Francisite $Cu_3BiO_2(Se^{4+}O_3)_2Cl$

Crystal Data: Orthorhombic. *Point Group:* $2/m\ 2/m\ 2/m$. As bladed crystals, elongated along [010], with dominant forms {100}, {011}, and {101}, to 0.25 mm; in divergent sprays. *Twinning:* Contact twins on {100}.

Physical Properties: *Fracture:* Conchoidal. Hardness = 3–4 D(meas.) = n.d. D(calc.) = 5.42

Optical Properties: Semitransparent. *Color:* Bright apple-green. *Streak:* Pale apple-green. *Luster:* Adamantine.
Optical Class: [Biaxial.] *Pleochroism:* Distinct, from pale green to bright green ∥ [010].
Orientation: Length-slow. $\alpha = > 1.79$ $\beta = > 1.79$ $\gamma = > 1.79$ 2V(meas.) = n.d.

Cell Data: *Space Group: Pmmn.* $a = 6.354(1)$ $b = 9.630(1)$ $c = 7.220(2)$ $Z = 2$

X-ray Powder Pattern: Iron Monarch quarry, Australia.
3.39 (100), 2.866 (80), 2.652 (70), 5.31 (60), 2.491 (60), 1.588 (60), 1.695 (35)

Chemistry:

	(1)	(2)
SeO_2	27.23	30.78
Bi_2O_3	35.75	32.31
CuO	32.62	33.10
Cl	4.11	4.92
$-O = Cl_2$	0.93	1.11
Total	98.78	100.00

(1) Iron Monarch quarry, Australia; by electron microprobe, average of seven analyses, absence of $(OH)^{1-}$ and H_2O and presence of $(SeO_3)^{2-}$ confirmed by IR; corresponds to $Cu_{3.10}Bi_{1.16}O_{2.12}(Se_{0.93}O_3)_2Cl_{0.88}$. (2) $Cu_3BiO_2(SeO_3)_2Cl$.

Occurrence: A rare secondary mineral in an oxidized barite lens in Precambrian sedimentary iron formation.

Association: Chorargyrite, muscovite, naumannite, bismuth, djurleite, Cu–Bi–Ag selenides, barite.

Distribution: From the Iron Monarch quarry, Iron Knob, South Australia. At the Baccu Locci mine, near Villaputzu, Sarrabus district, Sardinia, Italy.

Name: Honors Glyn Francis (1939–), Quality Control Officer at the Iron Monarch quarry, Australia, who collected the first specimen.

Type Material: South Australian Museum, Adelaide, G16415; The Museum of Victoria, Melbourne, Australia, M39650.

References: (1) Pring, A., B.M. Gatehouse, and W.D. Birch (1990) Francisite, $Cu_3Bi(SeO_3)_2O_2Cl$, a new mineral from Iron Monarch, South Australia: description and crystal structure. Amer. Mineral., 75, 1421–1425.