American Mineralogist, Volume 75, pages 706–713, 1990

NEW MINERAL NAMES*

John L. Jambor
CANMET, 555 Booth Street, Ottawa, Ontario K1A 0G1, Canada
David A. Vanko
Department of Geology, Georgia State University, Atlanta, Georgia 30303, U.S.A.

Criddleite*

D.C. Harris, A.C. Roberts, J.H.G. Laflamme, C.J. Stanley (1988) Criddleite, $TlAg_2Au_3Sb_{10}S_{10}$, a new gold-bearing mineral from Hemlo, Ontario, Canada. Mineral. Mag., 52, 691–697.

The mineral has been found as anhedral rims around aurostibite, as intergrowths with each of aurostibite, native gold, and native antimony in composite grains up to 30 by 70 μm, and as isolated grains in gangue. Five electron-microprobe analyses gave Tl 7.1–7.8, Ag 7.8–8.8, Au 22.3–23.2, Sb 47.3–48.2, S 12.8–13.3, sums 97.6–100.5 wt%, the average corresponding to $Tl_{0.92}Ag_{1.99}Au_{2.93}Sb_{9.87}S_{10.28}$. The compound was synthesized by heating charges in evaluated silica-glass tubes. VHN_{25} of synthetic material is 94–129. In reflected light, weakly bireflectant from gray-blue to slightly greenish gray-blue, distinctly to moderately anisotropic from buff to slate gray, commonly shows simple twinning. Reflectances were determined in 10-nm steps from 400 to 700 nm in air and in oil on a single lath-shaped grain; representative values in air (WTiC standard) for R_1 and R_2 are 400 40.6, 41.85; 440 39.4, 40.1; 490 37.9, 39.2; 540 36.7, 38.4; 590 35.3, 37.4; 640 33.7, 36.0; 690 32.6, 34.4; color values for illuminant A are x .437, .440, y .407, .408, Y% 35.8, 37.7, λ_d 493, 495, P_e 2.5, 1.8. The mineral and its synthetic counterpart have identical X-ray powder patterns. Single-crystal X-ray study of synthesized grains gave monoclinic (pseudotetragonal) symmetry, space group $A2$, Am, or $A2/m$. Cell dimensions refined from the powder pattern (synthetic material, Guinier-DeWolff film, $CoK\alpha_1$ radiation) are $a = 20.015(2)$, $b = 8.075(2)$, $c = 7.831(2)$ Å, $\beta = 92.01(2)°$; strongest lines are 5.63(90,011), 3.91(50,002), 3.456(50,320), 2.860(70,700), 2.813(100,022), 2.018 (60,040), and 1.959(70,004).

The mineral has been found in cores from four drill holes at the Hemlo gold deposit, northeastern shore of Lake Superior near Marathon, Ontario. The new name is for Alan J. Criddle of the British Museum (Natural History), London. Type material is in the British Museum (Natural History), London, in the Royal Ontario Museum, Toronto, Ontario, and in the Systematic Reference Series of the National Mineral Collection at the Geological Survey of Canada, Ottawa, Ontario. **J.L.J.**

Donharrisite*

W.H. Paar, T.T. Chen, A.C. Roberts, A.J. Criddle, C.J. Stanley (1989) Donharrisite, nickel-mercury sulfide, a new mineral species from Leogang, Salzburg Province, Austria. Can. Mineral., 27, 257–262.

The mineral occurs as brown, metallic, mica-like flakes up to 1 mm² by 0.1 mm thick, associated with cinnabar, native mercury, galena, and trace amounts of sphalerite, tennantite, chalcopyrite, polydymite, and pyrite on a museum specimen, collected before 1834, probably from the former Erasmus mine, Leogang, Salzburg Province, Austria. The average of seven electron-microprobe analyses gave Ni 35.2, Hg 43.3, S 20.6, sum 99.1 wt%, corresponding to $Ni_{8.22}Hg_{2.96}S_{8.82}$, ideally $Ni_8Hg_3S_9$. Brownish-gray streak, brittle, $VHN_5 = 47$, conchoidal fracture, perfect {001} cleavage, $D_{calc} = 5.18$ g/cm³ for the ideal formula and Z = 2. In reflected light, creamy white with a yellowish tint in air, creamy white in oil; distinct anisotropism in grayish colors. Reflectance percentages for two grains are given in 20-nm steps; representative values for R_1 and R_2 in air are 400 34.0, 37.0; 440 36.2, 39.3; 470 38.75, 41.7; 500 41.3, 44.2; 546 44.6, 47.4; 589 47.1, 49.9; 620 48.4, 51.2; 650 49.5, 52.0; 680 50.4, 52.6. Color values (illuminant C) are x .331, .329, y .337, .335, Y% 45.0, 47.85, λ_d 578, 578, P_e% 11.3, 10.3. X-ray single-crystal study gave monoclinic symmetry, space group $C2$, Cm, or $C2/m$, $a = 11.66(3)$, $b = 6.91(1)$, $c = 10.92(3)$ Å, $\beta = 97.43(20)°$ as refined from a 114.6-mm Gandolfi powder pattern (Co radiation). Strongest lines of the pattern are 5.75(70,200), 5.09(70,111), 3.71 (50,202),3.33(60,$\bar{3}$11), 2.683(60,$\bar{4}$02,$\bar{2}$22), 2.609 (30,$\bar{3}$13), 2.547(100,222), 2.220 (30,$\bar{1}$31,420,$\bar{4}$21), and 2.071(30,$\bar{1}$15,$\bar{2}$24).

The new name is for Donald C. Harris of the Geological Survey of Canada, Ottawa. The holotype specimen is in the Landesmuseum Joanneum, Graz, Austria, and fragments from it are in several other repositories. **J.L.J.**

Feruvite*

J.D. Grice, G.W. Robinson (1989) Feruvite, a new member of the tourmaline group, and its crystal structure. Can. Mineral., 27, 199–203.

---

* Before publication, minerals marked with an asterisk were approved by the Commission on New Minerals and Mineral Names, International Mineralogical Association.

0003–004X/90/0506–0706$02.00

Feruvite is the Fe-analogue of uvite, and the Ca-analogue of schorl. An average of five electron-microprobe analyses gave SiO_2 33.33, TiO_2 2.19, B_2O_3 11.25, Al_2O_3 23.38, FeO 13.56, MgO 7.80, MnO 0.07, CaO 3.30, Na_2O 1.16, K_2O 0.05, H_2O_{calc} 3.48, sum 99.57 wt%. Assuming 19 cations and 31 anions, and with the site occupancies for Mg and Fe determined by the X-ray crystal-structure refinement, the formula is $(Ca_{0.62}Na_{0.39}K_{0.01})_{\Sigma 1.02}(Fe^{2+}_{1.53}Mg_{1.21}Ti_{0.29}Mn_{0.01})_{\Sigma 3.04}(Al_{4.72}Mg_{0.82}Fe^{3+}_{0.34}Fe^{2+}_{0.12})_{\Sigma 6.00}$ $(BO_3)_3$ $(Si_{5.83}Al_{0.10})_{\Sigma 5.93}$ $O_{18}(OH)_4$, simplified as $(Ca,Na)\ (Fe,Mg,Ti)_3(Al,Mg,Fe)_6(BO_3)_3\ Si_6O_{18}(OH)_4$. The structure was refined to $R = 1.6\%$. The mineral occurs as dark brown-black, subhedral to anhedral grains up to 2 mm in diameter; gray streak, vitreous to dull luster, H = ~7, brittle, conchoidal fracture, nonfluorescent, $D_{meas} = 3.207(9)$ (heavy liquids), $D_{calc} = 3.21$ g/cm³ for the empirical formula and Z = 3. Optically uniaxial negative, $\omega = 1.687(1)$, $\epsilon = 1.669(1)$ for Na light; strongly pleochroic, *O* light brown, *E* very dark brown. Crystal-structure study indicated trigonal symmetry, space group *R*3*m*, $a = 16.012(2)$, $c = 7.245(2)$ Å as refined from the powder pattern (114.6-mm Gandolfi camera, Fe radiation). Strongest lines of the powder pattern are 6.43 (40,101), 4.24 (60,211), 4.00 (60,220), 3.50 (60,012), 2.979 (80,122), 2.586 (100,051), 2.051 (50,152), 1.928 (40,342), 1.600 (40,550), and 1.439 (40,740).

The mineral occurs as dark patches that make up to 30% of a pegmatitic, tourmalinized rock formed by hydrothermal replacement of aluminous and ferromagnesian host-rock silicates at Cuvier Island, New Zealand. Associated minerals are quartz, microcline, chlorapatite, and pyrite, and some feruvite grains have a dravite overgrowth. The new name alludes to the crystal-chemical similarity to uvite. The holotype specimen is in the National Mineral Collection at the National Museum of Natural Sciences, Ottawa, Ontario, Canada. **J.L.J.**

Foordite*

P. Černý, A.-M. Fransolet, T.S. Ercit, R. Chapman (1988) Foordite $SnNb_2O_6$, a new mineral species, and the foordite-thoreaulite series. Can. Mineral., 26, 889–898.

T.S. Ercit, P. Černý (1988) The crystal structure of foordite. Can. Mineral., 26, 899–903.

A representative electron-microprobe analysis and (range) gave SnO 25.4 (24.6–26.1), PbO 6.0 (5.3–6.6), Ta_2O_5 28.7 (27.0–30.9), Nb_2O_5 40.1 (36.5–40.7), sum 100.2 wt%, corresponding to $(Sn^{2+}_{0.87}Pb_{0.13})_{\Sigma 1.00}(Nb_{1.40}Ta_{0.60})_{\Sigma 2.00}O_6$, ideally $SnNb_2O_6$. The mineral is brownish yellow with a greenish tint, yellowish white streak, vitreous to adamantine luster, H = 6, perfect {100} and poor {011} cleavages, $D_{meas} = 6.734$, $D_{calc} = 6.664$ g/cm³ for the chemical formula and Z = 4. Optically biaxial positive, 2*V* intermediate, high refractive indices (calc. average 2.294). Crystal-structure study indicated monoclinic symmetry, space group *C*2/*c*; $a = 17.097(2)$, $b = 4.879(1)$, $c = 5.562(1)$ Å, $\beta = 90.85(2)°$ as refined from the diffractometer pattern (Fe radiation). Strongest lines of the powder pattern are 3.592(40,$11\bar{1}$), 3.100(50,$31\bar{1}$), 3.071(50,311), 2.849 (100,600), 1.853(30,620), 1.694(45,$91\bar{1}$,$42\bar{2}$), and 1.681 (45,802,911).

The holotype mineral occurs in contact with plumbomicrolite, cassiterite, ferrocolumbite, and ixiolite as part of a 30-g pebble in alluvial deposits along the Sebeya River near Lutsiro in western Rwanda. A second specimen, from Kubitaka, Punia, Zaire, has the cation composition $(Sn_{3.89}Pb_{0.04}Sb_{0.04})_{\Sigma 3.97}(Nb_{4.17}Ta_{3.73}Sn^{4+}_{0.12})_{\Sigma 8.02}$. The new name is for Eugene E. Foord of the U.S. Geological Survey. Foordite forms a series with thoreaulite, $SnTa_2O_6$. Type foordite is in the mineralogical collection of the Université Catholique de Louvain, Louvain-la-Neuve, Belgium. **J.L.J.**

Mcauslanite*

J.M. Richardson, A.C. Roberts, J.D. Grice, R.A. Ramik (1988) Mcauslanite, a supergene hydrated iron aluminum fluorophosphate from the East Kemptville tin mine, Yarmouth County, Nova Scotia. Can. Mineral., 26, 917–921.

The mineral occurs as clusters, up to 4 mm across, of radiating crystals on fracture surfaces in leucomonzogranite at the East Kemptville greisen-hosted tin mine, Yarmouth County, southwestern Nova Scotia. Electron-microprobe analysis gave FeO 23.0, MnO 6.3, Al_2O_3 14.1, P_2O_5 38.6, F 2.8, sum 84.8 wt%; H_2O determined for two samples by TG–EGA gave 34 and 35 wt%. The high total of the raw analyses is attributed to loss of loosely held H_2O under vacuum during carbon coating and electron-microprobe analysis. After normalization to 100 wt%, the results are FeO 18.1, MnO 5.0, Al_2O_3 11.1, P_2O_5 30.5, H_2O 34, F 2.2, sum 100.9, less O ≡ F 0.9, corresponding to $H_{1.02}(Fe^{2+}_{2.40}Mn_{0.67})_{\Sigma 3.07}Al_{2.08}(PO_4)_{4.10}F_{1.10}\cdot 17.49H_2O$, ideally $HFe_3Al_2(PO_4)_4F\cdot 18H_2O$. The mineral forms yellowish white, translucent, vitreous blades and translucent silky fibers up to 1 mm long and 0.2 mm wide, elongate [001], white streak, brittle, H = 3.5, good cleavage parallel to [001], nonfluorescent. Blades consist of {010}, {100}, and very minor {001}. $D_{meas} = 2.22(2)$ in heavy liquids, $D_{calc} = 2.17$ g/cm³ for the ideal formula and Z = 1. Optically biaxial negative, $\alpha = 1.522(1)$, $\beta = 1.531(1)$, $\gamma = 1.534(1)$ for Na light, $2V_{meas} = 55(5)°$, $2V_{calc} = 59.7°$, $X{:}b = 17°$ in β obtuse, $Y{:}c = 18°$ in α obtuse, $Z{:}a = 14°$ in γ obtuse. X-ray single-crystal study indicated triclinic symmetry, space groups $P1$ or $P\bar{1}$, $a = 10.055(5)$, $b = 11.568(5)$, $c = 6.888(5)$ Å, $\alpha = 105.84(6)°$, $\beta = 93.66(6)°$, $\gamma = 106.47(5)°$, as refined from the powder pattern (114.6-mm Gandolfi camera, Co radiation). Strongest lines of the powder pattern are 10.6(90,010), 9.53(85,100), 6.55(70,001), 4.96(100,011,$02\bar{1}$), 3.436(35,$01\bar{2}$), 2.812 (55,310), and 2.785(45,$\bar{1}40$).

Mcauslanite, vivianite, phosphophyllite, and childrenite-eosphorite occur as part of a complex supergene assemblage that fills joints and shear zones near the erosional surface at the deposit. The new name is for David A. McAuslan who, as eastern exploration manager for Shell Canada Resources Ltd., was instrumental in the discovery and development of the East Kemptville mine. The type specimen of mcauslanite is in the Systematic Reference Collection of the National Mineral Collection at the Geological Survey of Canada, Ottawa, Ontario. **J.L.J.**

Mückeite*

G. Schnorrer-Köhler, U. Neumann, Th. Doering (1989) Mückeite, $CuNiBiS_3$, a new ore mineral from the Grüne Au mine, Schutzbach/Siegerland. Neues Jahrb. Mineral. Mon., 193–200.

Electron-microprobe analysis gave a mean (and range) of Cu 15.1 (14.7–15.4), Ni 14.0 (13.9–14.2), Sb 2.1 (1.4–3.2), Bi 45.6 (43.0–46.6), S 22.9 (22.6–23.4), sum 99.7 wt%, corresponding to $Cu_{1.00}Ni_{1.01}(Bi_{0.92}Sb_{0.07})_{\Sigma 0.99}S_{3.01}$, ideally $CuNiBiS_3$, the bismuth analogue of lapieite, $CuNiSbS_3$. The mineral occurs in subhedral to euhedral crystals up to 1 mm long, tabular {010}, elongate [100], showing {100}, {010}, {001}, {101}, and another (*hk*0) plane. Color light gray with an orange tint, gray-black streak, metallic luster, cleavage very good {010}, good {001}, VHN_{100} = 152 (136–165), D_{calc} = 6.07 with Z = 4, D_{meas} = 5.88 g/cm^3 (low because of intergrown sulfide contaminants). In reflected light, creamy gray to light gray with a yellow-brown tint in air, olive-tinted gray to yellow-brown in oil; pleochroism distinct in air and strong in oil. Anisotropy weak in air, stronger in oil. Reflectance values in air (SiC standard) are 470 36.35, 35.70; 546 34.10, 39.00; 589 39.78, 40.20; 650 40.90, 42.25. Single-crystal X-ray study gave orthorhombic symmetry, space group $P2_12_12_1$, a = 7.509(2), b = 12.551(2), c = 4.877(1) Å as refined from the diffractometer pattern (Cu radiation). Strongest lines of the powder pattern are 3.177(80,031), 2.975(100,201), 2.895(40,140,211), 2.232(30,051), 2.159(30,241), 2.087(60,250), 1.863 (50,142,161), and 1.837(70,232).

The mineral occurs with millerite, polydymite, bismuthinite, and lapieite at the former Grüne Au mine at Schutzbach near Siegen, Siegerland area, Federal Republic of Germany. The new name is for Professor Arno Mücke of the Mineralogisch-Petrologisches Institut, University of Göttingen. Type material is in the Mineralogische Sammlungen of the University of Göttingen, and in the Mineralogisch-Petrographisches Institut of the University of Tübingen, F.R.G. **J.L.J.**

Nacareniobsite-(Ce)*

O.V. Petersen, J.G. Rønsbo, E.S. Leonardsen (1989) Nacareniobsite-(Ce), a new mineral species from the Ilimaussaq alkaline complex, South Greenland, and its relation to mosandrite and the rinkite series. Neues Jahrb. Mineral. Mon., 84–96.

Electron-microprobe analysis of the holotype specimen from the Kvonefjield Tunnel in the Ilimaussaq alkaline complex gave SiO_2 29.63, Al_2O_3 <0.05, TiO_2 2.79, Nb_2O_5 11.61, Ta_2O_5 0.34, ZrO_2 <0.10, Na_2O 10.01, CaO 19.92, SrO 0.27, Y_2O_3 0.78, La_2O_3 4.09, Ce_2O_3 10.32, Pr_2O_3 1.42, Nd_2O_3 4.19, Sm_2O_3 0.81, Dy_2O_3 0.05, F 6.87, O ≡ F 2.89, sum 100.21 wt%, corresponding to $(Nb_{0.71}Ti_{0.28}Ta_{0.01})_{\Sigma 1.00}$-$Na_{2.62}(Ca_{2.88}REE_{1.08}Sr_{0.02})_{\Sigma 3.98}(Si_{2.00}O_{7.00})_2(O_{0.7}F_{2.93})$ where Ce 0.51, La 0.20, Nd 0.20, Pr 0.07, Y 0.06, and Sm 0.04, ideally $NbNa_3Ca_3Ce(Si_2O_7)_2OF_3$. The mineral forms individual ruler-shaped crystals up to 3.0 × 0.04 × 0.04 mm, and crystal aggregates; elongate [001], tabular {100}, modified by {310} and {410}, colorless, transparent, vitreous luster, good {011} cleavage, H = 5, uneven fracture, nonfluorescent, D_{meas} = 3.45 (heavy liquids), D_{calc} = 3.43 g/cm^3 for the empirical formula and Z = 2. Optically biaxial positive, α = 1.6618(2), β = 1.6706(2), γ_{calc} = 1.6924(1) for Na light, $2V$ = 66(1)°, $X = b$, $Y \simeq c$, $\gamma \wedge a$ = 11° in the obtuse angle β (distinct from mosandrite, which has $Y = b$, $X \wedge b$ = 3°). X-ray single-crystal study gave monoclinic symmetry, space group $P2_1/a$, a = 18.901(5), b = 5.683(3), c = 7.462(2) Å, β = 101.29(4)° as refined from a Guinier-Hägg powder pattern. There is a pronounced subcell with $c' = c/2$. Strongest lines of the powder pattern are 3.089(50,600), 3.077 (100,012,$21\bar{2}$, $60\bar{1}$), 2.955(50,112,$31\bar{2}$), 2.031(50,322,$52\bar{2}$), 1.8652(40, $20\bar{4}$,712), 1.6879(40,$13\bar{2}$,530), and 1.5518(50,10.2.0).

The ideal formula for nacareniobsite is $NbNa_3Ca_3REE(Si_2O_7)_2OF_3$, distinct in that it has Nb:Ti = >1.0, but otherwise related in composition to "rinkite," "rinkolite," and "Ca rinkolite." Analyses of "Na-leached" nacareniobsite increase the compositional similarity to "hydrated rinkite" and "hydrated rinkolite." It is concluded that nacareniobsite-(Ce) belongs to the same group of minerals as "rinkite," "johnstrupite," and "rinkolite," but is distinct from mosandrite.

Nacareniobsite occurs in dissolution cavities and in the matrix of arfvedsonite nepheline syenite (lujavrite). The new name alludes to the chemical composition. Type material is at the Geological Museum, University of Copenhagen, Denmark.

Discussion. The authors report that an investigation of the "rinkite series," namely "rinkite, johnstrupite, rinkolite, and lovchorrite" is planned. Such an undertaking is heartily encouraged to unravel this untidy group and to place the nomenclature on a systematic basis. **J.L.J.**

Nanpingite*

Yueqing Yang, Yunxiang Ni, Liben Wang, Wenying Wang, Yaping Zhang, Chenghu Chen (1988) Nanpingite—A new cesium mineral. Yanshi Kuangwuxue Zashi, 7, 49–58 (in Chinese, English abstract).

Combined wet-chemical and electron-microprobe analyses gave SiO_2 38.54, TiO_2 0.002, Al_2O_3 25.61, MnO 0.07, FeO 2.44, MgO 1.78, CaO 0.007, Na_2O 0.00, K_2O 0.54, Li_2O 0.44, Rb_2O 0.25, Cs_2O 25.29, F 1.00,

H_2O 3.27, O ≡ F 0.42, sum 98.81 wt%, corresponding to $(Cs_{0.88}K_{0.06}Rb_{0.01})_{\Sigma 0.95}(Al_{1.64}Mg_{0.22}Fe_{0.17}Li_{0.15})_{\Sigma 2.18}[(Si_{3.16}Al_{0.84})_4O_{9.95}][(OH)_{1.79}F_{0.26}]_{\Sigma 2.05}$, ideally $CsAl_2(Si,Al)_4O_{10}(OH,F)_2$. The Cs-K distribution is uniform. The mineral occurs as plates and scales up to 10 mm in diameter, typically 1 to 5 mm, as radiating and comb aggregates, rarely as pseudohexagonal crystals. White to silver white color, transparent in flakes, H = 2–3, excellent {001} cleavage, vitreous luster (pearly on sheets), white streak, more brittle than muscovite, elastic but less than that of muscovite, $D_{meas} = 3.11(2)$, $D_{calc} = 3.19$ g/cm³ with Z = 4. Optically biaxial negative, $\alpha = 1.551(5)$, $\beta = 1.584(2)$, $\gamma = 1.588(2)$, $2V_{meas} = 46(2)°$, $r > v$ (weak), $Z = b$. X-ray single-crystal study indicated monoclinic symmetry, space group $C2/c$, mica polytype $2M_1$, $a = 5.362(3)$, $b = 8.86(1)$, $c = 21.42(1)$ Å, $\beta = 95.77(2)°$ as refined from the diffractometer powder pattern (Cu radiation). Strongest lines of the powder pattern are 3.622(5,11$\bar{4}$), 3.329(6,114), 2.993(5,115), 2.919(5,11$\bar{6}$), 2.664(100,008), 2.654 (14,20$\bar{2}$), 2.129(85,0.0.10), 2.122(16,223), 1.562(6,315), and 1.328(14,067).

The mineral, which is the cesium analogue of muscovite, occurs in association with montebrasite, quartz, and apatite in veinlets up to 4 cm wide and 2 cm long in the pollucite-rich middle zone of a muscovite-albite-spodumene pegmatite in the Nanping area, Fujian Province, China. The new name is for the locality. Type material is in the Institute of Mineral Deposits, Chinese Academy of Geological Sciences, Beijing, and in the National Museum of Geology, Beijing. **J.L.J.**

Ponomarevite*

L.P. Vergasova, S.K. Filatov, E.K. Serafimova, T.F. Semenova (1988) Ponomarevite $K_4Cu_4OCl_{10}$—A new mineral from volcanic sublimates. Doklady Akad. Nauk SSSR, 300, 1197–1200 (in Russian).

T.F. Semenova, I.V. Rozhdestvenskaya, S.K. Filatov, L.P. Vergasova (1989) Crystal structure of a new mineral ponomarevite, $K_4Cu_4OCl_{10}$. Doklady Akad. Nauk SSSR, 304, 427–430 (in Russian).

Analysis of the mineral (K, Na by flame photometry; Cu, Pb, Zn by atomic absorption; F by selective electrode; others by gravimetric techniques) gave Na_2O 2.76, K_2O 20.60, CuO 38.02, ZnO 0.31, PbO 0.03, Cl 42.50, F 0.03, SO_3 1.25, H_2O^- 0.62, H_2O^+ 0.37, insol. 3.30, O ≡ Cl_2 + F_2 9.60, sum 100.19 wt%. Subtracting appropriate amounts of mitscherlichite (formed during sample preparation?) and thenardite (presence confirmed by XRD), the adjusted analysis gives the formula $(K_{3.53}Na_{0.49})_{\Sigma 4.02}(Cu_{3.97}Zn_{0.03})_{\Sigma 4.00}O_{1.10}Cl_{9.82}$, based on Cu + Zn = 4, ideally $K_4Cu_4OCl_{10}$. The mineral dissolves readily in cold water; unstable in air at room temperature, turning to mitscherlichite after several days. Stable on heating in air up to 275 °C, whereupon disintegration to tenorite and sylvite begins. The DTA curve shows an endothermic transition at 408 °C. Single-crystal X-ray study shows the mineral to be monoclinic, space group $C2/c$, $a = 14.73(2)$, $b = 14.86(1)$, $c = 8.93(1)$ Å, $\beta = 104.9(1)°$, $V = 1889(5)$ Å³, Z = 4, $D_{calc} = 2.72$, $D_{meas} = 2.78$ g/cm³. The strongest X-ray lines (40 given) are 7.31(80,11$\bar{1}$), 6.074(70,111), 2.801(100,421,15$\bar{1}$,312), 2.787(80,24$\bar{2}$), and 2.470(65,15$\bar{2}$,332,530).

The mineral occurs as a cement and as a crust, 1–2 cm in thickness, having nodular (0.1 to 0.3 cm in diameter) and skeletal forms, in fumarole deposits of the main Tolbachik fissure eruption (1975–76), Kamchatka. Associated minerals are halite, sylvite, tenorite, tolbachite, dolerophanite, piypite, and chalcocyanite. Temperatures measured during sampling ranged from 280 to 400 °C. Grains are transparent red with a gold tint and orange-red streak. Microhardness (10-g load) is 71 kg/mm², fracture is brittle. Cleavage is imperfect parallel to {001}, forming flattened fragments that are rarely rectangular because of a {110} cleavage. Luster on cleavages is vitreous, but in aggregates is resinous to greasy. Microscopic crystals form pseudohexagonal plates with {104} and {010} pinacoids and {530} prism. Optically biaxial negative, no pleochroism or notable dispersion, $\alpha = 1.686(5)$, $\beta = 1.718(5)$, $\gamma = 1.720(5)$, $2V_{meas} = 28(5)°$, orientation $Y = b$, $X{:}c = 30°$. The name is for the volcanologist V.V. Ponomareva (1940–76), who carried out early studies of the Tolbachik fissure eruption.

Discussion. The location of type material is not reported. **D.A.V.**

Scrutinyite*

J.E. Taggart, Jr., E.E. Foord, A. Rosenzweig, T. Hanson (1988) Scrutinyite, natural occurrences of αPbO_2 from Bingham, New Mexico, U.S.A., and Mapimi, Mexico. Can. Mineral., 26, 905–910.

Ten electron-microprobe analyses gave a mean of 98.2(8) wt% PbO_2. The mineral is dark reddish brown, dark brown streak, submetallic luster, translucent red on thin edges, two cleavages, perfect on probably {100} and imperfect on probably {010}, hardness not determinable, $D_{calc} = 9.867$ g/cm³ for the stoichiometric formula and Z = 4. In reflected light, gray-white with reddish brown internal reflection, weakly bireflectant from gray-white to bluish gray, weakly anisotropic with a bluish color, nonpleochroic; reflectance values in air for grains oriented parallel and perpendicular to the principal cleavage are 589 nm 17.0–17.9, 546 nm 17.9–18.8. Strongest lines of a 114.6-mm Gandolfi pattern (Cu radiation) are 3.816(40,110), 3.117(100,111), 2.722(50,002), 1.840 (80,130), 1.635(40,113), and 1.527(50,132); calculated cell dimensions are $a = 4.971(2)$, $b = 5.956(2)$, $c = 5.438(3)$ Å, in good agreement with data for orthorhombic synthetic αPbO_2.

The mineral has been found in association with murdochite and plattnerite at the Sunshine #1 Tunnel, Blanchard claims, Hansonburg Mining District, Bingham, New Mexico, where less than 1 mg of material consisting of crystals 25 to 30 μm across and 1 to 2 μm thick are present as an oxidation-stage product on hypogene fluorite and quartz. This holotype specimen is in the U.S. National Museum. The mineral also has been identified as admixed with plattnerite on the rosasite and limonite matrix of a specimen from Mapimi, Durango, Mexico. The new name is derived from *scrutiny,* and refers to the care needed to make the initial identification. **J.L.J.**

Tetrahedrite group

Tetrahedrite-Cd

A.V. Voropayev, E.M. Spridonov, V.I. Shibrik (1988) Tetrahedrite-Cd—First discovery in the U.S.S.R. Doklady Akad. Nauk SSSR, 300, 1446–1448 (in Russian).

Three analyses by electron microprobe averaged Cu 23.44, Ag 18.13, Zn 2.56, Fe 0.45, Cd 5.81, As 0.71, Sb 26.10, S 22.37, Se 0.08, sum 99.65 wt%, corresponding to $(Cu_{6.86}Ag_{3.12}Cd_{0.96}Zn_{0.73}Fe_{0.15})_{\Sigma 11.82}(Sb_{3.98}As_{0.17})_{\Sigma 4.15}$-$(S_{12.97}Se_{0.02})_{\Sigma 12.99}$. X-ray study (no peaks given) gave a = 10.603(3) Å. The mineral occurs as aggregates up to 0.15 mm, intergrown with barite and galena in the limestone-hosted Ushkatin ore beds of Central Kazakhstan. Associated minerals are tennantite, pyrite, polybasite, pyrargyrite, chalcopyrite, arsenopyrite, and sphalerite. The mineral is gray in reflected light; reflectance values in air (nm, %): 440, 29.6; 480, 28.6; 520, 28.8; 560, 29.3; 600, 29.5; 640, 28.4; 680, 27.4; 700, 27.3. **D.A.V.**

Cd-freibergite

Dianwu Jia, Zengyou Fu, Huiwen Zhang, Chunpei Zhao (1988) The first discovery of Cd-freibergite in China. Acta Mineral. Sinica, 8, 136–137 (in Chinese, English abstract).

Electron-microprobe analyses for four grains (results for each given to 3 decimal places) averaged Cu 22.802, Ag 16.683, Cd 10.748(range 9.042–11.966), Zn 0.516, Fe 0.426, Sb 25.691, As 0.988, S 21.507, sum 99.541 wt%, corresponding to $(Cu_{6.95}Ag_{3.03})_{\Sigma 9.98}(Cd_{1.85}Zn_{0.15}$-$Fe_{0.15})_{\Sigma 2.15}(Sb_{4.19}As_{0.25})_{\Sigma 4.34}S_{13}$, simplified as $Cu_{10}Cd_2Sb_4S_{13}$. The mineral occurs as disseminated grains in galena, anglesite, and another lead salt in the oxidation zone of a Pb-Zn ore deposit at Xitieshan, Qinhai Province, China. Grain size is up to 30 μm, averages 3 μm, and is typically 2 to 5 μm. **J.L.J.**

Annivite

N.S. Bortnikov, A.S. Kudryavtsev, N.V. Troneva (1986) Bismuth-containing tetrahedrite-tennantite ores from the Tary-Ekan deposit (eastern Karamazar, central Asia). Mineral. Zhurnal, 8(3), 61–64 (in Russian).

Of sixteen electron-microprobe analyses of bismuthian tetrahedrite-tennantite from the Tary-Ekan deposit, the highest in Bi gave Cu 34.28, Ag 3.93, Zn 6.88, Fe 0.35, Pb 0.42, Sb 11.43, As 6.18, Bi 13.61, S 24.11, sum 101.19 wt%. Also cited is an analysis by L.M. Lur'ye et al. (*Geol. Rudnykh Mestorozhdeniy,* 6, 63–70, 1974) in which the Bi content is 18.28 wt%.

Discussion. The electron-microprobe analysis by Lur'ye et al. gave Cu 32.04, Ag 5.69, Zn 6.39, Bi 18.23, Sb 8.18, As 5.94, sum 98.75 wt%, corresponding to $(Cu_{9.23}$-$Ag_{0.98}Zn_{1.79})_{\Sigma 11.98}(Bi_{1.60}As_{1.45}Sb_{1.23})_{\Sigma 4.28}S_{12.74}$ after recalculation to 100 wt%. The analysis of Bortnikov et al. approximates $(Cu_{9.43}Ag_{0.99}Zn_{1.83})_{\Sigma 12.25}(Bi_{1.63}As_{1.48}\ Sb_{1.26})_{\Sigma 4.37}\ S_{13}$. The name *annivite* is commonly used in the Russian literature for the bismuth-dominant tetrahedrite-group member [e.g., E.M. Spiridonov "Species and varieties of fahlore (tetrahedrite-tennantite) minerals and their rational nomenclature," *Doklady Akad. Nauk SSSR,* 279, 447–453, 1984]; this usage, however, has not been approved formally by the IMA. For "tetrahedrite-Cd" and "Cd-freibergite" the use of hyphenated names should be avoided, as such usage implies species status even if this is not intended. A general formula in widespread use for the tetrahedrite group is $A_{10}B_2C_4X_{13}$ where B is typically Zn, Fe, Hg, Cd, etc.; the IMA, however, recognizes a nomenclature system corresponding only to the general formula $(A,B)_{12}C_4X_{13}$. Thus, both "tetrahedrite-Cd" and "Cd-freibergite" are cadmian tetrahedrite. **J.L.J.**

Vaughanite*

D.C. Harris, A.C. Roberts (1989) Vaughanite, $TlHgSb_4S_7$, a new mineral from Hemlo, Ontario, Canada. Mineral. Mag., 53, 79–83.

Electron-microprobe analysis gave Tl 18.3, Hg 17.5, Sb 43.4, As 1.1, S 20.5, sum 100.8 wt%, corresponding to $Tl_{0.98}Hg_{0.95}(Sb_{3.90}As_{0.17})_{\Sigma 4.07}S_{7.00}$. The mineral occurs as a 200-μm anhedral grain and as an aggregate 300 by 450 μm. Opaque, metallic luster, black streak, VHN_{25} = 100–115, brittle, no cleavage, even to arcuate fracture, D_{calc} = 5.62 g/cm³ with Z = 2 and the ideal formula $TlHgSb_4S_7$. In reflected light, weakly to moderately bireflectant and weakly pleochroic from slightly greenish gray to a slightly darker bluish gray. Moderately to strongly anisotropic; polarization colors mainly from shades of green, yellow, purplish brown to brown; rare blood-red internal reflection. Reflectance values (WTiC standard) are given in 20-nm steps and at the standard wavelength values in air and oil; R_1 and R_2 values in air and oil, respectively, are: 470 33.5, 39.2, 18.3, 23.6; 546 31.6, 39.3, 16.75, 23.65; 589 30.65, 38.6, 15.7, 22.9; 650 29.4, 36.4, 14.7, 20.7. Color values are given relative to CIE Illuminant A and C. X-ray single-crystal study indicated triclinic symmetry, space group $P1$ or $P\bar{1}$; a = 9.012(3), b = 13.223(3), c = 5.906(2) Å, α = 93.27(3), β = 95.05(4), γ = 109.16(3)° based on refinement from a 114.6-mm Gandolfi pattern (Co radiation) with strongest lines of 4.343 $(30,\bar{1}30)$, $4.204(100,\bar{1}21)$, 3.313(60,130), $2.749(40,02\bar{2},131)$, and $2.315(30,\bar{3}4\bar{1},\bar{2}51,122)$.

The mineral occurs in drill core from the Golden Giant gold ore body at Hemlo, 35 km east of Marathon, near the northeastern shore of Lake Superior, Ontario, in association with pääkkönenite, stibnite, realgar, native arsenic, stibarsen, and chalcostibite. The new name is for David J. Vaughan, Manchester University, England. Type material is in the British Museum (Natural History), London, England, and in the Systematic Reference Series of the National Mineral Collection, Ottawa, Canada. **J.L.J.**

Unnamed Pd-As-Sb-Te minerals

Y. Vuorelainen, R. Törnoos (1986) Platinum-group element alloy spherules from alluvial deposits in Finnish Lapland. Neues Jahrb. Mineral. Mon., 423–432.

In addition to gold nuggets and platinum-group-element (PGE) nuggets, panned heavy-mineral concentrates from alluvium contain numerous PGE grains. Of the approximately 140 000 PGE grains separated (95% of which are sperrylite), one is a Pd-As-Sb spherule about 200 μm in diameter in which the main component is an isomertiete-like phase for which electron-microprobe analysis gave Pd 76.3, Au 0.43, Sb 14.1, As 8.19, Te 0.71, sum 99.73 wt%, corresponding to $(Pd_{11.32}Au_{0.03})_{\Sigma 11.35}(Sb_{1.83}As_{1.73}Te_{0.09})_{\Sigma 3.65}$. In reflected light the phase is pale yellow-white and isotropic. Also abundant is a weakly anisotropic phase, with grayish white to creamy white bireflectance, for which analysis gave Pd 79.5, Au 3.30, Cu 0.25, Sb 1.65, As 6.82, Te 10.3, sum 101.82 wt%, corresponding to $(Pd_{7.84}Au_{0.17}Cu_{0.04})_{\Sigma 8.05}(As_{0.96}Te_{0.85}Sb_{0.14})_{\Sigma 1.95}$, ideally $Pd_8(As,Te)_2$ or Pd_8AsTe. Associated with this phase, and optically indistinguishable from it, is another for which analysis gave Pd 83.2, Au 0.13, Cu 0.20, As 16.9, Te 1.30, sum 101.73 wt%, corresponding to $(Pd_{9.95}Au_{0.01}Cu_{0.04})_{\Sigma 10.00}(As_{2.87}Te_{0.13})_{\Sigma 3.00}$, ideally $Pd_{10}As_3$. Minor inclusions are paler than the above three phases, isotropic, and gave Pd 63.2, Au 28.9, Cu 0.37, As 2.52, Te 7.55, sum 102.54 wt%, corresponding to $(Pd_{6.37}Au_{1.57}Cu_{0.06})_{\Sigma 8.00}(Te_{0.64}As_{0.36})_{\Sigma 1.00}$, simplified as $(Pd,Au)_8(Te,As)$. The spherule is from the Miessijoki River, Härkäselkä area, northern Finnish Lapland. **J.L.J.**

$(Ag,Bi)_2Se$

J. Parnell (1988) Mercury and silver-bismuth selenides at Alva, Scotland. Mineral. Mag., 52, 719–720.

Subrounded inclusions unrelated to fractures occur in pyrobitumen from the former Silver Glen mine at Alva, Central Region, Scotland. The mine was worked for silver and acanthite, but also contained cobalt, copper, lead, and zinc minerals. Six electron-microprobe analyses of the inclusions, which are up to 1 μm in diameter, gave Hg 0.67–3.32, Bi 26.08–34.41, Ag 13.59–21.47, Se 10.05–14.26, sum 55.04–66.81 wt%; totals are low because of overlap with the host pyrobitumen, but the atomic ratio (Hg+Bi+Ag)/Se ranges from 1.83 to 2.15 and averages about 2, suggesting a formula $(Ag,Bi)_2Se$ in which silver-bismuth varies between $Ag_{60}Bi_{40}$ and $Ag_{40}Bi_{60}$. The absence of end-member compositions, and the homogeneity in backscattered images, suggest that a single phase is present. Tiemannite and a mercury selenide also occur as inclusions in the pyrobitumen. **J.L.J.**

Unnamed Ag-Cu and Ag-Sn sulfides

I. Ya. Nekrasov, G.N. Gamyanin, Yu. Ya. Zhdanov, N.V. Leskova, N.A. Goryachev (1988) Mineralogy and geochemistry of silver mineralization in the Verkhoyan-Kolyma fold region. Mineral associations of tin-silver and silver-lead-zinc deposits. Mineralog. Zhurnal, 10(1), 3–14 (in Russian).

Electron microprobe analysis of $AgCu_4S_5$ gave Ag 28.2, Sn 0.6, Cu 41.5, S 29.6, sum 99.9 wt%, corresponding to $Ag_{1.42}Sn_{0.03}Cu_{3.54}S_5$. Analysis of $Ag_2Cu_2S_3$ gave Ag 46.6, As 0.2, Cu 28.4, S 20.4, sum 95.6 wt%, corresponding to $Ag_{2.03}Cu_{2.10}S_{2.99}As_{0.01}$. Analysis of $Ag_2Cu_4S_5$ gave Ag 33.4, Cu 41.5, S 24.7, sum 99.6 wt%, corresponding to $Ag_{2.01}Cu_{4.24}S_5$. The compound $AgCu_8As_4S_{13}$ is reported, though a typographical error makes the reported analysis unreliable. Analysis of Ag_2SnS_3 (average of two, from separate deposits) gave Ag 50.95, Sn 25.9, S 23.25, sum 100.1 wt%, corresponding to $Ag_{1.95}Sn_{0.90}S_3$. Descriptions of these minerals are not given, except to note that the last phase is less than 0.01 mm in size. The minerals occur in tin-silver deposits within mineralized granite- and granodiorite-porphyry, associated with ankerite, galena, freibergite, pyargyrite, miargyrite, boulangerite, acanthite, and canfieldite.

Discussion. The analysis for the $AgCu_4S_5$ phase corresponds to $Ag_{1.42}Cu_{3.54}S_5$. See also *Am. Mineral.,* 75, p. 435, 1990, where other Ag-Cu-S phases are reported, including "$AgCu_4S_5$." **D.A.V.**

Zincian chalcopyrite, zincian high cubanite, $Cu_7Fe_8S_{16}$ and $Cu_5Fe_9S_{14}$

L.M. Lebedev, G.A. Cherkashev, A.I. Tsepin (1988) New data on the mineralogy of sulfide muds from the Atlantis II Deep, Red Sea. Doklady Akad. Nauk SSSR, 301, 1186–1190 (in Russian).

Electron-microprobe analysis of zincian chalcopyrite gave Cu 24.43, Zn 11.63, Fe 30.22, As 1.20, S 36.81, sum 104.29 wt%, corresponding to $(Cu_{0.66}Zn_{0.31})_{\Sigma 0.97}Fe_{0.93}(S_{1.97}As_{0.03})_{\Sigma 2.00}$. Hexagonal grains 10–15 μm across, gray-yellow and isotropic in reflected light.

Analysis of zincian high cubanite (the isometric polymorph of orthorhombic cubanite) gave Cu 24.13, Zn 16.86, Fe 19.33, As 0.05, S 34.24, sum 94.61 wt%, corresponding to $Cu_{1.07}(Fe_{0.97}Zn_{0.72})_{\Sigma 1.69}S_{3.00}$. Grains 15–45 μm, light bronze with rose tint, isotropic, some intergrown crystallographically with chalcopyrite.

Analysis of $Cu_7Fe_8S_{16}$ gave Cu 30.70, Zn 0.01, Fe 30.93, As 1.49, S 35.89, sum 99.02 wt%, corresponding to $Cu_{6.78}Fe_{7.78}(S_{15.72}As_{0.28})_{\Sigma 16.00}$. Grains 20 μm, cream yellow, isotropic.

Analysis of $Cu_5Fe_9S_{14}$ gave Cu 23.65, Fe 39.31, As 1.91, S 34.30, sum 99.17 wt%, corresponding to $Cu_{4.76}Fe_{9.00}$-

$(S_{13.67}As_{0.33})_{\Sigma 14.00}$. Single grain 20 × 15 μm prismatic, light brass yellow, anisotropic brass yellow to blue-gray.

The minerals occur with pyrite, marcasite, sphalerite, chalcopyrite, and cubanite in cored metalliferous sediments from the Red Sea.

Discussion. The zincian high cubanite is isocubanite. **D.A.V.**

$Pb_6Bi_7(Cu,Ag)S_{17}$

Yunqing Yi, Jingui Zhang, Rub Zhang, Chongliang Du (1986) An unnamed sulfosalt mineral—Pb_6Bi_7-$(Cu,Ag)S_{17}$. Kuangwu Xuebao [Acta Mineralogica Sinica], 6(4), 338–343 (in Chinese, English abstract).

The mineral occurs as grains up to 0.72 mm, but mostly 0.03 to 0.4 mm in diameter, in the Laiyun copper-iron deposit, Hebei Province, China, mainly as intergrowths or inclusions in chalcopyrite in association with pyrite, galena, sphalerite, hessite, matildite, native silver, and two other Pb-Bi-Ag-Cu sulfosalts. One of six similar electron-microprobe analyses gave Pb 36.57, Cu 1.74, Ag 1.30, Bi 44.37, S 15.55 sum 99.60 wt%, corresponding to $Pb_{6.12}(Cu_{0.94}Ag_{0.41})Bi_{7.36}S_{16.84}$, idealized as $Pb_6(Cu,Ag)Bi_7S_{17}$. Grains are typically long tabular, also elongate rhombic [diamond-shaped], lead gray color, metallic luster, imperfect cleavage visible in a few grains. Hardness with 20-, 50-, and 100-g loads is 101.24, 119.75, and 158.36 kg/mm², respectively. White with a bluish tint in reflected light, negligible to weak bireflectance, distinct anisotropism with polarization colors bluish gray to light brownish gray. Reflectance percentages for R'_p and R'_g (WTiC standard) are 406 nm 42.2, 44.6; 438 42.3, 45.0; 481 41.5, 44.6; 497 40.9, 43.9; 543 39.7, 42.7; 592 39.1, 41.7; 615 39.2, 42.3; 645 38.4, 41.4; 659 39.0, 42.5; corresponding color values using S_E are Y% 39.54, 42.41, x .327, .328, y .327, .327, λ_d 477, 476, P_e% 2.43, 2.41. Orthorhombic dimensions calculated from the X-ray powder pattern are $a = 8.81$, $b = 13.06$, $c = 7.106$ Å; $D_{calc} = 7.04$ g/cm³ with Z = 1. Strongest lines of the powder pattern (57.3-mm camera, unfiltered Fe radiation) are 3.428(100,012), 3.059(40,140), 2.996(90,041), 2.765(50,202), 2.247 (40,250), 2.137(30,322), 2.023(30,133,161), and 1.895 (30,431). Elemental X-ray maps indicate Pb-Bi and Cu-Ag solid solution is present. The similarity to the composition of Phase x of Karup-Møller (*Can. Mineral.*, 10, 173–190, 1970) and to the aikinite group is noted. **J.L.J.**

Fe chlorides

G. Springer (1989) Chlorine-bearing and other uncommon minerals in the Strathcona Deep Copper Zone, Sudbury District, Ontario. Can. Mineral., 27, 311–313.

Electron-microprobe analysis of fracture-fillings of iron chloride in chalcopyrite and pentlandite gave Fe 53.9, Cl 18.2, OH by difference 27.9, sum 100 wt%, corresponding to $FeCl_{0.53}(OH)_{1.70}$, possibly $Fe_2(OH)_3Cl$. A 114.6-mm Debye-Scherrer powder pattern (Fe radiation) gave strongest lines of 5.62(40), 2.86(60), 2.33(100), 2.12(50), and 1.652 Å (50), similar to those for β-$Mg_2(OH)_3Cl$ in PDF 12–410. Converts to akaganeite on exposure to air.

Acicular inclusions, 10 by 100 μm, in chalcopyrite and cubanite have an electron-microprobe composition of Fe 43.5, Mn 7.14, Cl 32.2, OH by difference 17.2, sum 100 wt%, corresponding to $(Fe_{0.86}Mn_{0.14})Cl(OH)_{1.11}$, possibly (F,Mn)(OH)Cl. **J.L.J.**

New Data

Arsenic bearing-tučekite

A.S. Kasatov, A.N. Plaksenko, L.I. Polezhaeva, S.A. Rezhenova (1988) New data on copper-nickel sulfide ore minerals from the Voronezh crystalline massif. Zapiski Vses. Mineralog. Obshch., 117, 351–359 (in Russian).

Electron-microprobe analysis gave Fe 4.64, 2.78, Ni 48.68, 49.09, Co 0.25, 1.47, S 23.34, 24.04, As 5.02, 3.64, Sb 17.68, 18.14, sum 99.65, 99.18 wt%, corresponding to $(Ni_{9.11}Fe_{0.91}Co_{0.05})_{\Sigma 10.07}(Sb_{1.60}As_{0.74})_{\Sigma 2.34}S_8$ and $(Ni_{8.92}Fe_{0.53}Cp_{0.27})_{\Sigma 9.72}(Sb_{1.59}As_{0.52})_{\Sigma 2.11}S_8$. White with pale yellow tint in reflected light. Forms equant euhedral crystals up to 0.1 mm intergrown with nickeline and gersdorffite in Cu-Ni and Ni-Co sulfide ores hosted by mafic and ultramafic intrusions of the Voronezh massif. Other associated minerals are maucherite, melonite, cobaltite, and auroan silver. **D.A.V.**

Arsenohauchecornite

J.D. Grice, R.B. Ferguson (1989) The crystal structure of arsenohauchecornite. Can. Mineral., 27, 137–142.

Arsenohauchecornite is tetragonal, space group *I4/mmm*, $a = 10.2711(2)$, $c = 10.8070(4)$ Å as determined on holotype material. This superstructure results from the ordering of Bi and As, and the simplest formula is $Ni_{18}Bi_3AsS_{16}$ with Z = 2. Among other members of the hauchecornite group there is no possibility of a supercell in bismutohauchecornite or tučekite [for presently known compositions], but the superstructure is possible for hauchecornite and tellurohauchecornite. **J.L.J.**

Copper-free benjaminite

S.N. Nenasheva, Yu.S. Borodaev, N.N. Mozgova, A.V. Sivtsov, E.G. Ryabeva (1987) Novye Dannye Mineral., 34, 152–156 (in Russian).

Analysis by electron microprobe (average of five) gave Pb 5.78, Ag 15.05, Bi 62.22, S 17.15, sum 100.20 wt%, corresponding to $Ag_{3.0}(Pb_{0.6}Bi_{6.4})_{\Sigma 7.0}S_{11.5}$, ideally $Ag_3(Pb,Bi)_7S_{12}$. Electron diffraction gave $a = 13.2$, $b = 4.0$, $c = 20.2$ Å, $\beta = 102°$. The strongest powder diffraction lines (67 given) are 3.53(60)(204), 3.43(90)($\bar{1}$13), 3.30(80)($\bar{4}02$,401), 3.13(60)($\bar{1}14$), 2.847(100)($\bar{1}15$,311), 2.027(60)(020). The mineral occurs as thin veins in carbonate rock from Colorado (specimen 47755, Fersman Mineralogical Museum, Moscow). White with weak bireflectance in reflected light, strong anisotropy from pale blue to gray. Microhardness 211 kg/mm^2 (average of 10, with 20-g load). Reflectance values are (nm, R_1, R_2): 420 35.7, 44.6; 440 34.9, 43.4; 460 34.1 42.0; 480 33.4, 40.8; 500 32.9, 39.8; 520 32.5, 38.9; 540 32.2, 38.3; 560 32.2 37.6; 580 32.1, 37.1; 600 32.1, 36.6; 620 32.1, 36.3; 640 32.0, 36.0; 660 31.7, 35.8; 680 31.2, 35.8; 700 30.8, 35.8.

Discussion. Synthesis of this phase was reported in *Econ. Geol.,* 83, 405–418, 1988. **D.A.V.**

Cuprotungstite

M.B. Duggan (1988) Cuprotungstite from the Cordillera mine, Crookwell, New South Wales. Australian Mineral., 3, 61–64.

Electron-microprobe analyses of coalesced botryoidal globules up to 0.2 mm in diameter gave a range of CuO 28.16–34.41, PbO 0.10–0.73, WO_3 62.95–67.56 wt%; the averages from two areas have ratios of Cu/W = 1.49 and 1.37. The results are inconsistent with the previously accepted formula $Cu_2(WO_4)\cdot 2H_2O$, but are close to those required for $Cu_3(WO_4)_2(OH)_2$, namely, CuO 33.13, WO_3 64.37 wt%. The X-ray powder-diffraction pattern of the Australian material is in good agreement with those published previously. **J.L.J.**