

**Matulaite**

**Crystal Data:** Monoclinic. *Point Group:* 2/m. As rosettes of pseudo-hexagonal, thin-tabular, scaly to bladed crystals, to 1 mm, flattened on {001}; botryoidal and as spherules.

**Physical Properties:** *Cleavage:* Perfect on {001}. *Fracture:* Irregular. *Tenacity:* Slightly flexible. Hardness = 1.5 D(meas.) = 2.27(3) D(calc.) = 2.294

**Optical Properties:** Translucent. *Color:* Colorless, white, grayish white. *Streak:* White.

*Luster:* Vitreous.

*Optical Class:* Biaxial (-).  $\alpha(\text{calc.}) = 1.535(2)$   $\beta = 1.563(1)$   $\gamma = 1.579(1)$   $2V(\text{meas.}) = 73(2)^\circ$

*Orientation:*  $Y = b$ ;  $Z \wedge a = 8^\circ$ . *Dispersion:* None.

**Cell Data:** *Space Group:*  $P2_1/n$ .  $a = 10.604(2)$   $b = 16.608(4)$   $c = 20.647(5)$   $\beta = 98.848(7)^\circ$   
 $Z = 4$

**X-ray Powder Pattern:** Hellertown, Pennsylvania, USA.

9.96 (10), 6.37 (4), 4.42 (4), 2.395 (4), 4.83 (3), 3.79 (3), 3.66 (3)

<b>Chemistry:</b>	(1)	(2)
Fe <sub>2</sub> O <sub>3</sub>	7.25	6.43
Al <sub>2</sub> O <sub>3</sub>	29.69	28.76
P <sub>2</sub> O <sub>5</sub>	35.52	34.32
SiO <sub>2</sub>	0.39	
H <sub>2</sub> O	[31.86]	30.49
Total	104.71	100.00

(1) Bachman mine, Hellertown, Pennsylvania, USA; average of 19 electron microprobe analyses, H<sub>2</sub>O calculated from structure; corresponds to  $(\text{Fe}^{3+}_{1.08}\text{Al}_{6.92})_{\Sigma=8.00}(\text{P}_{5.94}\text{Si}_{0.08})_{\Sigma=6.02}\text{O}_{22}(\text{OH})_{10}(\text{H}_2\text{O})_{16}$ .  
(2)  $\text{Fe}^{3+}\text{Al}_7(\text{PO}_4)_4(\text{PO}_3\text{OH})_2(\text{OH})_8(\text{H}_2\text{O})_8 \cdot 8\text{H}_2\text{O}$ .

**Occurrence:** An uncommon secondary mineral in the oxidized zone of phosphatic iron deposits.

**Association:** Beraunite, rockbridgeite, dufrénite, cacoxenite, strengite, wavellite, goethite, hematite, afmite.

**Distribution:** In the USA, from the Bachman iron mine, Hellertown, Northampton Co., and at General Trimble's mine, Chester Co., Pennsylvania; in the LCA pegmatite, Bessemer City, Gaston Co., North Carolina; at the Candelaria mine, Candelaria district, Mineral Co., Nevada. From the Rotläufchen iron mine, Waldgirmes, near Wetzlar, Hesse, and at Hagendorf, Bavaria, Germany. From Fumade, Tarn, France.

**Name:** Honors Margaret Mary Matula (b. 1925), Allentown, Pennsylvania, USA, who supplied some of the first specimens.

**Type Material:** The Natural History Museum, London, England (2011,100); Natural History Museum of Los Angeles County, Los Angeles, California, USA (28323 and 28324).

**References:** (1) Moore, P.B. and J. Ito (1980) Jungit und Matulait: Zwei neue taflige Phosphat-Mineralien. *Aufschluss*, 31, 55-61 (in German with English abs.). (2) (1980) *Amer. Mineral.*, 65, 1067 (abs. ref. 1). (3) Kampf, A.R., S.J. Mills, M.S. Rumsey, J. Spratt, and G. Favreau, (2012) The crystal structure determination and redefinition of matulaite,  $\text{Fe}^{3+}\text{Al}_7(\text{PO}_4)_4(\text{PO}_3\text{OH})_2(\text{OH})_8(\text{H}_2\text{O})_8 \cdot 8\text{H}_2\text{O}$ . *Mineral. Mag.*, 76(3), 517-534. (4) (2012) *Amer. Mineral.*, 97, 2071 (abs. ref. 3).