{1}12$

Structure cell.[3] Space group probably $P2_1/n$. a_0 5.28 kX, b_0 9.75, c_0 8.71; [β 90°36′]; $a_0:b_0:c_0 = 0.542:1:0.893$. Cell contents $Fe_4(PO_4)_4 \cdot 8H_2O$.

Habit. Crystals tabular {010} or stout prismatic [001]. Also as botryoidal or reniform masses and crusts with a radial-fibrous structure.



Pleystein.



Sardinia.

Twinning. On {101}, frequently as interpenetration twins.

Phys. Cleavage {010} good, {001} indistinct. Fracture uneven. H. 3½–4. G. 2.76; 2.76 (calc.). Luster vitreous to subresinous. Color of crystals peach-blossom-red or reddish violet, rarely moss-green; aggregates bright rose-red to nearly colorless. Transparent to translucent.

Opt. In transmitted light, rose to colorless.

ORIENTATION[4]	n(Na)[4]	PLEOCHROISM	
$X \wedge c \sim 4°$	1.692	Pale rose	Biaxial negative (−).
Y b	1.725	Carmine-red	$2V$ 62° (Na).
Z	1.738	Colorless	$r > v$, very strong.

Chem. A hydrated ferric phosphate, $FePO_4 \cdot 2H_2O$. Dimorphous with strengite. Al apparently substitutes for Fe‴ in large amount in some material,[11] and a complete series may extend to metavariscite analogous to the strengite-variscite series. Mn may substitute for Fe (*vilateite*).[12]

Anal.

	1	2	3
Fe_2O_3	42.73	44.30	44.38
P_2O_5	37.99	38.85	37.71
H_2O	19.28	17.26	17.31
Total	100.00	100.41	99.40
G.	2.76	2.76	

1. $FePO_4 \cdot 2H_2O$. 2. Kalterborn mine, Siegen.[5] 3. Kreuzberg, Bavaria.[6] Average of two.

Tests. B.B. easily fusible to a black magnetic bead. In C.T. turns yellow and opaque and loses water. Soluble completely in HCl, nearly insoluble in HNO_3.

Occur. Originally found in the Kalterborn mine, near Eiserfeld, Siegen, Germany, in limonite iron ore. Found in Bavaria[7] with pharmaco-

siderite in pegmatite at the Kreuzberg in Pleystein, also in pegmatite between Wildenau and Plössberg, and with strengite and dufrenite (?) in pegmatite at Hagendorf. In the St. Giovannedu mine, Gonnesa, Sardinia.[4] At Kirunavaara, Sweden,[8] with strengite in magnetite ore. In the United States, with aluminian strengite at Manhattan, Nevada (*clinobarrandite*); also in pegmatite at the Palermo and Fletcher quarries near North Groton, New Hampshire, and at Pala, San Diego County, California.[9] In phosphatized andesite on Malpelo Island, Colombia, in the Pacific Ocean.[12] A manganian variety (*vilateite*) [13] occurs with heterosite and hureaulite in pegmatite at La Vilate near Chanteloube, France.

Artif.[10] Microscopic rose-red monoclinic crystals perhaps identical with metastrengite have been obtained by heating a solution of ferric chloride with phosphoric acid in a closed tube at 180°–190°.

Name. Phosphosiderite from phosphorus and σίδηρος, *iron*, in allusion to the composition. The name metastrengite is here used parallel to metavariscite to reveal the dimorphous relation to strengite.

Ref.

1. Originally described as orthorhombic, and so accepted by Dana (823, 1892) and Goldschmidt (6, 152, 1920), but shown to be monoclinic by morphological, optical, and etch study by De Angelis, *Ann. Mus. Civ. Stor. Nat. Genova*, 52, 138 (1926), and by x-ray methods by McConnell, *Am. Min.*, 24, 636 (1939). Elements of De Angelis; see also Koechlin, *Cbl. Min.*, 290 (1934), and Laubmann and Steinmetz, *Zs. Kr.*, 55, 523 (1920).
2. Goldschmidt (1920) and De Angelis (1926). It is uncertain whether {034}, {041}, and {771} reported in orthorhombic position by Bruhns and Busz (1890) are positive or negative in the monoclinic interpretation.
3. Strunz and Sztrókay, *Zbl. Min.*, 272 (1939); comparable values are given by McConnell (1939). Space group of McConnell, *Am. Min.*, 25, 719 (1940).
4. De Angelis (1926).
5. Bruhns and Busz (1890).
6. Laubmann and Steinmetz (1920).
7. Müllbauer, *Zs. Kr.*, 61, 318 (1925), and Laubmann and Steinmetz (1920).
8. Koechlin (1934).
9. Mrose, priv comm. (1949).
10. de Schulten, *C.R.*, 100, 1522 (1885).
11. Inferred from the presence of a monoclinic mineral (*clinobarrandite*) isostructural with metavaricite in the aluminian strengite ("barrandite" of Shannon, *Am. Min.*, 8, 182, 1923) from Manhattan, Nevada, as shown by McConnell (1940).
12. McConnell, *Bull. Geol. Soc. Am.*, 54, 707 (1943).
13. Presumed but not proved to be identical with metastrengite. Described by Lacroix (1910) as monoclinic, with $a:b:c = 1.6958:1:0.8886$, β 90°33′, and forms $c\{001\}$, $b\{010\}$, $m\{110\}$, $d\{201\}$, $n\{011\}$, $\{\bar{3}11\}$, $\{\bar{3}41\}$; G 2.745. The elements are close to those of metastrengite with the a-axis tripled. An analysis is lacking, but Mn is present in significant amounts in addition to Fe, (PO_4), and H_2O. This mineral is identical with the so-called Type 1 hureaulite from La Vilate described by Des Cloizeaux, *Ann. mines*, 53, 293 (1858).

40.3.3 **WEINSCHENKITE** $[(Y,Er)(PO_4)\cdot 2H_2O]$. *Laubmann (Geognost. Jahreshefte, Geol. Landes. München*, 35, 193, 1923). [Not weinschenkite *Murgoci (C.R.*, 175, 372, 426, 1922)].

Cryst.[1] Monoclinic; prismatic—$2/m$ (?).

$a:b:c = 0.361:1:0.415$; β 129°24′; $p_0:q_0:r_0 = 1.150:3.207:1$

$r_2:p_2:q_2 = 3.119:3.585:1$; μ 50°36′; p_0' 1.488, q_0' 0.415, x_0' 0.821