

PRESENTATION OF PAPERS

TEKTITES*

VIRGIL E. BARNES

Tektites are etched pebbles of acidic glass mostly black and lustrous in reflected light and bottle-green, smoky, or brown in transmitted light. They are found in siliceous gravels of Miocene to Pleistocene age. Tektites are found in Czechoslovakia, Australia, Indo-China, Philippine Islands, Dutch East Indies, Siam, China, Ivory Coast, and possibly in South America. In North America, tektites were recognized first in 1936 (*Univ. Texas Pub.* 3945, 477-582, 1940).

Tektites have an excellent flow structure outlined by adjacent schlieren of different chemical compositions. These heterogeneous glasses etch differentially producing the weathered surface distinctive of tektites. In obsidian the flow structure is outlined by crystallites and vesicles and not by difference in composition of the glass; consequently etched obsidian is free of fine flow lines and resembles tektites only in the coarser etch markings.

Tektites definitely are not of an igneous origin. This fact led indirectly to the prevalent assumption that they are meteorites. Chemically tektites correspond closely to clastic sedimentary rocks ranging from shale to sandstone in composition. The writer identified small included glass particles in tektites as lechatelierite. These lechatelierite particles must have been originally grains of quartz or other non-hydrous silica. These grains were melted during the process of tektite formation. Their presence probably excludes a meteoritic origin.

Lightning may produce tektites. Glass formed by power line short circuits through soil contains lechatelierite particles. This glass very closely resembles tektite glass and when artificially etched develops a typical tektite-like surface. Observations are needed on the effect of lightning upon clastic sedimentary rocks and their soils.

* Presented through the Geological Society of America.

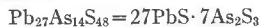
THE STRUCTURAL CELL OF JORDANITE

L. G. BERRY

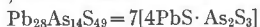
Single crystal *x*-ray photographs on a cleavage fragment (sp. gr. 6.44) from Binn, Switzerland, give a simple monoclinic lattice in which the cell with the shortest edges has the dimensions:

$$a_0 \ 8.89 \pm 0.03, \ b_0 \ 31.65 \pm 0.03, \ c_0 \ 8.40 \pm 0.02; \ \beta \ 118^\circ 21'$$

Space group $C_{2h}^2-P2_1/m$ or $C_2^2-P2_1$. In this lattice the structural cell given by Richmond has the edges $a' = [\frac{1}{2}01]$, $b' = [010]$, $c' = [\frac{1}{2}00]$. This cell is a half unit cell and is therefore inadmissible. The new cell content is:



with the calculated sp. gr. 6.49, rather than:



This cell content, which is not divisible by two, reconciles the several half-cell contents obtained by Richmond (1938) and by Fisher (1940).

ORE-BEARING PIPES IN THE TARRYALL RANGE, COLORADO

ROBERT D. BUTLER AND L. B. RILEY

A number of small pipe-like deposits in red granite have been opened by prospectors on the western slope of the Tarryall Range. Their diameters range from five to eight feet and an ideal cross-section is circular, although it may be oval, semicircular, or rectangular. Metallic minerals present are: earthy hematite, pyrite, sphalerite, galena, chalcopyrite.

and molybdenite. Gangue minerals are quartz, muscovite, and fluorite. Concentric alteration zones surrounding the pipes consist of bleached and silicified granite. Although pneumatolysis may have played a role in the formation of the pipes, an explanation involving only hydrothermal deposition is also tenable. The deposits resemble in most respects certain tin-bearing pipes in South Africa.

INTERFERENCE FIGURES IN CONVERGENT LIGHT

J. D. H. DONNAY

The usefulness of plans and elevations in the study of geometrical crystallography has been excellently demonstrated by A. F. Rogers (*American Mineral*, **8**, 19-31, 1923). The same methods of descriptive geometry can be applied with profit in optical crystallography, especially to the study of interference figures.

It is also proposed to use two meridional cross-sections, at right angles to each other and at 45° to the cross-hairs, through the surface of retardation. The *retardation curves* so obtained are helpful in explaining the motion of lines produced by the quartz wedge. (In the case of a biaxial crystal, sliced normal to the acute bisectrix, for instance, the *retardation curves* are drawn for the plane of the optic axes and for the plane of the acute bisectrix and the optic normal.)

REPRESENTATIVES OF THE BROOKITE SPACE-GROUP

J. D. H. DONNAY

The brookite space-group is D_{2h}^{15} ($Pcab$ or $Pbca$ according to crystal orientation). The morphological expression of this space-group is seen in the following characters: (1) No *double zone* is present. (2) All three central zones, $[(hkk)]$, $[(lkl)]$, $[(hhl)]$, are *simple zones*, intersecting in a common dominant face, to be taken as (111). (3) All three axial zones, $[(0kl)]$, $[(h0l)]$, $[(hk0)]$, are *simple zones* with dominant face "shifted" from unit position toward a pinakoid; the shifts are cyclic, either toward c , a , b , with dominant faces (012), (201), (120), respectively (orientation $Pcab$), or toward b , c , a with dominant faces (021) (102), (210), respectively (orientation $Pbca$).

These criteria need not all be present (as they are in *brookite**) to permit space-group identification. Thus, if only two central zones are developed, both simple, with a common dominant, the lattice is determined as primitive (examples: *scorodite*, *reddintite*). The unit-face (111) may be inferred from the dominant faces in the axial zones, using the rule that the dominant face in an axial zone must be either at unit distance, or at half the unit, or at twice the unit (examples: *hambergite*,* *sulfamic acid**). Very scant morphological information may suffice to point out the space-group (examples: *strengite*, *sulfamic acid*,* *oxalic acid**), especially if use be made of the generalization of the Law of Bravais.

* For the species marked with an asterisk, the space-group has been determined by x -rays; it agrees with the morphological result.

THE PROBLEM OF THE VARIATION IN CINNABAR COLORATION

ROBERT M. DREYER

Cinnabar varies in color from orange red to dark purple. This variation in cinnabar coloration is independent of (1) the size of the cinnabar aggregates, (2) variations in crystal structure, (3) any spectrographically detectable quantitative or qualitative differences in elemental concentrations, and (4) the total impurity concentrated in solid solution in the cinnabar. The cause of the variation in cinnabar coloration therefore is, as yet, indeterminate.

PETROGRAPHIC STUDY OF THE NEW MONT LAURIER-SENNETERRE HIGHWAY
(Preliminary Report)

CARL FAESSLER

The new highway crosses over 100 miles of unexplored territory, from Mont Laurier (82 miles due north of Ottawa) northwest to the Abitibi mining district. It connects two formations of doubtful relative age: the Grenville limestone, in the south, and the Keewatin gold-bearing greenstones (altered lavas), in the north.

(1) For the first 20 miles, the highway shows the continuation of the typical Grenville crystalline limestone and garnetiferous paragneiss, which underlies the Mont Laurier area. (2) Then the limestone disappears completely, while another gneiss is encountered characterized as follows: absence of garnets, well-marked foliation, and evidence of granitization. This gneiss was followed by the author for 60 miles; Aubert de la Rüe* traced it 25 miles farther, clear to the Temiskaming sedimentary schists and graywackes, which border on the Keewatin of the Abitibi region. (3) Basic dikes cut through all rocks along the highway; more numerous toward the south, they trend south-east, toward a large anorthosite body (Morin series), of which they are considered offshoots.

The new gneiss reported may prove to be a migmatite, resulting from the alteration of a more argillaceous facies of the Grenville, with igneous additions. A source of magmatic liquid was available for the granitization, as proved by the presence nearby of acidic stocks (Pine Hill, Guenette, Labelle, Rolland), known to be differentiates of the main Morin intrusive.

* Private communication.

CONSTITUTION AND POLYMORPHISM OF THE PYROAURITE AND SJOGRENITE GROUPS

CLIFFORD FRONDEL

The carbonate-hydroxides, pyroaurite, stichtite and hydrotalcite are shown by x -ray study to be isostructural. The dimorphism suggested by Aminoff and Broomé in 1930 for pyroaurite is definitely proven, and is shown to extend to stichtite and to hydrotalcite. Rhombohedral and hexagonal groups are recognized which each conform to the formula $R_2Mg_6(OH)_{16}CO_3 \cdot 4H_2O$, where $R = Fe, Al$ or Cr . Data for the six species involved, three here being described as new, follow:

Rhombohedral or Pyroaurite Group

	Cell Contents (Hexagonal unit)	a_0	c_0	ω	ϵ	Proven Localities
Pyroaurite	$3(Fe_2Mg_6(OH)_{16}CO_3 \cdot 4H_2O)$	6.19	46.54	1.564	1.543	8
Stichtite	$3(Cr_2Mg_6(OH)_{16}CO_3 \cdot 4H_2O)$	6.18	46.38	1.545	1.518	3
Hydrotalcite	$3(Al_2Mg_6(OH)_{16}CO_3 \cdot 4H_2O)$	6.13	46.15	1.511	1.495	4

Hexagonal or Sjogrenite Group (New)

Sjogrenite	$Fe_2Mg_6(OH)_{16}CO_3 \cdot 4H_2O$	6.20	15.57	1.573	1.550	1
Barbertonite	$Cr_2Mg_6(OH)_{16}CO_3 \cdot 4H_2O$	6.17	15.52	1.557	1.529	3
Manasseite	$Al_2Mg_6(OH)_{16}CO_3 \cdot 4H_2O$	6.12	15.34	1.524	1.510	3

The structural cells found by single-crystal and powder x -ray methods have the cited values of a_0 and c_0 halved for the rhombohedral series and a_0 halved for the hexagonal series. The dimensions here given are required for rational cell contents. Dimensionally $c_{0(rh.)} : c_{0(hex.)} = 3:1$, and the halved value of a_0 for both series (*ca.* 3.1) is nearly identical with $a_0 = 3.12$ of brucite.

The minerals are lamellar on {0001}, often with a partially or completely random stacking of micro-crystals about [0001]. The rhombohedral and hexagonal analogues very commonly occur intimately admixed, and in part are mutually oriented in parallel position. Brugnatellite, $\text{FeMg}_6(\text{OH})_{16}\text{CO}_3 \cdot 4\text{H}_2\text{O}$, is distinct from the minerals at hand, and the identity of houghite with hydrotalcite (actually manasseite) is confirmed. New localities for pyroaurite include Val Malenco and Val Ramazzo, Italy, and the first American occurrence, at Blue Mont, Maryland.

WHITLOCKITE: A NEW CALCIUM PHOSPHATE, $\text{Ca}_3(\text{PO}_4)_2$

CLIFFORD FRONDEL

Whitlockite is anhydrous tricalcium phosphate, $\text{Ca}_3(\text{PO}_4)_2$, with Ca substituted for Mg (Mg:Ca=1:13) and Fe (Fe:Ca=1:17). Rhombohedral, probably scalenohedral— $\bar{3}2/m$, with $a:c=1:3.547$. Habit rhombohedral {01 $\bar{1}$ 2}, with minor {0001}, {10 $\bar{1}$ 4}, {11 $\bar{2}$ 0}. Structure cell: $a_0=10.25 \pm 0.03$, $c_0=36.9 \pm 0.2$; $a_0:c_0=1:3.600$; $a_{rh}=13.65$, $\alpha=44^\circ 6\frac{1}{2}'$. Cell contents in the rhombohedral unit $\text{Ca}_{21}\text{P}_{14}\text{O}_{56}$. Space group (Weissenberg method) probably $R\bar{3}c$. No cleavage. Hardness 5. Specific gravity 3.12 (obsvd.), 3.19 (calc.). Colorless and transparent. Uniaxial—(neg.), with $\omega=1.629 \pm 0.002$, $\epsilon=1.626 \pm 0.002$ (for Na). The mineral is structurally distinct from graffonite and apatite.

Whitlockite occurs in the Palermo granite pegmatite near North Groton, New Hampshire, as a late hydrothermal mineral in the following association and sequence: whitlockite and quartz—rhodochrosite—apatite—zeolite. The mineral is named after Herbert P. Whitlock, a former president and secretary of this society and at present Curator of Minerals and Gems in the American Museum of Natural History.

SPATIAL DISTRIBUTION OF MINOR ELEMENTS IN SINGLE-CRYSTALS

C. FRONDEL, W. H. NEWHOUSE, R. F. JARRELL

It is shown spectrographically that the minor foreign elements present in single-crystals of galena, calcite and other species are not uniformly dispersed throughout the host crystal, but generally are distributed in adjoining or alternating regions of greater and lesser concentration. These concentration-regions are related to the growth surfaces of the host crystal, and fall into two types: (a) Pyramidal regions subjacent to particular faces on crystals bounded by several crystallographically different forms. The concentration differences arise in the unequal adsorptive capacity of the different forms on the growing crystal for the foreign elements in question. (b) Alternating bands parallel to the growth surfaces without any or marked selectivity as to the crystallographic kind of surface.

The spectrographic work on galena revealed that both Ag and Si are relatively concentrated in the growth regions subjacent to the octahedral faces of cubo-octahedrons. Other minor elements, including Cu, Fe, Al, Cr, Ba, Sr, Ca and Mg, show significant quantitative variations within galena single-crystals but apparently without any special relation to the morphology. Staining of sectioned and polished single-crystals develops a complex internal structure outlined by relatively reactive, dark stained, growth bands and segments. Correlated spectrographic examination indicates that the dark stained regions are enriched in Ag. The growth history of crystals from many different localities shows a general similarity: an early stage of octahedral, Ag-poor, galena followed by the appearance and gradual increase of cube faces with the concomitant deposition of Ag-rich galena in bands or segments especially upon the octahedral faces.

Spectrographic examination of calcite single-crystals further illustrates the features of distribution found with galena. Significant compositional variations are found between successive growth zones in habit-invariant single crystals and between overgrown crystals of different habit. No special connection, however, could be traced between the morphology,

color or growth history of the crystals and any of the foreign elements tested (Fe, Cu, Mn, Al, Sr, Mg).

The factors (temperature, concentration, pH, rate of growth, morphology, etc.) which determine the partition coefficient between the minor element content of the mother solution and the growing host crystal and their bearing on the minerogenetic interpretation of spectrographic and other analyses are discussed.

A STUDY OF THE BORDER ROCKS OF A GRANITE BATHOLITH, RED LAKE, ONTARIO

WILFRID K. GUMMER

Granites intrusive into volcanic rocks in the Red Lake area are commonly surrounded by a gradational zone of more basic rocks. The granite in such areas is rich in inclusions of gabbroic and dioritic composition. Inclusions are both rounded and angular and vary greatly in size; the more altered ones are the more faded. A detailed investigation of such an occurrence in the Mackenzie Island area was carried out and forms the basis of this paper.

The study of the petrography of the main granite of the Mackenzie batholith, of the volcanic rocks and of the intermediate or border rocks, has brought out several points which bear upon the origin of the border rocks. Most important is the formation in the granite and the border rocks of late potash minerals.

Rosival analyses were made on a suite of rocks passing from the main granite through the border facies into andesitic rock. Mineral and oxide components when plotted against silica yield curves indicating that the border rocks are truly intermediate between the granite and volcanic rock, in composition. The conclusion is reached that the border rocks are the result of contamination of the granite magma by the introduction of numerous inclusions of the country rock. Textures and mineralogical assemblages indicate reaction between the liquid and solid phases.

THE NATURE OF ARITE

RALPH J. HOLMES

Uncertainty has long existed concerning the validity of the mineral arite or the natural occurrence of intermediate members of the system Niccolite, NiAs—Breithauptite, NiSb. Intermediate members of this isomorphous series can be produced synthetically. Further x -ray study of synthetic intermediate members of this series and x -ray and microscopic examination of natural material from several occurrences including the type locality at Ar in the Pyrenees indicates that a mineral intermediate between niccolite and breithauptite exists in nature. It is believed that this material may be properly designated as arite.

AN OCCURRENCE OF PINITE ROCK

PAUL F. KERR AND WILLIAM W. LOMERSON

A large mass of sericite, samples of which invert to mullite on calcination, occurs in the Humboldt Range, Nevada. Associated with the sericite are alumino-silicates, which it is believed are responsible for the unusual thermal behavior. The mass is thought to have been originally a fine tuff or ash which has been altered by hydrothermal metamorphism to a rock consisting in large part of finely crystalline potash mica. The name pinite is suggested as a rock term to be applied to such a mass. The principal associated rock units of the area are rhyolitic volcanics of the Koipato formation overlain by the Middle and Upper Triassic Star Peak limestones. The pinitized zone lies near the crest of a northward trending ridge on the south side of South American Canyon just below the contact between the volcanics and the limestones in a member of the series similar to the Rochester trachyte of Knopf.

Topographic and geologic maps of the deposit have been prepared and laboratory examination has involved microscopic, α -ray, and chemical study.

A NEW HYDROUS TUNGSTEN OXIDE FROM ORURO, BOLIVIA

PAUL F. KERR AND FORD YOUNG

The oxidation of ferberite from this locality has resulted in the formation of two hydrous oxides of tungsten. Previous descriptions of the deposit have mentioned the occurrence of tungstite, $\text{WO}_3 \cdot \text{H}_2\text{O}$. Recent studies indicate that a second oxide is present. X-ray and optical examinations show that this material differs in structure from the recorded descriptions of tungstite and chemical investigation indicates that it contains two molecules of water. Since this mineral appears to be an intermediate product in the alteration of ferberite to tungstite and since it resembles tungstite in many of its physical properties, the name *hydrotungstite* is suggested.

AN INTERESTING DISTORTED DIAMOND CRYSTAL

EDWARD H. KRAUS AND CHESTER B. SLAWSON

A 5.1 carat industrial stone which is a distorted octahedron with "prismatic" development is described. The orientation and distribution of the natural etch figures on the various faces are discussed.

ROLE OF HARDNESS AND STRUCTURE IN THE SHAPING AND USE OF INDUSTRIAL DIAMONDS

EDWARD H. KRAUS AND CHESTER B. SLAWSON

The study of variation of hardness in the diamond in relation to the crystal structure has been extended to the shaping and use of industrial stones. The shaping of stones for diamond-set tools, as developed through experience, reveals that the hardest directions, or "ribs," are utilized. In the case of wire-drawing dies, present knowledge of the variation of hardness and of the structure of the diamond is not sufficiently drawn upon. Suggestions are made for the improvement of the drilling and shaping processes and for the better orientation of the stones which should tend to increase the usefulness of the dies. These suggestions involve a more scientific utilization of the hardness and structural properties of the diamond, that is, of its "structural strength."

THE MOON AS A SOURCE OF TEKTITES*

H. H. NININGER

Assuming that the lunar "craters" are of meteoritic origin, this paper suggests that tektites have had their origin in connection with the impacts which formed those craters.

Note is taken of the fact that meteorites would encounter the surface of the moon at their full interplanetary velocities. The absence of a lunar atmosphere would allow ejectamenta to leave their points of origin at velocities above the minimum velocity of escape from the satellite whose gravitational power is only one-sixth that of the earth. Some of the fragments so ejected reach the earth as tektites.

Possibly some of the recognized varieties of meteorites also have this origin.

* Presented through the Geological Society of America.

THE UNIT CELL AND SPACE GROUP OF GILLESPIE

A. PABST

Gillespie, $\text{FeO} \cdot \text{BaO} \cdot 4\text{SiO}_2$, has been found in only two localities, in an erratic boulder in Alaska and in Mariposa County, California, with sanbornite, $\text{BaO} \cdot 2\text{SiO}_2$, and barium

feldspar. Gillespite from both localities was examined by *x*-ray powder and single crystal methods. Identical patterns are obtainable from material of both sources.

The cell dimensions are: a_0 7.50 ± 0.01 Å and $c_0 = 16.05 \pm 0.01$ Å. If the cell content is $4\text{FeBaSi}_4\text{O}_{10}$, this corresponds to a density of 3.405, slightly higher than the directly determined value, 3.33.

Laue patterns confirm the tetragonal character reported by Schaller and indicate the Laue symmetry $D_{4h} - 4/mmm$. All patterns show $hk0$ with $h+k$ even only, hhl and $h0l$ with l even only. This indicates the space group $D_{4h}^8 - P4/ncc$.

Consideration of $hk0$ "reflections" shows that Fe and Ba are located on the 4 and $\bar{4}$ axes. Extreme weakness of odd layer lines on *c*-axis rotation patterns indicates a pseudo-cell having half the height of the true cell. Tetragonal Si_4O_{10} sheets parallel to (001) are the characteristic features of the structure. These sheets differ somewhat from any hitherto described but it is not yet possible to assign atomic positions with certainty.

As reported by Schaller, gillespite may be leached by hydrochloric acid with removal of iron and barium. There remain soft, pearly, flakes of hydrated silica retaining the shape and cleavage of the original particles. They remain uniaxial negative, but have much lower indices of refraction and the density is reduced to 2.0 or less. Laue, rotation and powder photographs of this material fail to show any diffraction effects.

THE IGNEOUS AND METAMORPHIC ROCKS OF THE RUMNEY QUADRANGLE, NEW HAMPSHIRE

LINCOLN R. PAGE

The igneous rocks of the Rumney quadrangle, located in west-central New Hampshire, belong to three magma series. The concordant Owls Head-Baker Pond complex, a member of the Oliverian magma series, apparently differentiated in situ. Regional deformation, probably late Devonian in age, granulated and crushed these rocks and developed an obscure secondary foliation across the primary igneous structure. The Bethlehem granodiorite gneiss and probably the Kinsman quartz monzonite, members of the New Hampshire magma series, were intruded during the late stages of this deformation. The youngest member of this series, the Concord granite, was emplaced by stoping and is clearly post-tectonic. The Three Ponds gabbro distorts the surrounding granodiorite gneiss suggesting that it made its chamber by distension of its walls rather than by the process of cauldron subsidence which is characteristic of other igneous masses of the White Mountain magma series. Pegmatite, aplite, and late lamprophyre and quartz porphyry dikes cut the older plutons and enclosing schists.

Two grades of metamorphic rocks are recognized in the area. Intermediate grade schists of the Ammonoosuc volcanics (Ordovician), Clough conglomerate and Fitch formation (Silurian) and Littleton formation (Devonian) crop out in the northwest part of the area. High grade sillimanite-mica and quartz-mica schists of the Littleton formation are typical of the central and eastern parts. At the contact of the Bethlehem granodiorite gneiss, garnet-diopside contact rock has developed in the Fitch formation. Retrograde metamorphism of the sillimanite schists was noted adjacent to the Concord granite.

JOSEITE FROM BRITISH COLUMBIA

M. A. PEACOCK

Clean fragments (sp. gr. 8.10 ± 0.05) from several specimens of a mineral resembling tetradymite, from Glacier Gulch, Hudson Bay Mountain, near Smithers, B. C., give identical *x*-ray powder spectra. The pattern is identical with that given by joseite (sp. gr. 8.03) from San José, Minas Geraes, Brazil (type from the collection of A. Damour), "grünlingite" (sp. gr. 8.15) from Carrock Fells, Cumberland (type locality), and "oruetite"

(sp. gr. 8.11) from Serranía de Ronda, Malaga, Spain (type locality). The pattern is different from those given by tetradymite— $\text{Bi}_2\text{Te}_2\text{S}$ and tellurbismuth— Bi_2Te_3 . Since the specimen from Brazil represents the material originally described by Damour (1845) and named josite by Kenngott (1853), the materials from British Columbia, Cumberland and Spain are referred to this species.

Single crystal x -ray photographs on the Canadian material give a rhombohedral lattice:

$$a_{rh} 13.45, \alpha 18^\circ 08' \text{ (from } a_0 4.24 \pm 0.01, c_0 39.69 \pm 0.06)$$

with no systematic omission of rhombohedral indices. With these elements the powder spectrum has been completely indexed. The existing relevant chemical analyses vary widely. The ideal content of the unit cell is probably $\text{Bi}_4(\text{Te}, \text{S})_8$, which includes the composition Bi_4TeS_2 recently given by Warren and Davis for a mineral from Glacier Gulch resembling josite.

IGNEOUS ROCKS OF THE COPPLE CROWN-MERRYMEETING LAKE AREA OF NEW HAMPSHIRE

ALONZO QUINN

The Copple Crown-Merrymeeting Lake area, like several other small areas in central New Hampshire, has considerable variety of rocks grouped together. Rock types here include, from oldest to youngest, felsite, diorite-gabbro, diorite, granite, quartz porphyry, and several dike rocks. Petrographically, they are related to the rocks of the White Mountain magma series of possible Carboniferous age. The variety of rock types indicates considerable differentiation of this magma.

The felsite may be extrusive, but the other rocks are intrusive. The intrusions cut sharply across the foliation and the contacts of the older rocks and are mainly in round or oval bodies. These relationships indicate a method of intrusion similar to that in nearby areas where ring-dikes and plug-like intrusions were formed.

THE GNOMONIC PROJECTION IN THE HEXAGONAL SYSTEM

LEWIS S. RAMSDELL

The implications of the G_1 and G_2 settings, used for gnomonic projections of hexagonal crystals, are made clear by constructing the unit cells from which the two projections are derived. This construction is carried out by means of the reciprocal lattice. It is shown that the G_1 setting is based on the simple structural cell, with the correct axial ratio c , whereas the G_2 setting is based on a triple cell, with an axial ratio $c_2 = c/\sqrt{3}$. This is contrary to the usage of Goldschmidt in his *Kristallformen der Mineralien*. The G_2 setting is commonly used for rhombohedral crystals, but the triple cell on which it is based has no direct relationship to the actual rhombohedral cell.

LAMPROBOLITE, A NEW NAME FOR BASALTIC HORNBLLENDE

AUSTIN F. ROGERS

The amphibole with subadamantine luster, high indices of refraction, strong to extreme birefringence, marked pleochroism, small extinction angle, and high ferric iron content has been regarded as a distinctive mineral under the names basaltic hornblende and oxyhornblende.

The former name is objectionable since it is a double name and since it is found in many types of extrusive rocks other than basalts.

Both names are objectionable in that they imply that the mineral in question is a variety of hornblende, but I would define hornblende so as to exclude basaltic hornblende and then "hornblende" may replace "common hornblende."

For the reasons stated, I propose the name *lamprobolite* (lamp-ro-bol'it) from the

Greek, *lampros*, shining or lustrous, and *bolis*, a missile, for this mineral. The new name seems to be an appropriate one since the best specimens available are the black (deep brown on thin edges), euhedral to subhedral crystals with brilliant cleavage surfaces from the basaltic tuffs (volcanic ejectamenta) of Lukow, Bohemia.

NEPHRITE JADE FROM MONTEREY COUNTY, CALIFORNIA*

AUSTIN F. ROGERS

Nephrite jade of fair quality suitable for cutting and polishing has recently been discovered in Monterey County, California.

The color of the nephrite varies from light greenish gray to black; the best material is dark American green (Ridgway). It is identified as nephrite by optical tests, specific gravity, and a quantitative chemical analysis. The nephrite occurs in rolled pebbles and boulders of various sizes with a weight range from less than a gram up to a maximum of about 55 kg.

It is also found in place in serpentine in a region of typical Franciscan rocks.

The locality is along the Coast in the southern part of Monterey County, somewhere between Point Sur and the Salmon Creek Ranger Station and in the extreme western part of the Santa Lucia Range.

* Presented through the Geological Society of America.

PETROLOGY OF THE PAWTUCKAWAY MOUNTAINS, NEW HAMPSHIRE*

CHALMER J. ROY AND JACOB FREEDMAN

The Pawtuckaway Mountains are located in Deerfield and Nottingham townships, Rockingham County, in southeastern New Hampshire. Rocks belonging to the White Mountain magma series, which is Mississippian in age, were intruded into the Winnepeaukee gneiss of the New Hampshire magma series, which is late Devonian in age. The intrusion formed as a circular mass of gabbro, diabase and diorite, which forced its way into the gneiss and bent foliation planes in the gneiss from the regional, northeast trend into partial parallelism with the igneous body. A foliation in the diabase and in one phase of the diorite body strikes parallel to the contact and dips inward. Injected into the more mafic rocks are bodies of fine-grained monzonite, of which the two largest bodies form a broken circle open to the southwest. A coarse-grained monzonite was later injected as the core of this arc, and a similar arc of coarse-grained monzonite surrounds the gabbro-diorite body on three sides and is also open to the southwest.

The Pawtuckaway Mountain rocks all formed from one parent magma which differentiated at depth. A porphyritic gabbro solidified against the gneiss walls as intruded magma differentiated in place into four types of diorite. The biotite, hornblende, pyroxene, and feldspar in the monzonites differ only slightly from those in the diorites.

Aplitic, monzonitic, and lamprophyric dikes cut all the major rock types. The aplitic dikes cut the lamprophyric dikes, but the relationship of monzonitic dikes to the other dikes is unknown.

* Presented through the Geological Society of America.

OLIVINE AND PYROXENE OF MT. TRIPYRAMID, NEW HAMPSHIRE*

ALTHEA PAGE SMITH

Olivine gabbro on Mt. Tripynamid provides one field test for Bowen and Schairer's experimental findings on incongruent relations in the system MgO-FeO-SiO₂. The gabbro belongs to the post-lower Devonian White Mountain magma series of alkaline affinities. In the gabbro, the FeO/MgO ratio of olivine (58/42) and pyroxene (44/56) CaMgSi₂O₆-54%, CaFeSi₂O₆-27%, MgSiO₃-12%, FeSiO₃-7% is so high that no incongruent reaction

by pyroxene on olivine would be expected. Inclusion of smooth, euhedral olivine grains in pyroxene confirms the postulate and indicates that crystallization proceeded with equilibrium. The expected absence of the silica enrichment which in other rocks is produced by incongruent reaction and fractional crystallization, is verified by the low quartz content of the intermediate rocks of the series.

Because of the crystallization with equilibrium, the olivine has a higher FeO/MgO ratio than the pyroxene, rather than either the lower ratio of many reaction-embayed olivines from other regions, or the equal ratio assumed in calculation of the norm.

* Presented through the Geological Society of America.

PERTHITE FROM CENTRAL NEW HAMPSHIRE*

ALTHEA PAGE SMITH

In the Mt. Chocorua area the post-lower Devonian intrusions of the White Mountain magma series contain four types of perthite. In type 1 albite-oligoclase is irregularly intergrown with alkali feldspar. Neither mineral follows planes of weakness in the other. One subtype forms borders on sodic oligoclase, the latter merging through increasingly sodic zones with the similarly oriented albite-oligoclase of the intergrowth. The latter is complex, containing patches of microperthite of type 2 within much of its homogeneous orthoclase. Proportions of albite-oligoclase and alkali feldspar vary. The latter continued crystallizing after completion of the intergrowth. Perthite of type 1 is believed to be of simultaneous, but not eutectic, crystallization.

Microperthite of type 2 forms borders on, and patches within feldspar intergrowth of type 1. Type 2 consists of albite in narrow, even-spaced, parallel plane lamellae in orthoclase. The regularity of intergrowth suggests exsolution.

In type 3, microperthite of type 2 contains albite dikelets which follow and widen planes of exsolution and, rarely, planes of cleavage. Part of this albite occupied open spaces and part replaced orthoclase.

In perthite of type 4, microcline is partially replaced by irregular blebs of albite. Rare euhedral grains of the latter suggest that this perthitization occurred as early as the deuteric, or interstitial, stage.

* Presented through the Geological Society of America.

THE SPINEL GROUP

A. N. WINCHELL

Graphs have been prepared showing the variations in composition and physical properties in some parts of the spinel group, so far as possible with available data. This leads to the conclusion that there are at least two parts of the group between which there is not continuous gradation in composition so far as now known.

OPTICAL PROPERTIES OF CLEAVAGE FLAKES

E. D. TAYLOR

The optical properties of cleavage flakes are good determinative characters. The *orientation of the cleavage plane* is a constant, and can be easily determined on inspection in convergent light. Obliquities of optical directions to the plane of cleavage can be measured by means of a calibrated eye-piece micrometer. Measuring the retardation Δ of a plate (Berek compensator) and determining its thickness (calibrated focusing motion of the microscope) are simple operations. The *birefringence of the cleavage*, $n' - n'' = \Delta/t$, is thus easily obtained, with an error of only one, or less, in the third decimal place. The *refractive indices of the cleavage*, n' and n'' , can be measured, by the usual immersion method, without any rolling

of grains. Pleochroic colors displayed by a cleavage plate are most easily ascertained.

Although the study of cleavage flakes has long been used, especially by French mineralogists, as a check in mineral identification, only one attempt was made (by Buttgenbach) to systematize the presentation of data relative to cleavage (for about 100 minerals). New determinative tables, based on optical properties of cleavages, for all cleavable rock-forming minerals (about 200), are presented in the hope that they may be useful to supplement current identification methods. In addition, stereographic projections, on the plane of the cleavage considered, are presented in all cases (about 100) where the normal to the cleavage is inclined more than 5° to any principal optical direction.

HYDROTHERMAL DEPOSITS IN THE SPECIMEN MOUNTAIN VOLCANICS, COLORADO

ERNEST E. WAHLSTROM

Thrust fault zones in the Specimen Mountain volcanics have provided channelways along which post-volcanic hydrothermal solutions moved. Deposition in the faults and replacement of adjacent favorable layers in pyroclastics and flows has produced extensive deposits of jasper and common opal. Associated with the deposits are numerous geodes containing onyx, agate, and platy calcite.

The mineralizing solutions probably came from depth and are related to the magma which was the source of the Specimen Mountain volcanics. However, considerable time elapsed between the extrusion of the volcanics and the deposition from solutions.

THE CHROME-MICAS

D. R. E. WHITMORE

The literature of the chrome-micas is reviewed. Methods of separation of pure chrome-mica are outlined, and a new analysis of fuchsite from Pointe du Bois, Manitoba, is presented with eleven analyses compiled from the literature, from widely separated localities. The analyses are discussed from a structural point of view after the manner of Stevens, and the relationship of fuchsite to mariposite, and mariposite to alurgite is examined.

Results of an investigation of the paragenetical relationships of chrome-mica are set forth. A review of the literature and study of thin and polished sections suggest a close genetic relationship of chrome-mica to ferruginous carbonate, and also to gold in gold bearing quartz veins. Spectroscopic study suggests that traces of chromium are present in the vein minerals of the Hollinger mine.

New optical data on both mariposite and fuchsite specimens are presented.

UNIT CELL OF DICKINSONITE

C. W. WOLFE

A Weissenberg study has been made of analyzed dickinsonite from Poland, Maine. Rotation, 0-layer-line, and 1-layer-line pictures were about [010], and rotation and 0-layer-line pictures were taken about [001]. The results obtained are: $a_0 = 16.70 \text{ \AA}$, $b_0 = 9.95 \text{ \AA}$, $c_0 = 24.69 \text{ \AA}$, $\beta = 104^\circ 41'$; $a_0 : b_0 : c_0 = 1.695 : 1 : 2.507$; space group is $C_{2h}^6 - C_{2/c}$. Probable contents of unit cell: $4[\text{H}_2\text{Na}_6\text{Mn}_{14}(\text{PO}_4)_{12} \cdot \text{H}_2\text{O}]$. Calculated specific gravity = 3.438. Measured specific gravity: Poland—3.38, Branchville—3.41.

On two Poland crystals the following forms were found in good position as referred to the structural lattice: $c\{001\}$, $m\{110\}$, $d\{102\}$, $l\{302\}$, $j\{401\}$, $D\{\bar{1}02\}$, $E\{\bar{3}04\}$, $F\{\bar{1}01\}$, $H\{\bar{2}01\}$, $P\{\bar{1}11\}$. The structural elements do not correspond with those of Brush and Dana, derived from Branchville material. The transformation formula, Brush and Dana to structure, is: $\bar{1}00/010/102$. This is but approximate, since Brush and Dana considered their morphological studies to be inadequate. That the Poland dickinsonite is the same as the Branchville material is indicated by the analyses and by identical powder pictures obtained in this study.

Among those who were present at the scientific sessions were:

Alexander, W. H., Jr.	Goldich, S. S.	Pabst, A.
Ames, John	Goodfriend, M.	Petermann, J. E.
Anderson, G. H.	Goodrich, Dale	Peterson, N. P.
Argabrite, W. G.	Goodspeed, G. E.	Phillips, D. D.
	Gwynne, C. S.	Pondram, W. L.
Barnes, V. E.		Poor, R. H.
Barnes, Mrs. V. E.	Hall, R. B.	
Bissell, H. J.	Harrison, J. A.	Rogers, A. F.
Blank, H. R.	Heinrich, E. W.	Ross, Reuben J., Jr.
Bruce, E. L.	Holzwasser, F.	Roy, C. J.
Brundidge, B. D.	Hunt, W. F.	Runner, J. J.
Buddington, A. F.		Runner, Jessie R.
	Ingerson, Earl	
Cardwell, D. H.		Shand, S. J.
Clabaugh, E.	Kerr, P. F.	Shayes, F. P.
Crowell, J. C.	Kraus, E. H.	Shonberg, H. H.
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Dalgarn, J. C.	Larsen, E. S., Jr.	Slawson, C. B.
Dalleson, Sam	Lemon, E.	Sleight, V. G.
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Dreyer, R. M.	McConnell, Duncan	Thomas, E. T.
	Meltzes, L. H.	Timm, Bert
Foshag, W. F.	Merritt, C. A.	
Fountain, H. C.	Murdoch, Joseph	Weidman, Samuel
		Willems, H. W. V.
Giles, A. W.	Needham, C. E.	Winchell, A. N.
Glass, J. J.	Nininger, H. H.	Winchell, Horace
		Wright, F. E.