Chalcophanite $(Zn, Fe^{2+}, Mn^{2+})Mn_3^{4+}O_7 \cdot 3H_2O$

Crystal Data: Hexagonal. *Point Group:* $\bar{3}$. As tabular platelets, to 8 mm, with {0001} and $\{10\bar{1}0\}$ giving a pseudo-octahedral appearance; commonly in drusy botryoidal or stalactitic aggregates; also colloform, granular, or massive.

Physical Properties: *Cleavage:* Perfect on {0001}. *Tenacity:* Thin plates are flexible. Hardness = 2.5 VHN = 87–166 (50 g load). D(meas.) = 4.00(10) D(calc.) = 3.827

Optical Properties: Opaque, transparent on very thin edges. *Color:* Purplish to iron black; deep red-brown to opaque in transmitted light; white with deep red internal reflections under reflected light. *Streak:* Chocolate-brown. *Luster:* Metallic to submetallic.
Optical Class: Uniaxial (–). *Pleochroism:* Very strong, in gray and white. $\omega = \gg 2.72$ $\epsilon = \sim 2.72$ *Anisotropism:* Very strong. *Bireflectance:* Well defined; in gray and white.
R_1–R_2: (400) 11.4–38.0, (420) 11.0–36.6, (440) 10.6–35.2, (460) 10.3–33.8, (480) 10.0–32.2, (500) 9.8–30.7, (520) 9.8–29.2, (540) 9.7–28.0, (560) 9.5–26.9, (580) 9.3–26.2, (600) 9.3–25.8, (620) 9.2–25.4, (640) 9.2–24.8, (660) 9.0–24.4, (680) 8.9–24.0, (700) 8.9–23.8

Cell Data: *Space Group:* $R\bar{3}$. $a = 7.541(3)$ $c = 20.824(8)$ $Z = 2$

X-ray Powder Pattern: Sterling Hill, New Jersey, USA; nearly indistinguishable from aurorite and jianshuiite.
6.96 (100), 3.50 (60), 4.08 (50), 2.24 (50), 2.57 (40), 1.597 (40), 1.900 (30)

Chemistry:

	(1)	(2)	(3)
MnO_2	59.94		65.82
Fe_2O_3	0.25	0.1	
MnO	6.58	65.3	

	(1)	(2)	(3)
ZnO	21.70	21.6	20.54
H_2O	11.58	[13.0]	13.64
Total	100.05	[100.0]	100.00

(1) Sterling Hill, New Jersey, USA; average of two analyses. (2) Do.; by electron microprobe, total Mn as MnO, H_2O by difference. (3) $ZnMn_3O_7 \cdot 3H_2O$.

Occurrence: A common component of the weathered zones above zinc- and manganese-bearing base-metal deposits.

Association: Cryptomelane, manganite, hetaerolite, birnessite, todorokite, woodruffite, kaolinite, quartz.

Distribution: In the USA, at Sterling Hill, Ogdensburg, and Franklin, Sussex Co., New Jersey; from the Price mine, near Newport, Giles Co., Virginia; in the Philipsburg district, Granite Co., Montana; in Colorado, at the Wolftone mine, Leadville, Lake Co.; from the Mohawk mine, San Bernardino Co., California; in the Lone Star mine, Fierro-Hanover district, Grant Co., New Mexico; at Bisbee, Cochise Co., Arizona; and in the Tintic district, Juab Co., Utah. In Mexico, from the Ojuela mine, Mapimí, Durango. In Australia, from Broken Hill, New South Wales; at the Reaphook Hill zinc deposit, near Blinman, Flinders Ranges, and the Iron Monarch mine, 50 km northwest of Whyalla, South Australia. At Bytom, Upper Silesia, Poland. In the N'chwaning mine, near Kuruman, Cape Province, South Africa. Large crystals from Tamera, Tunisia. A number of other minor localities are known.

Name: From the Greek for *copper* and *to appear*, for the mineral's change in color on ignition.

Type Material: n.d.

References: (1) Palache, C., H. Berman, and C. Frondel (1944) Dana's system of mineralogy, (7th edition), v. I, 739–740. (2) Ostwald, J. (1985) Some observations on the chemical composition of chalcophanite. Mineral. Mag., 49, 752–755. (3) Post, J.E. and D.E. Appleman (1988) Chalcophanite, $ZnMn_3O_7 \cdot 3H_2O$: new crystal-structure determinations. Amer. Mineral., 73, 1401–1404. (4) Grice, J.D., B. Gartrell, R.A. Gault, and J. Van Velthuizen (1994) Ernienickelite, $NiMn_3O_7 \cdot 3H_2O$, a new mineral species from the Siberia complex, Western Australia: comments on the chalcophanite group. Can. Mineral., 32, 333–337. (5) Dunn, P.J. (1995) Franklin and Sterling Hill. New Jersey. No publisher, n.p., 586–588.