Namuwite $(Zn, Cu)_4(SO_4)(OH)_6 \cdot 4H_2O$

Crystal Data: Hexagonal. *Point Group:* $\overline{3}$. In flat platy hexagonal crystals, to 60 μm, or elongated trangular needles; typically aggregated into incrustations.

Physical Properties: *Cleavage:* Perfect on {0001}. Hardness = 2 D(meas.) = 2.77 D(calc.) = 2.81

Optical Properties: Semitransparent. *Color:* Pale sea-green. *Streak:* Very pale green. *Luster:* Pearly.
Optical Class: Uniaxial, very low birefringence. $n = 1.577(5)$ ω = n.d. ϵ = n.d.

Cell Data: *Space Group:* $P\overline{3}$. $a = 8.330(1)$ $c = 10.540(2)$ $Z = 2$

X-ray Powder Pattern: Aberllyn mine, Wales.
10.59 (100), 2.71 (42), 2.63 (41), 4.15 (25), 1.57 (23), 2.41 (22), 1.55 (20)

Chemistry:

	(1)	(2)	(3)
SO_3	14.9	13.73	14.04
CuO	22.0	23.48	13.16
ZnO	37.8	32.28	53.02
H_2O^+	13.4		
H_2O^-	11.1		
H_2O		[21.77]	[25.03]
Total	99.2	[91.26]	[105.25]

(1) Aberllyn mine, Wales; by AA, SO_3 and H_2O by TGA; corresponds to $(Zn_{2.50}Cu_{1.49})_{\Sigma=3.99}(SO_4)(OH)_6 \cdot 4.34H_2O$. (2) Smallcleugh mine, England; by electron microprobe, H_2O calculated for stoichiometry; corresponds to $(Zn_{2.30}Cu_{1.71})_{\Sigma=4.01}(SO_4)_{0.99}(OH)_{6.04} \cdot 4H_2O$. (3) Granetal, Germany; by electron microprobe, H_2O calculated for stoichiometry; corresponds to $(Zn_{3.28}Cu_{0.83})_{\Sigma=4.11}(SO_4)_{0.88}(OH)_{6.46} \cdot 4H_2O$.

Occurrence: An uncommon secondary mineral formed in the oxidized zone of hydrothermal Cu–Zn bearing mineral deposits; may be derived from metallic slags.

Association: Hydrozincite, schulenbergite, serpierite, ktenasite, devilline, gypsum.

Distribution: In Wales, from the Aberllyn lead mine, about two km from Bettws-y-coed, Llanrwst district, Gwynedd, and at the Frongoch mine, Dyfed. In England, from the Smallcleugh mine, Nenthead, Cumbria, and in the Waterbank mine, Ecton Hill, Staffordshire. In Germany, in the Harz Mountains, from Granetal, at the Glücksrad mine, near Oberschulenberg, and in slag at the Juliushütte, Astfeld; from the Friedrichssegen mine, near Bad Ems, and at Virneberg, near Rheinbreitbach, Rhineland-Palatinate; at Stolberg, near Aachen, North Rhineland-Westphalia. In the Veneziana mine, near Torrebelvicino, Vicenta, Italy. From the Kamariza mine, and in slag, at Laurium, Greece. At Tsumeb, Namibia. From the ZCA#4 mine, Balmat, St. Lawrence Co., New York, USA.

Name: For the NAtional MUseum of Wales, Cardiff, Wales, in the collection of which the type specimen was noted.

Type Material: National Museum of Wales, Cardiff, Wales, 27.111.GR414; The Natural History Museum, London, England, 1983,341; National Museum of Natural History, Washington, D.C., USA, 150334.

References: (1) Bevins, R.E., S. Turgoose, and P.A. Williams (1981) Namuwite, $(Zn, Cu)_4SO_4(OH)_6.4H_2O$, a new mineral from Wales. Mineral. Mag., 46, 51–54. (2) (1983) Amer. Mineral., 68, 281 (abs. ref. 1). (3) Groat, L.A. (1996) The crystal structure of namuwite, a mineral with Zn in tetrahedral and octahedral coordination, and its relationship to the synthetic basic zinc sulfates. Amer. Mineral., 81, 238–243.