

Crystal Data: Orthorhombic, pseudocubic. *Point Group:* 2/m 2/m 2/m. As flattened pyramidal crystals and pseudo-octahedra, to 3 mm, with slightly concave faces; striations ⊥ to elongation. *Twinning:* Polysynthetic, crosshatched, observed in thin section, probably pinacoidal.

Physical Properties: *Cleavage:* None. *Fracture:* Uneven to conchoidal. *Tenacity:* Brittle. Hardness = 4 D(meas.) = 3.32(2) D(calc.) = 3.24

Optical Properties: Transparent to opaque due to goethite inclusions. *Color:* Dark bottle-green to yellow-green; in thin section, yellowish bottle-green. *Streak:* Apple-green. *Luster:* Vitreous to adamantine when fresh; resinous on crystal surfaces. *Optical Class:* Biaxial. $n = 1.92-1.94$ 2V(meas.) = n.d.

Cell Data: *Space Group:* Pmmn. $a = 7.6191(2)$ $b = 7.6191(2)$ $c = 7.5534(4)$ $Z = 8$

X-ray Powder Pattern: Broken Hill, Australia. 3.784 (100), 1.692 (17), 2.393 (16), 2.676 (15), 1.892 (10), 1.545 (9), 2.023 (6)

Chemistry:	(1)	(2)
SiO ₂	2.99	
Fe ₂ O ₃	65.53	74.73
ZnO	1.13	
PbO	2.70	
H ₂ O	25.2	25.27
CO ₂	1.0	
Total	98.55	100.00

(1) Broken Hill, Australia; by electron microprobe, average of eight analyses, Fe³⁺ confirmed by Mössbauer spectroscopy, H₂O and CO₂ by CHN analyzer; corresponds to (Fe³⁺_{0.92}Si_{0.06}Zn_{0.01})_{Σ=0.99}(OH)_{2.96}[(H₂O)_{0.08}(CO₂)_{0.03}Pb_{0.01}]_{Σ=0.12}. (2) Fe(OH)₃.

Occurrence: On a museum specimen from a metamorphosed Pb-Zn deposit, probably from the surface oxidation zone.

Association: Goethite, coronadite.

Distribution: From the Proprietary mine, Broken Hill, New South Wales, Australia. From the Clara mine, central Black Forest, Germany.

Name: Honors John Desmond *Bernal* (1901-1971), British crystallographer and historian of science.

Type Material: Museum Victoria, Melbourne; South Australian Museum, Adelaide, Australia, G17627.

References: (1) Birch, W.D., A. Pring, A. Reller, and H.W. Schmalle (1993) Bernalite, Fe(OH)₃, a new mineral from Broken Hill, New South Wales: description and structure. *Amer. Mineral.*, 78, 827-834. (2) McCammon, C.A., A. Pring, H. Keppler, and T. Sharp (1995) A study of bernalite, Fe(OH)₃, using Mössbauer spectroscopy, optical spectroscopy and transmission electron microscopy. *Phys. Chem. Minerals*, 22, 11-20. (3) Welch, M.D., W.A. Crichton, and N.L. Ross (2005) Compression of the perovskite-related mineral bernalite Fe(OH)₃ to 9 GPa and a reappraisal of its structure. *Min. Mag.*, 69, 309-315. (4) (2006) *Amer. Mineral.*, 91(1), 220 (abs. ref. 3). (5) Kolitsch, U. (1998) Bernalite from the Clara Mine, Germany, and the incorporation of tungsten in minerals containing ferric iron. *Can. Mineral.*, 36, 1211-1216.