NEW MINERAL NAMES*

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Calciantantite*


Microprobe analysis gave Ta$_2$O$_5$ 91.09, Nb$_2$O$_5$ 2.84, CaO 6.05, Na$_2$O 0.05, sum 100.03%, corresponding to (Ca$_{0.99}$Na$_{0.01}$) (Ta$_{0.98}$Nb$_{0.02}$)$_4$O$_{11}$, or CaTa$_4$O$_{11}$.

The X-ray pattern (22 lines) (unfiltered Fe radiation) has strongest lines 3.15(7)110, 3.02(10)111, 2.47(6)112, 2.793(7)200, 1.551(7)304, 1.508(10)222. These are very close to the data of Gasperin, Bull. Soc. Franc. Mineral., 86, 115-116 (1963) for synthetic CaTa$_4$O$_{11}$. The mineral is hexagonal, space group P6$_3$ or P6$_3$/m, a = 12.22 Å, c = 7.46 Å, D calc. 7.46.

Calciantantite occurs as square to rectangular to hexagonal crystals 0.03-0.05 mm as inclusions in microcline or as veinlets 0.1-0.3 mm in microlite. Colorless, transparent, luster adamantine, no cleavage. Hardness 970 kg/sq. mm, 40g load; 1200 kg/sq. mm, 20g load. Does not luminesce in UV light, but becomes slightly blue in cathode rays. Anisotropic, reflectances 486 nm, 17.0,16.6; 551 nm, 17.1,16.7; 656 nm, 18.2,18.0%.

The mineral occurs in granitic pegmatites, restricted to a zone of plagioclase with relics of spodumene. Associated minerals include scheelite, apatite, and sometimes wodginite.

The name is for the composition. Type material is at the Mineralogical Museums of the Acad. Sci. USSR, Moscow, and its Kola branch, Apatite. M.F.

Claraite*


The mean of two chemical analyses yielded CuO 52.5, ZnO 8.0, MnO 1.2, CO$_2$ 11.6, H$_2$O 27.0 (by difference), sum = 100.0%. The chemical formula, calculated on the basis of 3 cations, is (Cu$_{2.5}$Zn$_{0.36}$Mn$_{0.69}$)(CO$_3$)$_{1.05}$(OH)$_{0.95}$3.85H$_2$O, or, ideally, (Cu$_2$Zn)$_3$CO$_3$(OH)$_4$4H$_2$O with Z = 66.

Single crystals were not obtained. Claraite has optical dispersion, r = n, which suggests it is triclinic. The strongest lines in the X-ray powder diffraction pattern are: 3.426(10)006, 3.245(4)155, 2.570, 2.239(3)113, 2.006(4)483, 1.781, 2.027, 1.565, 1.326, 2.538, 1.538, 2.070, 4.481, 5.381, 7.071, 2.966(4)483, 7.181, 2.027, 1.565, 1.326, 2.538, 1.538, 2.070. These diffractions are indexed on a hexagonal pseudocell with a = 26.22 and c = 21.56 Å.

Claraite forms blue spherules with a perfect {1010} cleavage.

*C. Minerals marked with asterisks were approved before publication by the Commission on New Minerals and Mineral Names of the International Mineralogical Association.

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Cuzticite*. Eztlite*


The new minerals were found together in oxidized ores at the Bambolla mine, Moctezuma, Sonora. Both occur with various iron oxides, emmonsite, schmitterite, and kuranakhite. Analysis of cucyticite by Marjorie Duggan yielded Fe$_2$O$_3$ 41.1, Mn$_2$O$_3$ 0.42, TeO$_2$H$_2$O 13.6, sum 100.2% *no valence determination, corresponding closely to the formula Fe$_2$TeO$_6$H$_2$O. Cuzticite is yellowish, H = 3, D = 3, occurring in crutches with a scaly structure. The X-ray powder pattern was indexed on a hexagonal cell, a = 5.045, c = 10.63 Å. Strongest lines of the powder pattern are 3.246(10)103, 2.518(7)110, 4.871(4)003, 2.239(3)113 and 1.564(3)123.

Analysis of eztlite gave Fe$_2$O$_3$ 24.3, PbO 25.5, TeO$_2$ 26.8, TeO$_6$ 8.6, H$_2$O 12.3, sum 97.5% leading to the formula Fe$_2$Pb$_2$(TeO$_6$)$_2$H$_2$O$_{10}$8H$_2$O. Eztlite is blood red, as paper-thin sparking crusts, H = 3, D = 4.5. A possible cell found by the Ito method is monoclinic a = 6.58, b = 9.68, c = 20.52 Å, β = 90.15°. Strongest lines of the powder pattern are 3.426(10)006, 3.289(10)200, 4.037(9)104, 3.239(9)210. Eztlite grains are deep cloudy orange in thin section and are not pleochroic. Estimated indices are n$_p$ = 2.14, n$_g$ = 2.15 (white light). A good cleavage, probably (001), is always length slow with extinction (to γ) of 3°, consistent with monoclinic (or lower) symmetry.

The names are derived from the Nahua language; cucyticite from cuciz, something red, and eztlite from eztl meaning blood. Type material is at the British Museum (N.H.) and the University of Arizona. A.P.

Jeanbandyite*


Microprobe analysis of six crystals yielded MgO 0.61 (0.24-1.27), SiO$_2$ 0.79 (0.55-0.94), MnO 5.82 (4.04-7.54), Fe$_2$O$_3$ 22.07 (19.22-24.71), SnO$_2$ 49.61 (48.30-51.59), H$_2$O 21.10 (18.14-22.44) by difference, sum = 100.00%. Fe was assigned as Fe$_3^+$ based on microchemical tests. This analysis is calculated on the basis of 6 (OH) as: (Fe$_{2.75}$Mg$_{0.25}$)Sn$_{0.5}$Sb$_{0.5}$Si$_{0.5}$OH$_6$ with excess charge balance assumed to be due to a small portion of the Fe
being present as Fe$^{2+}$. The idealized formula is Fe$_2$S$_{14}$SiO$_{20}$OH$_6$ or (Fe$^{3+}$,Sn$^{4+}$)(SiO$_3$)$_3$(OH)$_6$, with $3x + 4y = 1$.

X-ray study indicated jeanbandyite is tetragonal, $P4_2/n$ (pseudo-cubic) with $a = c = 7.648\AA$, $Z = 4$, $D$ calc. = 3.81, $D$ meas. = 3.81. The strongest lines in the powder pattern (22 given) are: 4.41(20)(l l r), 3.83(100)(200), 2.7 r(70)(220), 1.9 l 2(20x400), 3.81. The strongest lines in the X-ray powder pattern (22 given) are: $D$ calc. = 9.948. The strongest lines (17 given) are 3.33 (10, but 3.33); 2.7 h, 0.72; 2.64(41) (204), 2.00(26)(322,314), 1.82(20)(234,411).

The mineral occurs as 0.2 mm pseudo-octahedral aggregates of jeanbandyite crystals epitaxially grown on wickmanite. Forms present are [111], [001], and [100]. Jeanbandyite is brown-orange; streak pale brown yellow; hardness 3/4; cleavage is fair, parallel to {001} and {100}. Optically uniaxial negative, $\epsilon = 1.833(5)$ and $\omega = 1.837(5)$. Jeanbandyite occurs on museum specimens from level 295 of the Contacto vein. Líllagüa, Bolivia and other levels of the mine. Associated minerals include fluorapatite, stannite, pyrite, jamesonite, cassiterite, and crandallite, among others. Jeanbandyite is a member of the stottite group and is related to wickmanite and schoenfliesite.

The name is for Mrs. Jean Bandy of Wickenburg, Arizona, wife of Mark Chance Bandy who collected the material. Type material is preserved at the Smithsonian Institution, Harvard University, and the Los Angeles County Museum of Natural History. P.J.D.

**Meta-uranocircite II**

F. Khosravan-Sazedi (1982) The crystal structure of meta-uranocircite II, Ba(UO$_2$)$_2$(PO$_4$)$_2$6H$_2$O. Tschermskas Min. Petr. Mitt., 29, 193-204.

X-ray study of 0.6 mm synthetic crystals corresponding to the meta-uranocircite II of Walenta (J. Geol. Landesamt Baden-Württemberg, 6, 113-135 (1964) showed it to be monoclinic, $P112_1/a$, with $a = 9.789$, $b = 9.882$, $c = 16.868\AA$, $\gamma = 89.95^\circ$, $\alpha = 4$, for the formula given above. The studied single crystals are yellow, rectangular, biaxial negative, with $2V = 28-40^\circ$. Partial chemical analysis yielded Ba = 14.7% (microprobe), $H_2O = 11\%$, compared with the theoretical composition of the hexahydrate which requires Ba 14.08, $H_2O 11.07\%$.

Discussion: Because this phase is monoclinic, it warrants a full description of natural material and IMA consideration of the species and the name. P.J.D.

**Steacyite**


The mineral described by Perrault and Richard (1973) as ekanite is redefined as steacyite, Th(Na,Ca)$_2$(K$_2$,Ca)$_6$Si$_8$O$_{20}$OH$_6$. Chemical analyses yield: SiO$_2$ 52.18, 57.92; ThO$_2$, 26.74, 28.03; UO$_2$, 2.47,--; Fe$_2$O$_3$, 0.18,--; MnO, 0.07; CaO, 6.00, 4.92; MnO, 1.64; MgO, 0.17; Na$_2$O, 3.53, 3.36; K$_2$O, 4.10, 3.42; H$_2$O, 4.40;--. Sums 99.60, 100.00%. X-ray study indicated steacyite is tetragonal; space group $P4_2/mmc$, $a = 7.58(1), c = 14.77(2)\AA$. The strongest lines in the X-ray powder pattern are: 5.30(45)(102), 3.38(100)(202), 3.32(55)(104,211), 2.64(41)(204), 2.00(26)(322,314), 1.82(20)(234,411).

Physical description (from Perrault and Richard, 1973) shows that steacyite occurs as dark brown crystals composed of [100] and [001] in a three-dimensional cruciform habit. The hardness is 5; no cleavage observed; $D$ calc. 3.32, $D$ meas. 2.95 (porous material); radioactive. Steacyite is uniaxial, negative, with $\epsilon = 1.572$, $\omega = 1.573$. Steacyite occurs with nendakhevicheite, analcime, and acmite in pegmatite veins in the nepheline syenite of Mt. St. Hilaire, Quebec, Canada. The name is in honor of Mr. Harold R. Steacy, curator of the National Mineral Collection housed at the Geological Survey of Canada. Type material is deposited at the l’Ecole Polytechnique de Montreal and cotype material at the Geological Survey of Canada. The crystal structure of steacyite was published by Richard and Perrault (Acta Cryst., B28, 1994-1999 (1972)). P.J.D.

**Sopcheite**


Microprobe analyses of 2 samples gave Ag 32.62, 33.56; Pd 25.26, 23.92; Fe 0.80, 2.13; Cu 0.09,--; Ni 0.03,--; Te 41.32, 42.13; Bi 0.17,--; As none, none; sum 100.29, 101.74%, corresponding to the formulas (Ag$_9$Fe$_{16}$Cu$_{3}$O$_{10}$N$i_{0.0}$Pd$_{2.96}$ (Te$_{0.04}$Bi$_{0.0}$) and (Ag$_9$Fe$_{23}$)(Pd$_{2.74}$Fe$_{0.25}$Te$_{4.02}$). A mineral of this composition was reported from Sudbury by Cabri and Laflamme, Econ. Geol., 71, no. 7 (1976), but X-ray data were not obtainable on it.

The X-ray powder pattern was indexed by Akira Kato on an orthorhombic cell, with $a = 9.645$, $b = 7.906$, $c = 11.040\AA$, $D$ calc. 9.948. The strongest lines (17 given) are 3.33 (10, but 3.33); 2.7 h, 0.72; 2.56(5)(023), 2.56(6)(031), 2.30 (5b)(410,132), 1.805(7b)(241,106).

In reflected light gray with brown tint. Anisotropic, with color effects yellowish-red to bluish. Reflectances are given at 16 wave lengths: 460 nm, 43.3; 540, 43.0; 580, 44.4; 660, 47.3%. Internal reflections absent. Hardness, 10 g load, 134-209, av. 170 ± 35 kg/sq. mm.

The mineral forms xenomorphic veins in chalcopyrite of the Sopcha massif, Monchegorsk pluton. The mineral is in grains not exceeding 0.02 mm. It is intergrown with merenskyite and is associated with chalcopyrite and mackinawite.

The name is for the locality. Type material is at the Mineralogical Museum, Kola Branch, Acad. Sci. USSR, Apatite. M. F.

**Vuorelainenite**


Microprobe analyses of crystals from Outokumpu, Finland, and Sättra, Sweden, respectively, yielded: TiO$_2$, 0.6; V$_2$O$_5$, 63.3, 58.3; Cr$_2$O$_3$, 4.7, 5.8; Al$_2$O$_3$, 1.4; MnO$_2$, 22.0, 27.1; FeO, 7.6, 5.8; ZnO [2.4], 0.5, sum = 100.0, 99.5 percent. The idealized end member is Mn$_2$V$_2$O$_5$ but many grains (9 analyses given) have substantial Cr$_2$O$_3$ (range 4.7-30.6%) in partial solid solution to manganochrome. Vuorelainenite is the vanadium analogue of manganochrome and the manganese analogue of coulsonite.
X-ray study of fragments yielded powder diffraction data which are indexed on a cubic cell with \(a = 8.48(5)\,\text{Å}\). The strongest lines are: 2.985(4)(022), 2.559(10)(113), 2.118(3)(004), 1.633(8)(115,333), 1.502(8)(044). Vuorelainite occurs as euhedral, 5–80 \(\mu\text{m}\) grains which are opaque and have a brownish gray reflectance color. Hardness (VHN) is 900; D calc. = 4.64. Reflectances in air are (nm, %): 470, 15.7; 546, 15.4; 589, 15.6; 650, 16.2.

Vuorelainite is found at the contacts between pyrrhotite and gangue and also between pyrrhotite, rutile and pyrophyllite at the Sättra Mine, in Central Sweden. It was also described previously from Outokumpu, Finland by Long et al., 1963 (Am. Mineral., 48,33-41). A second occurrence of schreyerite is at the Sättra mine and analyses are provided.

Vuorelainite is named in honor of Yrjo Vuorelainen, former exploration geologist with the Outokumpu Company and discoverer of the Outokumpu material. Type material is preserved (#153A4) at the Free University in Amsterdam. P.J.D.

**Unnamed Ag–Au–Hg alloy**


Electron microprobe analyses of 10 spots in one crystal yielded Ag 61.51, Au 24.78, Hg 14.47, sum = 100.76%, which yields Ag₉₂₄Au₁₆₄Hg₈₉₄. This phase was found at contacts between galena and owyheeite as grains about 200 \(\mu\text{m}\) with high reflectivity and polishing hardness greater than galena. Grain size limitations precluded X-ray study. The samples are from Rajpura-Dariba, Rajasthan, India. P.J.D.

**Unnamed HgNH₂NO₃**


Crystals of mercury amidonitrate, HgNH₂NO₃, were identified on the basis of wet chemical analysis which yielded 72 weight percent Hg and the presence of N in two valence states, together with a characteristic X-ray powder diffraction pattern. The strongest lines in the diffraction pattern, which unambiguously identify the compound, are: 2.953(100)(222), 7.244(80)(011), 5.92(80)(111), 3.414(60)(122), 2.741(60)(123), 2.562(60)(004), 2.487(60)(223,014). The crystals were reportedly found in the 600 level of an unnamed mine in Pitkin County, Colorado, where they were associated with silver and a likasite-like mineral. The crystals occur as light yellowish gray euhedra with {111} and {110} as the only forms. There is no apparent cleavage, but some crystals exhibit a radial texture. The density is 5.03 meas. and 5.15 calc.

The crystals may have formed from the decomposition or reaction of mining explosives, in particular cellulose nitrate, [C₆H₇O₅(NO₂)]₃, used in dynamite, and mercury fulminate, Hg(CNO)₂, used in older dynamite caps.

A crystal structure analysis of these crystals by Randall et al., (1982) Journal of Solid State Chemistry, 42, 221–226, confirmed that this compound is cubic, space group P₄₁₃₂ or P₄₃₂ with \(a = 10.254\,\text{Å}\). The compound was not named because of the likely unnatural occurrence. P.J.D.

**e-MnO₂**


The natural analogue of e-MnO₂, manufactured for the battery industry by electrolytic deposition from aqueous Mn(II) salts, has been identified by electron microscopy in the Akhtenski limonite deposits of the southern Urals. The e-MnO₂ occurs with psilomelane, together with cryptomelane, nusite, pyrolusite or polymorphs of todorokite, as aggregates of small platey particles dark gray or black in color. Electron microdiffraction patterns yielded the hexagonal unit cell data \(a = 2.85, c = 4.48\,\text{Å}\); \(P6_3/mmc (C66/mmc)\). X-ray energy dispersive analyses showed the natural e-MnO₂ to be pure MnO₂ (c.f. pyrolusite and ramsdelrite), while X-ray photo-electron measurements demonstrated the presence of Mn²⁺ only and the absence of H₂O and OH⁻ ions. The electron diffraction pattern of e-MnO₂ more closely resembles that of ferroxhyte (e-FeOOH) than does the vernadite (the impure \(\alpha\)-MnO₂ polymorph) diffraction pattern. It is suggested that e-MnO₂ is an extremely disordered variety of natural e-MnO₂. The formation of e-MnO₂ in the Akhtenski deposit is associated with the supergene alteration of Mn-bearing siderite in the absence of manganese-oxidizing microorganisms, the presence of which favor the formation of vernadite. The authors also report e-MnO₂ occurring with nusite in the deposits of Urbanus, Eizengans, East Germany and in the Gumeshevskii deposit in the Urals. R. G. B.

**Unnamed Pb–Ti–Fe–Re-oxide**


The mean of 4 microprobe analyses employing different standards yielded: TiO₂ 58.09, MnO 0.89, Fe₂O₃ 21.95, SrO 4.39, Y₂O₃ 2.49, ReO₂ 2.63, PbO 9.84, sum = 100.28%. This yields the formula, calculated on the basis of 38 oxygens, \((\text{Pb}_{0.87}\text{Sr}_{0.81}\text{Y}_{0.43})\Sigma_{1.33} (\text{Ti}_{14.43} \text{Fe}_{8.95}\text{Re}_{0.23}\Sigma_{0.23} \text{Mn}_{2.3})\Sigma_{0.94}{\text{O}_{38}}\) with \(Z = 3\). X-ray study indicated this mineral is trigonal, space group \(R3\), with \(a = 10.44\) and \(c = 20.82\,\text{Å}\) on a hexagonal cell. It forms hexagonal crystals, flattened on {001}, up to 1.0 mm in size, opaque, black, with metallic luster. D meas. = 5.0, calc. = 5.02. Hardness (Vickers) is 1100–1185 VHN. In plane-polarized reflected light, the mineral is cream-white to white; under crossed nichols it is isotropic to weakly anisotropic with brown to blue-gray reflectance colors. Uncalibrated reflectivity values range from 17.5–19.7%.

This species is considered to be a member of the senaite-crichtonite group or in solid solution between these minerals and magnetoplumbite. The substantial difference is in the presence of two large cations; senaite group minerals have only one. P.J.D.

**Unnamed Pb–Mo sulfide**


Microprobe analysis of a 3 \(\mu\text{m}\) grain in ulmannite yielded S 25.3, Mn 0.1, Fe 3.7, Pb 37.1, Bi 6.3, W 6.2, sum = 94.5%. The
optical properties are similar to those of molybdenite. The data suggest a structure analogous to those of castaingite, CuS - 2MoS₂, femolite, FeS - 5MoS₂ and several other phases. P. J. D.

**NEW DATA**

**Ekanite**


Nonmetamict ekanite from the Tombstone Mountains, Yukon Territory, Canada, was studied by X-ray methods and found to be tetragonal, space group 1422 with a : 7.483(3) and c : 14.893(6)Å. The X-ray powder pattern correlates with that of thermally recrystallized type ekanite. The compounds formerly referred to as “ekanite”, but with space group P4/mmc, are now considered different from ekanite and are discussed in the description of steacyite (Can. Mineral., 20, 59-63.). P. J. D.

**Galkhaite**


Microprobe analyses of 47 crystals showed the presence of essential Cs and leads to the formula (Hg, Cu, Zn, Ti, Fe, Cr)₄(Cs, Ti, Zn)(As, Sb)₅S₁₂ in which the Cs content varies from 0.33 to 0.98 per 12 S. The formula is verified by a crystal structure determination. Galkhaite is isometric, space group I4₃m with c = 10.365(3)Å. Thallium is present in all analyses and is distributed over two sites. The studied material (21 analyses given) is from the Getchell Mine, Humboldt County, Nevada. The paper discusses other occurrences, analyses, and type material. P. J. D.

**Killinite**


Optical examination of material from the type locality shows it to be biaxial negative, with indices of refraction a = 1.545, b = 1.561, γ = 1.565; 2V low to medium; optic plane parallel to (010); X normal to (001). X-ray study shows killinite to be a 1M dioctahedral mica and the calculation of three analyses (not given) confirms these observations and indicates a close relationship to hydromuscovite-illite. Killinite is stated to be a variety of muscovite.

**Loveringite**


**Mohsite**

Analysis of neotype mohsite shows that it contains Pb and Sr, but negligible Ca, indicating that it is not the Ca-rich member of the crichtonite group, but an intermediate member of the sene–crichtonite series. P. J. D.

**Mooreite**


Microprobe analysis of mooreite from Sterling Hill, New Jersey, yielded MgO 26.75, ZnO 23.99, MnO 9.76, SO₃ 11.60, H₂O 27.90 (by difference), sum = 100.00%. This yields the new chemical formula M₈g₁₀Zn₄₀Mn₁₁(MO₄)(SO₄)₂(OH)₂₆ · H₂O with Z = 2.

Crystallographic study indicates that mooreite is monoclinic, P2₁/a with a = 11.147(3), b = 20.350(6), c = 8.202(3)Å, β = 92.69(4)°. The crystal structure was refined to R = 0.060. P. J. D.

**Pitticite, Yukonite**


**Pitticite**

Microprobe analyses of 7 pitticites from various localities indicate that it is a gel-like mineral of widely varying composition with no apparent stoichiometry. Previously reported minor
amounts of Si, Ca, P and Al are constituents of pitticites but are non-essential. Pittcite is retained as a generic name for amorphous, gel-like, ferric iron arsenate minerals of varying chemical composition.

**Yukonite**

Yukonite is reported from a second occurrence at the Sterling Hill Mine, Ogdensburg, Sussex County, New Jersey, where it occurs as gel-like, waxy aggregates of brownish color and as dark red, remnant pseudomorphs after koettigite-parasymphite, associated with ogdensburgite. Microprobe analyses (2) yielded: SiO$_2$ 0.6, 2.2; Al$_2$O$_3$ 0.8, 1.0; Fe$_2$O$_3$ 28.8, 28.8; MgO 0.4, 0.6; CaO 10.4, 10.4; MnO 2.1, 2.2; ZnO 3.3, 3.8; As$_2$O$_3$ 32.1, 39.1; SO$_2$ 0.2, 0.2; H$_2$O (by difference) 19.7, 12.5; sum = 100.0, 100.0 percent. Pittcite has a weak X-ray powder diffraction pattern with strongest lines 3.06(8), 3.25(10), 2.79(8), 2.52(3), 2.33(3), 2.23(3), 1.63(4b). P. J. D.

**BOOK REVIEWS**


As noted in the Preface by L. G. Berry, this book is divided into two parts corresponding to a two course sequence offered to undergraduates at the University of Oxford. Part I (Chapters 1-7) deals with the more classical aspects of crystallography whereas Part II (Chapters 8-18) considers the crystallographic applications of diffraction. Each chapter includes a problem set for which answers are provided.

Many basic concepts are developed rapidly, though clearly, in the first four chapters (p. 1-36). Starting with the analogy of stacking bricks to the formation of a euhedral crystal, the concepts of axes, axial ratios, interaxial angles and interfacial angles are introduced. Building on this analogy, the concepts of translational symmetry—repetitive patterns and simple lattices—and the unit cell are developed. Next, symmetry operations (reflection, proper rotation and roto-inversion) and their relationship to crystals and unit cells are explained and combinations of symmetry operations are used to define the seven crystal systems. In Chapter 4 the crystallographic axes are defined and nomenclature for crystal faces (Miller indices) and zone axes are covered.

The remainder of Part I consists of stereographic projection (Chapter 5), an introduction to crystal forms (Chapter 6) and a development of the 32 crystal classes (Chapter 7). This is more or less standard fare; however, the author does note his preference for several specific form names (ditetragonal sphenoid rather than tetragonal scalenohedron, for example). Hermann–Mauguin notation is used exclusively in Part I in preference to the less popular Schoenflies notation which is not mentioned. Part I concludes with a brief appendix which points out the similar properties within each of the three sets of roto-inversion axes: $2n+1$, $2(2n+1)$ and $4n$.

Perhaps the most remarkable aspect of this book is the breadth of topics covered in Part II. Although coverage of each topic is by necessity brief, the author has concisely treated each topic with detail and rigor sufficient to provide a firm foundation from which the student may choose to build. This part opens with a discussion of the properties of X-rays and an introduction to diffraction (Bragg’s Law). Chapters on the geometry, applications and indexing procedures involving both powder techniques (Debye-Scherrer, Gandolfi, Guinier) and selected single crystal techniques (rotation, oscillation) are included.

A brief but excellent treatment of X-ray reflection intensities is given in Chapter 10. This includes development of the structure factor ($F_{\text{hkl}}$) and the various correction factors (temperature factor, multiplicity, Lorentz, polarization, etc.). Chapter 15 gives an overview of structure determination using rutile as an example. Other topics include electron diffraction (Chapter 16) and crystallographic aspects of twinning, polytypism and crystal defects (Chapter 17).

The development of the 14 Bravais lattices (Chapter 11) and space group concepts including screw axes and glide planes (Chapter 14), are also reserved for Part II. By covering these topics after the student has been exposed to X-ray diffraction, the author is able to stress the application of systematic extinctions to lattice and space group determinations.

In summary, this book is a well organized, concise and clearly written introduction to both “classical” and “modern” crystallography. It should serve as an excellent text for any two course introductory sequence in crystallography similar to the Oxford University format.

M. W. Phillips
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This volume maintains the high standard set by Volume 1 (Northwest Europe) in providing excellent descriptions in English for many mineral deposits for which little or no information has been available in other than the national language. It includes both metallic and non-metallic deposits (fuels are not covered). The volume has a large page size (11 1/2 × 8 inches), enabling the adequate reproduction of maps and diagrams. This book is