Zeunerite $Cu(UO_2)_2(AsO_4)_2 \cdot 12H_2O$

Crystal Data: Tetragonal. *Point Group*: 4/*m* 2/*m* 2/*m*. Crystals, to 4 cm, flat tabular on {001}, commonly in subparallel growths.

Physical Properties: *Cleavage*: On {001}, perfect; on {100}, distinct. Hardness = 2.5 D(meas.) = 3.47 D(calc.) = 3.391 for $16H_2O$. Radioactive; commonly dehydrates to metazeunerite.

Optical Properties: Transparent, becoming translucent on dehydration. *Color*: Green to emerald-green. *Luster*: Vitreous.
Optical Class: Uniaxial (–). ω = 1.610-1.613 ε = 1.582-1.585 *Pleochroism*: *O* = blue-green; *E* = pale blue-green.

Cell Data: *Space Group*: *P*4/*nnc*. a = 7.1797(3) c = 20.857(1) Z = 2

X-ray Powder Pattern: Synthetic $Cu(UO_2)_2(AsO_4)_2 \cdot 16H_2O$.
10.65 (10), 3.59 (9), 5.04 (8), 3.39 (7), 1.926 (6), 6.86 (5), 2.08 (5)

Chemistry: (1) Identification rests on comparison of the X-ray powder pattern and optical data with those of synthetic $Cu(UO_2)_2(AsO_4)_2 \cdot 16H_2O$.

Mineral Group: Autunite group.

Occurrence: An uncommon secondary mineral in the oxidized zone of arsenic-bearing hydrothermal uranium deposits.

Association: Olivenite, mansfieldite, scorodite, azurite, malachite.

Distribution: Material which is fully hydrated at the time of study is relatively rare, although most meta-zeunerite is a dehydration product of pre-existing zeunerite. In Germany, from the Walpurgis vein, Weisser Hirsch mine, Neustädtel-Schneeberg, Saxony; at Sailauf, northeast of Aschaffenburg, Bavaria; in the Anton mine, Heubachtal, near Schiltach, from Menzenschwand, and elsewhere in the Black Forest. In England, at a number of places in Cornwall, as at Wheals Gorland and Maid, Gwennap; in the South Terras mine, St. Stephen-in-Brannel; at Wheal Edward, St. Just. In France, from the Cap Garonne mine, near le Pradet, Var; at the Margnac mine, Compreignac, Haute-Vienne; in the Rabéjac uranium deposit, seven km south-southeast of Lodève, Hérault. In the USA, from the Dexter mine, Calf Mesa, San Rafael district, Emery Co., Utah; at the Majuba Hill mine, Antelope district, Pershing Co., Nevada; in various of the Colorado Plateau-type U-V deposits, Colorado. Large crystals from Brumado, Bahia, Brazil.

Name: Honoring Gustav Anton *Zeuner* (1828-1907), Director, School of Mines, Freiberg, Germany.

Type Material: State Museum of Mineralogy and Geology, Dresden; Mining Academy, Freiberg, Germany, 21730; now metazeunerite.

References: (1) Palache, C., H. Berman, and C. Frondel (1951) Dana's system of mineralogy, (7th edition), v. II, 989-990 [name reserved for natural occurrence of the higher hydrate]. (2) Frondel, C. (1958) Systematic mineralogy of uranium and thorium. U.S. Geol. Sur. Bull. 1064, 191-195.
(3) Locock, A.J. and P.C. Burns (2003) Crystal structures and synthesis of the copper-dominant members of the autunite and meta-autunite groups: torbernite, zeunerite, metatorbernite and metazeunerite. Can. Mineral., 41, 489-502. (4) (2004) Amer. Mineral., 89(1), 252 (abs. ref. 3).