

**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 <sub>2</sub>	2.99	
Fe <sub>2</sub> O <sub>3</sub>	65.53	74.73
ZnO	1.13	
PbO	2.70	
H <sub>2</sub> O	25.2	25.27
CO <sub>2</sub>	1.0	
Total	98.55	100.00

(1) Broken Hill, Australia; by electron microprobe, average of eight analyses, Fe<sup>3+</sup> confirmed by Mössbauer spectroscopy, H<sub>2</sub>O and CO<sub>2</sub> by CHN analyzer; corresponds to (Fe<sup>3+</sup><sub>0.92</sub>Si<sub>0.06</sub>Zn<sub>0.01</sub>)<sub>Σ=0.99</sub>(OH)<sub>2.96</sub>[(H<sub>2</sub>O)<sub>0.08</sub>(CO<sub>2</sub>)<sub>0.03</sub>Pb<sub>0.01</sub>]<sub>Σ=0.12</sub>. (2) Fe(OH)<sub>3</sub>.

**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)<sub>3</sub>, 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)<sub>3</sub>, 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)<sub>3</sub> 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.