Millerite NiS

Crystal Data: Hexagonal. *Point Group:* $\bar{3}\ 2/m$. Typically as slender to capillary crystals, to 7 cm, elongated ‖ [0001], in radiating groups of hairlike, interwoven masses; columnar tufted coatings. Single crystals may be helically twisted about [0001] or form rings. As cleavable masses up to several cm across. *Twinning:* By pressure on $\{01\bar{1}2\}$.

Physical Properties: *Cleavage:* Perfect on $\{10\bar{1}1\}$ and $\{01\bar{1}2\}$. *Fracture:* Uneven. *Tenacity:* Brittle; capillary crystals elastic. Hardness = 3–3.5 VHN = 179 D(meas.) = 5.5 D(calc.) = 5.374

Optical Properties: Opaque. *Color:* Pale brass-yellow to bronze-yellow, tarnishes to iridescence. *Streak:* Greenish black. *Luster:* Metallic. *Pleochroism:* Weak in air, appreciably stronger in oil, pale yellow-brown to bright yellow. *Anisotropism:* Strong.
R_1–R_2: (400) 26.4–30.0, (420) 29.8–34.0, (440) 35.6–38.8, (460) 41.0–42.1, (480) 45.1–44.8, (500) 48.4–46.9, (520) 51.5–48.4, (540) 53.9–49.8, (560) 55.5–50.8, (580) 57.0–51.8, (600) 58.3–51.6, (620) 59.2–53.3, (640) 59.9–53.8, (660) 60.4–54.2, (680) 60.5–54.4, (700) 60.5–54.3

Cell Data: *Space Group:* $R\bar{3}m$. $a = 9.607$ $c = 3.143$ $Z = 9$

X-ray Powder Pattern: Canada.
2.777 (100), 1.8631 (95), 2.513 (65), 4.807 (60), 2.228 (55), 1.8178 (45), 2.946 (40)

Chemistry:

	(1)	(2)
Ni	63.68	64.67
Fe	1.03	
Co	0.21	
Cu	0.00	
S	35.47	35.33
Total	100.39	100.00

(1) Marbridge mine, Canada; by electron microprobe, corresponding to $(Ni_{0.98}Fe_{0.02})_{\Sigma=1.00}S_{1.00}$.
(2) NiS.

Occurrence: Most commonly as a low-temperature mineral, in cavities in limestones and carbonate veins and in barite; an alteration product of other nickel minerals; also in sedimentary rocks, associated with coal measures, and rarely in serpentines.

Association: Gersdorffite, polydymite, nickeline, galena, sphalerite, pyrite, chalcopyrite, pyrrhotite, pentlandite, cubanite, calcite, dolomite, siderite, barite, ankerite.

Distribution: Numerous localities world-wide. In Germany [TL], from Müsen and Wissen, and as large crystals at Ramsbeck, North Rhine-Westphalia; from Kamsdorf, Thuringia. At Kotalahti, Finland, large cleavages. From Kladno, Czech Republic. At Merthyr Tudful, Glamorgan, Wales. In the USA, from the Sterling mine, Antwerp, Jefferson Co., New York; at the Gap Nickel mine, Lancaster Co., Pennsylvania. In geodes from Keokuk, Lee Co., Iowa; St. Louis, St. Louis Co., Missouri; Esterbrook Park, Milwaukee, Waukesha Co., Wisconsin, and at Hall's Gap, Lincoln Co., Kentucky. In Canada, from Temagami, Ontario; at the Thompson mine, Thompson, Manitoba; in the Orford nickel mine, Brompton Lake, and as large cleavages from the Marbridge mine, Malartic, Quebec. At Kambalda, 56 km south of Kalgoorlie, and in the Agnew mine, Leinster, Western Australia. From the Trojan nickel mine, Bindura, Zimbabwe. On Mabilikwe Hill, Northern Transvaal, South Africa.

Name: Honors William Hallowes Miller (1801–1880), British mineralogist, Cambridge University, Cambridge, England, who first studied crystals of the mineral.

References: (1) Palache, C., H. Berman, and C. Frondel (1944) Dana's system of mineralogy, (7th edition), v. I, 239–241. (2) Grice, J.D. and R.B. Ferguson (1974) Crystal structure refinement of millerite (β–NiS). Can. Mineral., 12, 248–252. (3) Zhu Nai-jue, Liang Li, and Shi Ni-cheng (1991) Experimental electron density analysis of millerite. Scientia Sinica, 35(9), 1047–1055 (in English). (4) (1962) NBS Mono. 25, 1, 37. (5) Beran, A. and T. Mohsenzadeh (1982) A reflected light investigation of nickeline, breithauptite and millerite. Tschermaks Mineral. Petrog. Mitt., 30, 267–275.