

**Crystal Data:** Monoclinic. *Point Group:* 2/*m*. Crystals are elongated, to 2 cm, commonly in subparallel aggregates.

**Physical Properties:** *Cleavage:* Prismatic, imperfect. *Fracture:* Uneven. *Tenacity:* Brittle. Hardness = 3 VHN = 108–117, 111 average (100 g load). D(meas.) = 5.71(23) D(calc.) = 5.77

**Optical Properties:** Transparent to opaque. *Color:* Colorless to white; in reflected light shows abundant colorless internal reflections. *Streak:* White. *Luster:* Adamantine.

*Optical Class:* [Biaxial.]  $\alpha$  = n.d.  $\beta$  = n.d.  $\gamma$  = n.d. 2V(meas.) = n.d. *Anisotropism:* Weak to moderate. *Birefractance:* Moderate, gray to dark gray.

R<sub>1</sub>–R<sub>2</sub>: (400) 14.2–14.8, (420) 14.0–14.6, (440) 13.8–14.4, (460) 13.7–14.1, (480) 13.4–13.9, (500) 13.2–13.7, (520) 13.1–13.5, (540) 12.9–13.4, (560) 12.8–13.2, (580) 12.7–13.1, (600) 12.6–13.0, (620) 12.5–12.9, (640) 12.5–12.9, (660) 12.4–12.8, (680) 12.3–12.8, (700) 12.3–12.7

**Cell Data:** *Space Group:* P2<sub>1</sub>/*m*.  $a = 4.2043(8)$   $b = 9.199(2)$   $c = 16.663(3)$   
 $\beta = 91.82(1)^\circ$   $Z = 2$

**X-ray Powder Pattern:** Bounds Cliff, England.

4.02 (10), 2.296 (8), 2.377 (6), 4.16 (5), 2.108 (4), 3.79 (3), 3.045 (3)

**Chemistry:**

	(1)	(2)
CO <sub>2</sub>	4.10	3.93
PbO	81.30	79.75
Cl	18.67	19.00
H <sub>2</sub> O	1.61	1.61
–O = Cl <sub>2</sub>	4.21	4.29
Total	101.47	100.00

(1) Bounds Cliff, England; by electron microprobe, Pb and Cl average of three analyses, C and H by CHN analyzer, presence of (CO<sub>2</sub>)<sup>2-</sup> and H<sub>2</sub>O confirmed by IR; original elemental analysis here converted to oxides; corresponds to Pb<sub>4.02</sub>(CO<sub>3</sub>)<sub>1.03</sub>[Cl<sub>5.82</sub>(OH)<sub>0.16</sub>]<sub>Σ=5.98</sub>•0.90H<sub>2</sub>O.

(2) Pb<sub>4</sub>(CO<sub>3</sub>)Cl<sub>6</sub>•H<sub>2</sub>O.

**Occurrence:** A rare reaction product of sea water with a metal-bearing vein exposed at sea level (Bounds Cliff, England); produced by the action of sea water on lead-bearing slag (Laurium, Greece; Baratti Beach, Italy); a corrosion product of lead object (Mahdia, Tunisia).

**Association:** Phosgenite, galena, jamesonite, cerussite, pyrite, sphalerite, chalcopyrite, dolomite, quartz (Bounds Cliff, England).

**Distribution:** From Bounds Cliff, St. Endellion, Cornwall, England. Large crystals at Laurium, Greece, in slag. At Baratti Beach, Tuscany, Italy, in slag. In the Kairakty polymetallic barite deposit, central Kazakhstan. From a shipwreck near Mahdia, Tunisia.

**Name:** Honors Richard William Barstow (1947–1982), mineral collector and dealer of Cornwall, England.

**Type Material:** The Natural History Museum, London, England, 1990,25 and E.1353.

**References:** (1) Stanley, C.J., G.C. Jones, A.D. Hart, P. Keller, and D. Lloyd (1991) Barstowite, 3PbCl<sub>2</sub>•PbCO<sub>3</sub>•H<sub>2</sub>O, a new mineral from Bounds Cliff, St Endellion, Cornwall. *Mineral. Mag.*, 55, 121–125. (2) (1992) *Amer. Mineral.*, 77, 670 (abs. ref. 1). (3) Kutzke, H., H. Klapper, S. Merlino, M. Pasero, N. Perchiazzi, and G. Eggert (2000) The crystal structure of barstowite, Pb<sub>4</sub>Cl<sub>6</sub>(CO<sub>3</sub>)•H<sub>2</sub>O, determined on crystals from Etruscan slag and from a Late-Hellenistic shipwreck. *Zeits. Krist.*, 215, 110–113.

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