Frankhawthorneite $Cu_2(Te^{6+}O_4)(OH)_2$

Crystal Data: Monoclinic. *Point Group:* $2/m$. As stubby crystals, bladed on {010} and prismatic on [001], to 0.1 mm.

Physical Properties: *Fracture:* Uneven. *Tenacity:* Brittle. Hardness = 3–4
D(meas.) = n.d. D(calc.) = 5.43

Optical Properties: Transparent. *Color:* Medium leaf-green; pale gray in reflected light, with viridian-green internal reflections. *Streak:* Pale leaf-green. *Luster:* Vitreous.
Optical Class: [Biaxial.] n = [2.00] α = n.d. β = n.d. γ = n.d. 2V(meas.) = n.d.
Anisotropism: Weak, somber brown. *Bireflectance:* Weak.
R_1–R_2: (400) 12.6–14.2, (420) 12.3–13.7, (440) 12.0–13.3, (460) 11.7–12.9, (480) 11.4–12.6, (500) 11.2–12.4, (520) 11.0–12.2, (540) 10.9–12.0, (560) 10.7–11.9, (580) 10.6–11.7, (600) 10.5–11.6, (620) 10.4–11.4, (640) 10.3–11.3, (660) 10.2–11.2, (680) 10.1–11.2, (700) 10.1–11.2

Cell Data: *Space Group:* $P2_1/n$. $a = 9.107(4)$ $b = 5.213(1)$ $c = 4.605(2)$ $\beta = 98.74(3)^\circ$
$Z = 2$

X-ray Powder Pattern: Centennial Eureka mine, Utah, USA.
2.598 (100), 2.891 (70), 4.337 (60), 3.838 (50), 4.506 (40), 1.834 (40), 1.713 (40)

Chemistry:

	(1)	(2)
TeO_3	48.77	49.79
CuO	45.20	45.10
H_2O	[5.05]	5.11
Total	[99.02]	100.00

(1) Centennial Eureka mine, Utah, USA; by electron microprobe, average of five analyses, H_2O calculated, presence of $(OH)^{1-}$ confirmed by IR and crystal-structure analysis; corresponds to $Cu_{2.03}(Te_{0.99}O_4)(OH)_2$. (2) $Cu_2(TeO_4)(OH)_2$.

Occurrence: A very rare secondary mineral formed by the oxidization of primary Cu–Te-bearing sulfides.

Association: Mcalpineite, hematite, acanthite, chrysocolla, connellite, enargite, hinsdalite–svanbergite, pyrite, quartz.

Distribution: From the dumps of the Centennial Eureka mine, Tintic district, Juab Co., Utah, USA.

Name: Honors Frank Christopher Hawthorne (1946–), Professor of Crystallography and Mineralogy, University of Manitoba, Winnipeg, Canada, who has determined the crystal structures of many copper minerals.

Type Material: Canadian Geological Survey, Ottawa, Canada, 67263.

References: (1) Roberts, A.C., J.D. Grice, A.J. Criddle, M.C. Jensen, D.C. Harris, and E.A. Moffatt (1995) Frankhawthorneite, $Cu_2Te^{6+}O_4(OH)_2$, a new mineral species from the Centennial Eureka mine, Tintic District, Juab County, Utah. Can. Mineral., 33, 641–647. (2) Grice, J.D. and A.C. Roberts (1995) Frankhawthorneite, a unique HCP framework structure of a cupric tellurate. Can. Mineral., 33, 649–653. (3) (1996) Amer. Mineral., 81, 516–517 (abs. refs. 1 and 2).