Aurorite $(Mn^{2+}, Ag, Ca)Mn_3^{4+}O_7 \cdot 3H_2O$

Crystal Data: Hexagonal. *Point Group:* $\overline{3}$ or 3. As small, irregular masses and platy or scaly grains, to 8 μm.

Physical Properties: Hardness = < 3 D(meas.) = n.d. D(calc.) = [3.81]

Optical Properties: Opaque, transparent on very thin edges. *Color:* Black; pale brown in transmitted light at the edges of very thin, platy grains.
Optical Class: Biaxial. $n = > 2$ 2V(meas.) = n.d. *Anisotropism:* Yellow-gray to brownish gray. *Bireflectance:* Strong; cream-white to medium black.
R_1–R_2: (400) 10.4–36.5, (420) 10.3–35.3, (440) 10.2–34.0, (460) 9.99–32.4, (480) 9.67–30.6, (500) 9.49–29.2, (520) 9.31–27.8, (540) 9.16–26.6, (560) 9.11–25.6, (580) 8.93–24.9, (600) 8.88–24.5, (620) 8.87–24.0, (640) 8.85–23.7, (660) 8.84–23.4, (680) 8.82–22.9, (700) 8.80–22.7

Cell Data: *Space Group:* $R\overline{3}$ or $R3$. $a = 7.514(4)$ $c = 20.734(5)$ $Z = 2$

X-ray Powder Pattern: Aurora mine, Nevada, USA; nearly indistinguishable from chalcophanite and jianshuiite.
6.94 (10), 3.46 (7), 4.06 (5), 2.54 (5), 2.23 (5), 1.429 (5), 2.45 (4)

Chemistry:

	(1)	(2)		(1)	(2)
As_2O_5	trace		MgO	0.12	
MnO_2	[59.99]	[70.5]	CaO	2.50	2.8
SiO_2	0.11		SrO	n.d.	
Al_2O_3	0.15	0.5	BaO	3.07	2.9
Fe_2O_3	0.07		Na_2O	0.07	
FeO		0.2	K_2O	1.11	0.4
MnO	[7.89]	[3.4]	Ag_2O	7.50	6.0
NiO	0.03		S	n.d.	
CuO	1.06		Cl	n.d.	
ZnO	0.25	0.3	H_2O	[14.78]	[13.0]
PbO	1.30		Total	[100.00]	[100.0]

(1) Aurora mine, Nevada, USA; by electron microprobe; Mn 44.02%, partitioned as MnO_2 59.99% by analogy to chalcophanite, the remainder reported as MnO; H_2O by difference; then corresponding to $(Mn^{2+}_{0.48}Ag_{0.28}Ca_{0.19}K_{0.10}Ba_{0.06}Cu_{0.06}Pb_{0.02}Mg_{0.01}Zn_{0.01})_{\Sigma=1.21}$ $Mn^{4+}_{2.97}O_7 3.53H_2O$. (2) Do.; by electron microprobe; method of partitioning Mn not stated, H_2O by difference.

Occurrence: In veinlets filling microfractures in manganoan calcite (Aurora mine, Nevada, USA).

Association: Manganoan calcite, argentian todorokite, cryptomelane, pyrolusite, chlorargyrite, silver, quartz (Aurora mine, Nevada, USA).

Distribution: In the USA, from the Aurora mine, Hamilton, White Pine Co., and at Yucca Mountain, Nye Co., Nevada; at Morenci, and in the Ash Peak mine, near Duncan, Greenlee Co., from the Sheep Tanks district, La Paz Co., and in the King of Arizona mine, Kofa district, Yuma Co., Arizona. At Sterling Hill, Ogdensburg, Sussex Co., New Jersey. In the Kawazu mine, Shizuoka Prefecture, Japan.

Name: For the occurrence at the Aurora mine, Nevada, USA.

Type Material: n.d.

References: (1) Radtke, A.S., C.M. Taylor, and D.F. Hewett (1967) Aurorite, argentian todorokite, and hydrous silver-bearing lead manganese oxide. Econ. Geol., 62, 186–206. (2) (1967) Amer. Mineral., 52, 1581 (abs. ref. 1). (3) 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. (4) Criddle, A.J. and C.J. Stanley, Eds. (1993) Quantitative data file for ore minerals, 3rd ed. Chapman & Hall, London, 29.