Tyrrellite $(Cu, Co, Ni)_3Se_4$

Crystal Data: Cubic. *Point Group:* $4/m\ \overline{3}\ 2/m$. Rounded grains and subhedral cubes.

Physical Properties: *Cleavage:* {001}, poor. *Fracture:* Conchoidal. *Tenacity:* Brittle. Hardness = ∼3.5 VHN = 343–368 (100 g load). D(meas.) = n.d. D(calc.) = 6.6(2)

Optical Properties: Opaque. *Color:* Pale bronze; pale brassy bronze in reflected light. *Streak:* Black. *Luster:* Metallic.

R: (400) 41.8, (420) 42.6, (440) 43.5, (460) 44.4, (480) 45.0, (500) 45.5, (520) 45.9, (540) 46.3, (560) 46.5, (580) 46.8, (600) 47.0, (620) 47.3, (640) 47.5, (660) 47.6, (680) 47.8, (700) 48.0

Cell Data: *Space Group:* $Fm3m$. a = 10.005(4) Z = 8

X-ray Powder Pattern: Ato Bay, Canada.
1.769 (10), 2.501 (9), 2.886 (7), 3.016 (6), 1.926 (6), 5.780 (4), 3.537 (4)

Chemistry:

	(1)	(2)
Cu	12.7	13.7
Co	17.7	11.6
Ni	6.9	12.0
Se	62.4	62.0
Total	99.7	99.3

(1) Beaverlodge district [*sic*; Goldfields district], Canada; by electron microprobe, corresponding to $Cu_{1.01}Co_{1.52}Ni_{0.60}Se_{4.00}$. (2) Hope's Nose, England; by electron microprobe; corresponding to $Cu_{1.10}Ni_{1.04}Co_{1.00}Se_{4.00}$.

Mineral Group: Linnaeite group.

Occurrence: With other selenides, as the youngest hydrothermal replacements and open space fillings in sheared Precambrian rocks, which also contain uraninite deposits (Goldfields district, Canada).

Association: Umangite, klockmannite, clausthalite, pyrite, hematite, chalcopyrite, chalcomenite (Ato Bay, Canada); berzelianite, eucairite, crookesite, ferroselite, bukovite, kruťaite, athabascaite, calcite, dolomite (Petrovice deposit, Czech Republic).

Distribution: In Canada, from the western part of the Eagle claims, and also at the head of Ato Bay, Beaverlodge Lake, Goldfields district, Saskatchewan [TL]. From Bukov, near Tisnova, on Koksín Hill, near Mitov, and in the Petrovice uranium deposit, near Ždăr, Czech Republic. At Hope's Nose, Torquay, Devon, England. In Argentina, from Tuminico, Sierra de Cacho, and at Los Llantenes, La Rioja Province.

Name: Honors Joseph Burr Tyrell (1858–1957), American geologist, first to visit the area of discovery in Canada.

Type Material: Canadian Geological Survey, Ottawa, 61592; Royal Ontario Museum, Toronto, Canada.

References: (1) Robinson, S.C. and E.J. Brooker (1952) A cobalt–nickel–copper selenide from the Goldfields district, Saskatchewan. Amer. Mineral., 37, 542–544. (2) Sindeeva, N.D. (1964) Mineralogy and types of deposits of selenium and tellurium, 77–78. (3) Criddle, A.J. and C.J. Stanley, Eds. (1993) Quantitative data file for ore minerals, 3rd ed. Chapman & Hall, London, 590–591.