

PRESIDENTIAL ADDRESS AND PRESENTATION OF PAPERS

MENTE ET MALLEO ATQUE CATINO

BY NORMAN L. BOWEN

A consideration of the three-fold character of investigation in mineral science and a plea for better coordination of effort in these activities. (Complete address in this issue.)

VOLCANOES OF THE MEDICINE LAKE HIGHLAND, CALIFORNIA*

BY CHARLES A. ANDERSON

The Medicine Lake Highland in northeastern California rises above the western margin of the Modoc lava plateau. The highland is a broad Pleistocene shield volcano of platy andesite, 20 miles in diameter, perched upon Pliocene plateau basalt (Warner basalt). Following the formation of the shield, a caldera, 4 to 6 miles across, formed by collapse. Renewed activity took place along the margins of the caldera, more viscous lava poured into it until the marginal volcanoes rose above the caldera walls and discharged lava down the outer slopes of the shield. An elliptical rampart of later volcanoes now marks the location of the original caldera walls. Recent volcanic activity is indicated by scattered parasitic basaltic cinder cones and the outpouring of basaltic lava from the outer flanks of the highland. The well-known Modoc lava beds include the northern cover of Recent basalt. Recent dacite and rhyolite flows have been erupted from the central portion of the highland; the rhyolitic flows were preceded by explosive eruptions which have showered the region with pumiceous ejecta. The last of these eruptions probably took place not more than 500 years ago.

* Presented under the auspices of the Geological Society of America.

FLUORITE DEPOSITS IN WESTMORELAND,
NEW HAMPSHIRE*

BY H. M. BANNERMAN AND R. E. STOIBER

The fluorite deposits in Westmoreland, New Hampshire, occur as fissure fillings in a series of tension fractures in granite gneiss. The veins being worked are from three to five feet in width, and some of them have been traced laterally five to six hundred feet. They dip approximately 70 degrees while the foliation of the gneiss in which they lie is generally quite flat. The veins are banded, crustified, and replete with open cavities. The fluorite is accompanied mainly by quartz, but considerable quantities of barite, calcite, dolomite, kaolin and sericite are present, and streaks of such sulphides as chalcopyrite, pyrite, sphalerite, and a little galena appear throughout the deposits, together with some finely crystallized malachite and smithsonite. The veins have suffered no appreciable deformation since their deposition. Data at hand suggest that they are of post-Paleozoic age, possibly Triassic.

* Presented under the auspices of the Society of Economic Geologists.

SURFACE REFLECTION AREAS IN WEISSENBERG PHOTOGRAPHS

BY M. J. BUERGER

A distinction is made between transmitted and surface x -ray reflections. The distribution of these two kinds of reflections on Weissenberg photographs is systematically derived for any crystal habit, for zero- and n -layer photographs, and for both normal beam and equi-inclination technique. Surface reflection areas have two important applications: (1) They are of aid in allowing for absorption in Weissenberg photographs. If the distribution

of faces on the crystal is known, then the Weissenberg projection can be blocked out into contribution areas. (2) They provide an explanation for the distribution of background in Weissenberg photographs. Intense background patterns can be purposely developed under appropriate conditions and they are characteristic of the crystal form development. It is suggested that background patterns may be of aid in the surface goniometry of crystals having faces too small or too imperfectly developed for optical goniometric investigation.

**SILICIFICATION TYPES ALONG THE HANGING
WALL OF THE LONDON FAULT,
MOSQUITO RANGE, COLORADO***

BY ROBERT D. BUTLER†

Dolomitic formations of Devonian and Mississippian age crop out on the east or hanging-wall side of the London fault south of the Alma district. The dolomites contain replacement ore bodies of barite-carbonate-pyrite-sphalerite-galena-tennantite, some of which are associated with vein quartz. The deposits occur within a rudely semicircular area truncated at the west by the London fault. A period of silicification of the dolomites preceded the formation of the ore minerals. Two types of replacement silica have been observed: (1) idiomorphic, in which the silica initially took the form of euhedral quartz crystals which became cemented by additional silica into an aggregate resembling a sandy limestone; (2) allotriomorphic, in which the structure ranges from a felted to a granular aggregate. A lateral zoning pattern of the ores has been recognized by utilizing serial variations of mineralogic and textural features, but the group of deposits as a whole are classed as "cooler" mesothermal. The silicification textures show areal variations which occupy positions in harmony with the zonal concept. Distribution of ore is not related to amount of silicification, but valuable ore bodies have been found only within a small area where certain silicified facies are present. The early epigenetic materials, silica, as well as the late copper, lead, and silver minerals, are areally related to the position of the London fault and by their variations indicate the locus of thermal and solution supply.

* Published by permission of the Director of the Geological Survey, United States Department of Interior.

† Presented under the auspices of the Society of Economic Geologists.

‡ Introduced by W. H. Newhouse.

**MINERAL DEPOSITS OF THE NORTHEASTERN PART OF
THE HUMBOLDT RANGE, NEVADA**

BY EUGENE N. CAMERON

The principal mineral deposits of the northeastern Humboldt Range are found in folded and faulted acid volcanics, overlying Triassic limestones, and Jura-Cretaceous (?) granite porphyry. The deposits are closely associated with major fault zones which trend roughly parallel to the folds. Among the exploited types, two are important: silver-bearing veins and stockworks, and quartz-stibnite veins.

Hypogene sulphides of the silver-bearing veins and stockworks include pyrite, sphalerite, freibergite, silver-bearing galena, and jamesonite, with minor amounts of arsenopyrite, stibnite, chalcopyrite, bournonite, and pyrrargyrite. The principal gangue mineral is quartz. Calcite, barite, albite, apatite, scheelite, and epidote occur in places in the veins. Covellite, sooty argentite, and native silver appear to be supergene. The commercial value of the silver deposits is believed to be due to supergene enrichment.

Quartz-stibnite veins in limestone and rhyolite have been worked at several localities. The veins are of the replacement-fissure type and consist of stibnite replacing and filling fractures in massive quartz. Oxidation of a vein in Jackson Canyon yielded workable bodies of intermingled stibiconite and quartz.

Wall rocks of the deposits have been altered by silicification and sericitization, accompanied locally by development of pyrite, arsenopyrite, talc, chlorite, calcite, dolomite, albite, and apatite.

Structural features indicate a close relationship between mineralization and the Jura-Cretaceous (?) deformation which produced the major fault zones. The variety of forms exhibited by the deposits is believed to reflect the structural behavior of different kinds of wall rocks during deformation.

REGIONAL GRANITIZATION AND METAMORPHISM IN NEW ENGLAND†

BY I. W. CURRIER

Origin of granites at Chelmsford-Westford, Massachusetts, and Milford, New Hampshire, is attributed to general intensive granitization of schists by dominantly hydromagmatic processes. Simple injection gneisses are negligible. Metasomatism has developed alkalic feldspars, quartz, and muscovite in definite paragenetic relations, displacing original bases (magnesium, iron, calcium, titanium). The probability is suggested that, driven into upper zones, these bases formed hornblende, garnet, biotite, epidote, and chlorite schists of common regional aspects. Petrographic and field studies of metamorphic rocks in east-central Vermont and adjacent areas to the east and southeast lead to the hypothesis that this process is a fundamental cause of the regional metamorphism. A broad zonal arrangement of granitic and metamorphic rocks is indicated, as follows: (1) a coastal belt of coarse intrusive granite stocks (Maine coast, Rockport, and Quincy, Massachusetts, et al.); (2) a broad belt to the west and northwest composed largely of replacement granites (Chelmsford, Milford); (3) another belt farther to the west and northwest, of dominantly pegmatitic aspects with highly mineralized schists, that contains commercial deposits of mica, garnet, feldspar, and fluorspar; and (4) still farther west and northwest, in western New Hampshire and eastern Vermont a belt of schists showing incipient granitization.

This hypothesis bespeaks a general batholithic invasion of eastern New England. The deeper, dominantly intrusive zone is exposed along the coast, but underlies the entire province east of the Green Mountains, though at progressively greater depths toward the west. The overlying zones of granitization and metamorphism are thus exposed in successive belts as outlined.

* In part Geological Society project 49-33, and in part Geological Survey project on study of New England commercial granites.

† Presented under the auspices of the Geological Society of America.

THE SIGNIFICANCE OF CRYSTAL HABIT

BY J. D. H. DONNAY

Crystal habit depends on two kinds of factors: external (conditions of crystallization, presence of foreign ions, etc.) and internal (symmetry of the motif, structure, etc.). External factors may, for individual crystals, modify the normal habit imposed by internal factors for the species as a whole. A statistical survey of isolated habits usually leads to the recognition of the normal habit.

A study of crystal habit implies consideration of the following features: (1) presence or absence of forms (combinations); (2) relative importance (size, frequency, persistence) of forms; (3) relative importance of zones; (4) rules of zonal development (extinction criteria); (5) relative size of the various faces of any one form (malformation).

All these features but one (malformation) are satisfactorily explained by the influence

of the space-group symmetry: (1) The habit may be predicted if the space-group (or even the diffraction symbol) is known. (2) The "morphological aspect" (or the diffraction symbol) and hence the space-group or possible space-groups may be predicted from the dominant habit features.

One reservation must be made. In many simple ionic structures, chemically different ions may act alike on the morphological development; in such cases, the crystal habit is the expression of the symmetry of ionic positions, regardless of their nature.

STEREOSCOPIC CRYSTAL DRAWING

BY D. JEROME FISHER

Various projections are in use to facilitate the interpretation of crystal solids in terms of the measured angles between their faces or other significant planes, and their edges or analogous directions. The objective of crystal drawing is to furnish a strongly suggestive picture of a plane-faced solid. Of necessity angles will thus be distorted; the essential thing is that they appear to be correct. Various methods of attaining this end to greater or less degree are available; some choice should be made which combines to a maximum extent ease of construction with excellence of result. Stereoscopic pairs drawn in parallel perspective from a gnomonic base are easily prepared and are quite effective, mainly because the depth element in the projection of crystals need never be very large. Anaglyphs are more valuable because of their remarkable plastic properties. They are easily projected on a screen, but require special colored inks when drawn on paper.

U-STAGE AXIAL ANGLE APPARATUS

BY D. JEROME FISHER

This apparatus replaces the inner plate of the regular universal stage. In addition is needed a special condensing lens which substitutes for the whole microscope substage. The new plate supports a small rotatable lower segment, the upper part of which is faced with polaroid. The inverted thin section is clamped to this plate by a ring into which may be placed either a rotatable upper segment or plate fitted with polaroid. Provision is made for synchronous rotation of the two polaroids. This apparatus permits the direct measurement of both $2V$ and $2E$ for not too-small crystals, though abnormally thick sections are needed for minerals of low birefringence. The apparatus should be of value in determining minerals by the $V-E$ - $Beta$ relationship, in obtaining the value of $Beta$ for high-index biaxial minerals, in petrofabric analysis of reasonably coarse-grained rocks not only in terms of the c -axis direction of quartz but of both optic axes in feldspars, and it offers a very simple and convincing demonstration of classroom value that the interference figure is perhaps better regarded as a direction image.

SODIUM BICARBONATE FROM SEARLES LAKE, CALIFORNIA

BY W. F. FOSHAG

Sodium bicarbonate has been encountered in large amounts in one of the deep wells drilled by the American Potash and Chemical Corporation in Searles Lake. It occurs with abundant gay-lussite as pockets or thin beds at depths from 120' to the lowest portion of the well at 285'. The common form of occurrence is as an open reticulated mesh of twinned monoclinic crystals. $\alpha=1.375$, $\beta=1.505$, $\gamma=1.582$. Na_2O 36.74, CO_2 51.15, H_2O 10.76, R_2O_3 0.16, CaO 0.20, insol. 0.82. Sum 99.83. Samples of "nahcolite" from near Naples, consist of burkeite and a compound $\text{NaCO}_3 \cdot 3\text{NaHCO}_3$, hitherto unreported as a mineral and could account for the "nahcolite."

**ORIENTED INCLUSIONS OF BROOKITE, ZIRCON, AND
GARNET IN MUSCOVITE**

BY CLIFFORD FRONDEL

Inclusions of brookite, zircon and garnet in muscovite were described with respect to their orientation to the mica. The method of investigation comprised: (1) the measurement of the crystallographic position of each crystal relative to the muscovite, (2) the plotting of the positions thus determined against frequency of occurrence, and (3) identification of positions of preferred orientation by statistical analysis of the frequency plots.

MAKING STRUCTURE MODELS

BY SAMUEL G. GORDON

Holes approximately the size of colored beads (on the scale of 1 cm. = 1 Å) representing atoms are punched in sheets of cellulose acetate (plastrocele). The beads are cemented into the holes. The beaded sheets are assembled and placed in a crystal model made of thin glass plates taped at the edges. This mold is filled with partially polymerized "lucite." When hard, the glass mold is removed. The result is a clear glass-like crystal model enclosing beads showing the atomic structure.

**THE NEW MINERAL HALL OF THE ACADEMY OF NATURAL
SCIENCES OF PHILADELPHIA**

BY SAMUEL G. GORDON

The mineral collections are now exhibited in newly designed *frameless* glass cases, lined with black velveteen, with concealed lighting (outside of the cases). Large specimens in wall cases are on individual glass shelves supported by concealed brackets. An effort has been made to set each specimen to the best advantage, many being upon glass stands. Labels are of cellulose acetate, printed with aluminum ink from type. Educational exhibits (What is Geology? What is a Mineral? What is a Crystal? etc.) are at the entrance. There is a crystal collection, and an index, with cross references, to the minerals in the cases. The new Fluorescence Exhibit will be automatically set in operation by visitors passing photoelectric cells.

TWINNING IN GLAUBERITE

BY A. C. HAWKINS

Casts in soft solder have been made from cavities in the red Brunswick shales of Triassic age occurring at Milltown in Somerset County, New Jersey. The crystal forms are those of glauberite and in size and perfection they excel modern occurrences of the mineral. Twinning appears to be common, as interpenetration twins; some twinning is similar to the closely related species thenardite, but there appear to be other twinning laws involved. Full elucidation of the problem will require much careful study. (Twinning has never been reported on glauberite.)

**CONCERNING THE CRYSTAL STRUCTURE OF THE CLAY
MINERALS, DICKITE AND HALLOYSITE**

BY STERLING B. HENDRICKS

Dickite, $\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2 \cdot 2\text{H}_2\text{O}$, is shown to have a somewhat random type of structure based upon the space group $C_6^4\text{-Cc}$. The structure suggested by J. W. Gruner (Zeits. Krist., vol. 83, p. 394 (1932)) is possibly correct save for this detail. Halloysite, $\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2 \cdot 4\text{H}_2\text{O}$, readily dehydrates to metahalloysite, $\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2 \cdot 2\text{H}_2\text{O}$, as was observed by M. Mehmel

(Zeits. Krist., vol. 90, p. 35 (1935)). However it is shown that the hydrated mineral has $(\text{OH})_4\text{Al}_2\text{Si}_2\text{O}_6$ and $2\text{H}_2\text{O}$ layers rather than separate $\text{Al}_2(\text{OH})_6$ and $\text{Si}_2\text{O}_6(\text{OH})_2$ layers as suggested by Mehmel.

ORTHOPIROXENES OF THE BUSHVELD TYPE

BY H. H. HESS AND A. H. PHILLIPS

Orthopyroxenes of the Bushveld Complex and many similar plutonic intrusions have in many cases been described as monoclinic because of small extinction angles observed. This pyroxene, however, when oriented on a universal stage so that it is parallel to (100) or (010) shows parallel extinction, though in other positions the extinction may appear inclined.

A characteristic feature of this pyroxene is the occurrence of very fine parallel striations on many grains when observed under crossed nicols. These striations are extremely thin lamellae of another mineral of approximately the same mean index as the orthopyroxene but of higher birefringence. They are parallel to (010). Furthermore they extinguish at an angle near 35° on either side of the (010) plane of the orthopyroxene when a section of the latter is viewed parallel to its (100) plane. It seems fairly certain that these lamellae are a diopsidic clinopyroxene. They are so oriented with respect to the orthopyroxene that they have their c axes in common, but the b axis of the clinopyroxene coincides with the a axis of the orthopyroxene.

Chemical analyses of these orthopyroxenes, show about 10% diopsidic molecules and a rough estimate of the total volume of the lamellae is also about 10% of the whole pyroxene. This type of orthopyroxene is very common in plutonic rocks but never occurs, so far as the writer is aware, in volcanic rocks, though orthopyroxenes of volcanic rocks show the same proportion of diopsidic molecules. It is, therefore, suggested that the lamellae represent an ex-solution phenomenon which takes place with slow cooling but is prevented by rapid cooling.

The lamellae explain a part of the observed extinction angles as a result of the composite effect of the lamellae and orthopyroxene host when viewed in certain orientations. The remainder of the observed extinction angles is simply due to the orientation of the mineral. Any orthorhombic crystal with prismatic cleavage probably will give extinction angles in certain orientations.

EXPERIMENTS BEARING ON THE RELATION OF PYRRHOTITE TO OTHER SULPHIDES*

BY R. L. HEWITT AND G. M. SCHWARTZ

The problem of the existence of solid solutions between pyrrhotite and pentlandite, chalcopyrite, galena, and sphalerite was investigated by the heat treatment of suitable ores. Pentlandite was put into solid solution in pyrrhotite above 425 degrees C. and upon slow cooling from 800 degrees C. it unmixed. The unmixed pentlandite oriented itself around pyrrhotite grain boundaries and under high magnifications was observed to contain oriented laths of a mineral tentatively called pyrrhotite. The formation of these laths may be caused by the unmixing of a solid solution of pyrrhotite in pentlandite or by the breakdown of pentlandite expelling pyrrhotite.

Pyrrhotite and chalcopyrite form two solid solutions. Pyrrhotite will dissolve in chalcopyrite above 300 degrees C. The two minerals then react to form chalcopyrite which makes a very fine intergrowth with chalcopyrite in an aureole about pyrrhotite masses in the samples treated. Above 600 degrees C. chalcopyrite will dissolve in pyrrhotite and upon unmixing forms oriented laths in the pyrrhotite.

The eutectic intergrowth formed by pyrrhotite and galena has a composition of approximately 71 per cent galena and 29 per cent pyrrhotite by weight. The eutectic temperature

lies between 765 and 775 degrees C. The variation between these figures and those for the artificial PbS-FeS system may be caused by impurities.

Crystallographic intergrowths between pyrrhotite and sphalerite were never produced although such intergrowths have been described and observed in many ores and it is assumed that hydrothermal conditions lower the temperature of formation for such intergrowths considerably below that required in a dry melt.

Small crystals of pyrrhotite, chalcopyrite, and galena were formed and the evidence indicates that they were produced by volatilization and subsequent deposition.

* Presented under the auspices of the Society of Economic Geologists.

STRUCTURE OF THE CALUMET STOCK, COLORADO

BY ARTHUR L. HOWLAND

The Calumet stock, of granodioritic composition, lies at the southern end of the Mosquito Range, about 8 miles northeast of the town of Salida. Its outcrop is about 12 miles in a north-south direction and has a maximum width of slightly over 5 miles, but the outcrop of the southern end is separated from the outcrop of the main mass by overlying Tertiary volcanics. The long axis of the intrusion coincides with a synclinal axis in the Paleozoic rocks. A study of the well-developed platy structure in the intrusive indicates that it has spread out sill-like into the Paleozoic beds, the platy structure being parallel to the steeply or gently dipping sediments on either side.

ADAPTATION OF AN ELECTRICAL COUNTER TO REPLACE THE INTEGRATING MICROSCOPE STAGE

BY CORNELIUS S. HURLBUT, JR.

This electrical tabulator, consisting of a series of counters, has several advantages over the old type integrating stage. The microscope is unencumbered except by a small mechanical stage to which the counter is connected by a flexible cable. The thin section lies directly on the microscope stage, enabling one to take interference figures. As many traverses as one wishes may be made across a thin section and the totals carried by the counters. A counter recording the total distance of traverse makes unnecessary the addition of the individual totals in calculating percentages.

THE MINERALS SEEN ON THE NORTHERN EXCURSION OF THE 17TH INTERNATIONAL GEOLOGICAL CONGRESS

BY CORNELIUS S. HURLBUT, JR.

The "Northern Excursion" went north from Leningrad across Karelia and into the Kola Peninsula. In Karelia only two localities of mineralogical interest were visited, at Shunga and Chupa.

In the Kola Peninsula several interesting mineral localities were visited, most of which were associated with the alkaline rocks of that region. Of most interest were the many minerals and unusual associations found in the Khibine pluton. Here is found the apatite-nephelinite association that is mined by the million tons; also several rare minerals are found there in sufficient quantity to warrant mining.

RELATION BETWEEN PERIOD OF INTRUSION AND PRO- DUCTION OF FOLIATION IN A GRANITIC INTRUSIVE NEAR HANOVER, NEW HAMPSHIRE

BY EDWARD PECK KAISER

The granitic intrusive is largely gneissic, and is wrapped by schist bands. The intrusive boundary is not sharp, but rather consists of a zone of rocks intermediate in both texture and composition between the granitic gneisses and the schists.

Petrographic and field relations indicate that both foliation and linear alignment were produced after complete solidification of the intrusive. Petrofabric diagrams show a typical *b*-girdle with point maxima, indicating that the *b*-axis (linear direction in the rock) was an axis of rotation during deformation. Movement then was at right angles to the linear direction, rather than parallel to it.

Linear alignment, therefore, is not here a flow structure, but a tectonic structure. It may have followed flow structure in part, but some discrepancies are noted.

TUNGSTEN MINERALIZATION AT OREANA, NEVADA

BY PAUL F. KERR

The tungsten deposit at Oreana, Nevada, exhibits a number of characteristics not found in other commercial tungsten deposits in the United States. Beryl, oligoclase, albite, fluorite, phlogopite and quartz are prominently associated with scheelite in the ore. Garnet and epidote ordinarily so common in the contact metamorphic deposits of the western United States are virtually absent. Neither is the mineralization of the quartz-vein type which yields tungsten in a number of western localities. The scheelite mineralization at Oreana is considered pegmatitic, a type of occurrence unique among tungsten localities in the region.

Two forms of deposition have been observed. (1) Scheelite occurs in almost vertical pegmatite dikes cutting metadiorite. The dikes may be composed almost entirely of scheelite, of feldspar, of fluorite or of quartz. Scheelite in these dikes is associated chiefly with sodic plagioclase, phlogopite, and beryl. (2) Scheelite also occurs in lens-like masses along a contact between limestone and metadiorite, associated with sodic plagioclase and phlogopite. The contact plane is undulating but inclined at about 30 degrees, the metadiorite intrusive occurring above the contact plane, the limestone below.

Zones of silicification and alteration lead downward from the limestone-metadiorite contact within the limestone. Traces of scheelite have been found in these zones but no ore. It is believed, however, that these alteration zones in the limestone represent contributing channels leading to ore deposition above.

THE OSSEO, CANADA, METEORITE

BY JOHN PUTNAM MARBLE

This kamacitic iron, a very coarse octahedrite, was found in the Temiskaming District, Ontario, Canada, about 1934. It carries few troilite nodules, and schreibersite is rare. The Newmann lines are bent in places, which may indicate distortion in flight. An etched, polished section, and an analysis of a typical portion have been made.

A STRUCTURAL INVESTIGATION OF THE ISOMORPHISM OF THE APATITE GROUP

BY DUNCAN MC CONNELL

One or more specimens of fluor-apatite, francolite (grodnolite and staffelite), dahllite (including podolite), dehrnite, lewistonite (including kurskite), fermorite, ellestadite, wilkeite, mangan-apatite and colophonane (including quercyite) were examined by *x*-ray methods and were found to produce powder diagrams which differ from one another but slightly. The chemical analyses of these minerals indicate that calcium may be replaced by Na, K, Mn, Sr, Mg, and carbon. Phosphorus may be replaced by S, Si, As, V, and carbon; fluorine by chlorine and oxygen and by hydroxyl groups. The lattice dimensions of these minerals were determined and, whenever the analytical results seemed sufficiently reliable, the theoretical density was calculated and compared with the measured density.

This study has permitted certain conclusions regarding the nomenclature of these minerals and has resulted in an explanation of carbonate-apatites, alkali-apatites and oxy-apatite. All of these types of substitution can be explained in terms of the structure of fluor-apatite.

These substances are all members of various isomorphous series of the apatite group, but only in several instances have the end-members been discovered. Besides fluor-apatite the only ones known are hydroxy-apatite (1935) and ellestadite (1937). It is not possible to calculate the compositions of the end-members in most cases because some of the ions (C, OH, F, et al.) can enter the structure in more than one sort of ionic position and the relative distribution between the several positions may vary with the amount of the ion present. Furthermore, one type of ionic substitution may be mutually dependent upon another type, producing isomorphous mixtures of extreme complexity.

CLEAVAGE-LUMINESCENCE IN MICA

BY V. B. MEEN

Mica from Kilmar, Quebec, was found to luminesce when split. The optical properties and chemical composition were discussed. Certain other micas were found to show the same phenomenon.

HARMOTOME FROM DELAWARE COUNTY, PENNSYLVANIA, A BARIUM ZEOLITE OF HYDROTHERMAL ORIGIN

BY ADOLPH E. MEIER AND W. HAROLD TOMLINSON

Small creamy white to transparent cruciform penetration twins of harmotome were found lining the joint seams of a tongue of gabbroid rock in serpentine near Glen Riddle, Pennsylvania. Identity of the mineral was confirmed by optical measurements and chemical analysis. Closer study of the rock exposure revealed an interesting suite of associated minerals such as barium potash feldspars, corundum, and montmorillonite.* The results of the study indicate a fairly low temperature, hydrothermal origin for the harmotome.

The paper was divided into two parts. The first part gave a brief description of field and petrographic relationships necessary for an understanding of the discussion of the paragenesis of the harmotome which followed. The second part covered optical and crystallographic measurements, and chemical analysis of the harmotome. Data obtained on loss of water with heating, with attendant changes in optical properties, were also included. The bearing of the latter on the possible formation temperature of the harmotome was also discussed briefly. On the whole the general properties of the mineral seem to be within the limits of variation of data obtained on harmotome from other localities.

* Montmorillonite has been discussed in the November, 1937 issue of *The American Mineralogist*. Origin of the corundum will be treated in a future paper.

GENESIS OF CERTAIN ADIRONDACK GARNET DEPOSITS

BY WILLIAM J. MILLER

The garnet deposits discussed in this paper occur in northwestern Warren County, New York, and adjacent regions.

Twenty-five years ago the writer advocated a theory according to which the garnets were produced by action of quartz syenite magma upon inclusions of basic Grenville gneiss. This theory needs to be modified. The garnets with conspicuous reaction rims of hornblende seem to have been produced by action of quartz syenite magma upon metagabbro, and the garnets without reaction rims seem to have been produced by action of anorthosite magma upon metagabbro, followed by attack of the combination by syenite magma.

SULPHATE MINERALS OF THE COMSTOCK LODGE, NEVADA*

BY CHARLES MILTON AND W. D. JOHNSTON, JR.

The following sulphates have been identified in old mine workings of the Comstock Lode: gypsum, epsomite, copper-zinc-epsomite, goslarite, magnesia-goslarite, melanterite, zinc-magnesia-chalcanthite, pickeringite, coquimbite, alunogen, copiapite, voltaite, and rhomboclase. These minerals are being deposited in or above the Sutro Tunnel which drains the lode. Iron, copper, and zinc sulphates are deposited in or beneath veins containing hypogene pyrite, chalcocopyrite, and sphalerite. No silver was found in the sulphates. Pickeringite and epsomite are most abundant in areas of highly altered wall rocks. Timbers on the Sutro Tunnel level are shredded by the growth of pickeringite and epsomite crystals between the wood fibers.

* Presented under the auspices of the Geological Society of America.

THE UNWEATHERED MANGANESE DEPOSITS OF THE
BATESVILLE DISTRICT, ARKANSAS*†

BY H. D. MISER AND D. F. HEWETT

Since its discovery, about 1849, the Batesville district has been the source of a large quantity of manganese oxides that occurred in clays residual from the weathering of the enclosing Fernvale limestone (Ordovician). Since 1928, however, a considerable quantity of manganese carbonate and hausmannite has been mined and shipped from tabular lenses that lie parallel with the bedding and near the top of the enclosing Fernvale limestone and, therefore, close to the overlying Cason shale (Ordovician), which contains nodules (Girvanella) that are rich in manganese carbonate. Although they are largely manganese carbonate, some bodies contain considerable hausmannite, as well as bementite, and neotocite. Accessory minerals include hematite, pyrite, barite, and fluorite. The form and distribution of some small bodies of carbonate, as well as the larger bodies, that have been mined indicate that they are related to fractures that cut across the Fernvale limestone but, so far as known, do not extend into the overlying and underlying formations.

It has been known for many years that unweathered Fernvale limestone, even remote from bodies of manganese oxide or carbonate, contains appreciable manganese carbonate that was probably deposited with the limestone. It seems probable, therefore, that the concentrated bodies of manganese carbonate now being explored were formed by the concentration of the manganese disseminated through the Fernvale limestone, although at present exotic sources cannot be completely dismissed. The widespread presence of bementite, which is only known in deposits of hydrothermal origin, as well as neotocite, barite, and fluorite, indicates that the waters that accomplished this concentration were warm rather than cold. Their source is obscure.

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† Presented under the auspices of the Society of Economic Geologists.

CRYSTAL STRUCTURE AND DENSITY OF DELAFOSSITE

BY ADOLF PABST

Ramdohr (*Zentralblatt für Mineralogie (A)* pp. 289-303 (1937)) has taken the structure of delafossite, CuFeO_2 , to be identical with that of artificial cuprous ferrite determined by Soller and Thompson (*Phys. Rev.*, vol. 47, p. 644 (1935)).

The structure belongs to the space group $D_{3d}^5-R\bar{3}m$. The unit rhombohedron, $a = 5.96 \text{ \AA}$, $\alpha = 29^\circ 26'$, is assumed to contain one CuFeO_2 . Atomic coordinates are given as: Cu (0, 0, 0); Fe ($\frac{1}{3}$, $\frac{1}{3}$, $\frac{1}{2}$); O ($1/9$, $1/9$, $1/9$) and ($-1/9$, $-1/9$, $-1/9$).

The density corresponding to this structure is 5.52, notably higher than the value 5.07 given for delafossite by Friedel.

The hexagonal cell corresponding to the rhombohedral cell of Soller and Thompson has an axial ratio of 5.645 or 3×1.882 . This compares with Roger's value, 1.94 (*Am. Jour. Sci.*, vol. 35, pp. 290-294 (1913)) obtained on crystals from Bisbee.

Interplanar spacings calculated from powder diffraction patterns of delafossite from Bisbee, Arizona, and from Kimberley, Nevada, as well as a powder pattern of delafossite published without interpretation by Waldo (*Am. Mineral.*, vol. 20, pp. 575-597 (1935)) agree nicely with spacings calculated from Soller and Thompson's cell for cuprous ferrite.

HEAVY MINERALS IN THE GRANITIC ROCKS OF THE YOSEMITE REGION

BY ADOLF PABST

A study of the minerals separated from granitic rocks of the Yosemite region by the use of heavy liquids revealed no unusual or unexpected constituents. In spite of the fact that all of the principal intrusives of the region have certain group characteristics in common, a few of the rock types may be clearly distinguished by differences in the assemblage of accessory minerals.

The examination of basic inclusions for their accessory minerals again suggests a close genetic relation to the host rocks. No explanation of this is offered.

YEATMANITE, A NEW MINERAL, AND SARKINITE FROM FRANKLIN, NEW JERSEY

BY CHARLES PALACHE, L. H. BAUER, AND HARRY BERMAN

Yeatmanite, $(\text{Mn}, \text{Zn})_{18}\text{Sb}_2\text{Si}_4\text{O}_{29}$, is a new mineral from Franklin, N. J. It is triclinic, pseudo-orthorhombic, with multiple twinning on $b(010)$ and macroscopic twinning on (023) . Elements (x -ray): $a:b:c=0.7811:1:0.4775$. $\alpha=103^\circ 49'$; $\beta=101^\circ 45'$; $\gamma=87^\circ 12'$. Cleavage perfect $\parallel (100)$; H. 4, G. 4.80. Biaxial, negative; X near $a[100]$, Y near $b[010]$, $Z/\sqrt{c[001]}=3\frac{1}{2}^\circ$. Indices (Na): $nX=1.873$, $nY=1.905$, $nZ=1.910$, all ± 0.03 . $2V$ about 49° , $r < v$, dispersion moderate. Clove-brown crystalline plates embedded in willemite.

WAVE SURFACES AND INDICATRICES

BY A. L. PARSONS

A graphical representation of the reciprocal relations between wave velocity and indices of refraction in air, isotropic substances, uniaxial and biaxial crystals. By the use of reciprocal circles and ellipses the indicatrix of biaxial crystals is shown to have a form similar to the wave surface with the optic axes emerging at the little depression where the circle representing β meets the ellipse whose semi major and semi minor axes are γ and α .

GOLDSCHMIDTINE, A NEW ANTIMONIDE OF SILVER

BY M. A. PEACOCK

System and morphological lattice, orthorhombic—C; $a:b:c=0.6312:1:0.6860$. Thirteen forms. Habit, stout prismatic $\{001\}$, pseudo-hexagonal, with dominant forms, $c\{001\}$, $b\{010\}$, $m\{110\}$. Twinning, on (110) , in all crystals. Structural lattice, orthorhombic—C; $a_0=7.75 \pm 0.05 \text{ \AA}$, $b_0=12.32 \pm 0.05 \text{ \AA}$, $c_0=8.42 \pm 0.05 \text{ \AA}$; $a_0:b_0:c_0=0.629:1:0.683$; $V_0=804$ cubic \AA . Specific gravity, 6.83 ± 0.03 . $M_0=3328$. The base-centered cell contains $\text{Ag}_{20}\text{Sb}_{10}$. Cleavage, none. Hardness, $2\frac{1}{2}$. Scarcely sectile. Crystals tin-white to lead-gray; opaque. Polished surfaces homogeneous, tin-white, distinctly anisotropic. Analysis (Gonyer): Ag 64.78, Sb 35.01, S 0.06, Pb, As, Cu, Sn none=99.85. Composition Ag_2Sb . Occurs with

native silver, ruby silver and galena on a specimen from Andreasberg, Harz. Named in memory of Victor Goldschmidt (1853-1933) of Heidelberg. Goldschmidtine differs in all its essential properties from those reliably determined on dyscrasite—Ag₃Sb.

DIRECT PROJECTION OF OPTICAL FIGURES*

BY TERENCE T. QUITKE

A detachable stage holding a semi-translucent hemispherical surface permits reading of optical angles ($2E$), and orientation of mineral grains by inspection. The attitude and azimuth of optic axes may be read from vertical and horizontal scales upon the hemisphere of projection. Projection is achieved by the use of a polaroid plate in the base of the accessory stage placed over a mineral or rock slide, thus superposing a flat analyzer over the convergent polarized light from sub-stage illumination.

* Presented under the auspices of the Geological Society of America.

THE SYMMETRY, UNIT CELL, AND COMPOSITION OF HANKSITE

BY LEWIS S. RAMSDELL

Laue photographs of hanksite show the symmetry C_{6h} , hence the actual symmetry may be C_{6h} , C_6 or C_{3h} . Since the crystals are neither trigonal nor hemimorphic in development, C_{6h} would seem the most probable. The unit cell is a very large one. Oscillation photographs about the a , b and c axes, together with powder photographs, give the values $a=10.46\text{\AA}$ and $c=21.18\text{\AA}$, $a:c=1:2.024$. This cell contains 2 molecules of $9\text{Na}_2\text{SO}_4 \cdot 2\text{Na}_2\text{CO}_3 \cdot \text{KCl}$.

NICKEL CONTENT OF AN ALASKAN TROCTOLITE*†

BY JOHN C. REED

A troctolite sill about 126 feet thick lies in a thick sequence of greenstone schists, graphitic phyllites, and quartzites on Admiralty Island near Juneau, Alaska. Diorite or gabbro bodies are also present in the vicinity. The sill, called at the outcrop, the Mertie Lode, occupies a position near the crest of a large southeastward pitching anticline. The sill in its known extent is probably only a small part of a much larger body.

The sill is coarse grained, but has a diabasic texture. Measurements of volumetric proportions of the component minerals of the rock by means of traverses across thin sections show the rock, as represented by the thin sections, to contain about 62.3 per cent labradorite, 34.2 per cent olivine, 2.2 per cent pyroxene, 0.82 per cent pyrrhotite, 0.20 per cent magnetite, 0.13 per cent chalcopyrite and 0.06 per cent pentlandite.

The rock contains about 0.18 per cent chalcopyrite and 0.10 per cent pentlandite by weight. The copper content, therefore, is about 0.06 per cent and the nickel content about 0.025 per cent (the composition of pentlandite is not definite but the nickel content of that mineral used in the calculations was 24.65 per cent, which was the nickel content of pentlandite from a not far distant locality on Yakobi Island, analyzed by A. H. Phillips).

A chemical analysis by R. C. Wells of a panned concentrate from a chip sample of the sill showed $3\frac{1}{2}$ times as much copper as nickel. This appears to check within reasonable limits of error of sampling and petrographic measurements, the ratio of copper to nickel or about $2\frac{1}{2}$ to 1 obtained by petrographic measurements.

Assuming that the relative proportions of metallic minerals as determined petrographically is reasonably correct, then a mixture of the opaque minerals of the sill in those proportions, with no silicates, would contain only 1.4 per cent nickel.

* Published by permission of the Director of the Geological Survey, United States Department of Interior.

† Presented under the auspices of the Society of Economic Geologists.

ON TARBUITITE

BY WALLACE E. RICHMOND, JR.

Excellent crystals of tarbuttite, a basic zinc phosphate, from Broken Hill mines, Rhodesia, are triclinic: $a:b:c=0.6296:1:0.5971$; $\alpha=89^\circ 37\frac{1}{2}'$, $\beta=91^\circ 28\frac{1}{2}'$, $\gamma=107^\circ 41'$ (new elements derived from ten crystal measurements on the two-circle goniometer computed in the new position, the normal triclinic setting); twenty of the twenty-nine accepted forms were observed; also the new form $q\{\bar{1}02\}$ and the new but uncertain form $\{3\bar{2}1\}$; ten reported forms were discredited; cleavage $\{010\}$ perfect; habit short prismatic approximating pseudo-isometric. X-ray measurements gave: $a_0=8.097 \text{ \AA}$, $b_0=12.91 \text{ \AA}$, $c_0=7.688 \text{ \AA}$; $\alpha=89^\circ 34\frac{1}{2}'$, $\beta=91^\circ 35\frac{1}{2}'$, $\gamma=107^\circ 47'$; $a_0:b_0:c_0=0.6271:1:0.5957$. The pseudo-isometric lattice is a multiple lattice of the proper crystal lattice. From existing analyses and densities the unit cell contains $8[\text{Zn}_2\text{PO}_4(\text{OH})]$.

New optical data:

	ϕ	ρ	$n(\text{Na})$	
X(colorless)	7°	58°	1.660	} Positive $\pm 0.003 \text{ 2V} = 50^\circ \pm 2^\circ$
Y(colorless)	-159	25°	1.705	
Z(colorless)	-86	80	1.713	

DIADOCHITE, A MINERALOID FROM THE NEW IDRIA MINE,
SAN BENITO COUNTY, CALIFORNIA

BY AUSTIN F. ROGERS

A yellow-brown, resin-like, massive material found in an old fill of one of the drifts of the New Idria quicksilver mine proves to be amorphous, and so is called a mineraloid.

Chemical analyses reveal that it is a hydrous ferric sulfate-phosphate, analogous to the corresponding sulfate-arsenate, pitticite, which is a more common mineraloid.

A quantitative analysis leads to the formula: $2\text{Fe}_2\text{O}_3 \cdot 3(\text{SO}_3, \text{PO}_5) \cdot 15\text{H}_2\text{O}$, which is surprisingly definite for a mineraloid.

This is apparently the first American occurrence of diadochite (phosphoreisensinter)

MEROSYMMETRY VERSUS MEROHEDRISM

BY AUSTIN F. ROGERS

Although Groth's names of crystal classes based upon general forms are superior to other names, it is often convenient to refer to the class with the maximum symmetry in any system and also to classes of lower-grade symmetry.

For this purpose the terms holohedral and merohedral have usually been used. The merohedral forms (hemihedral, tetartohedral, etc.) are said to be produced from the holohedral forms by suppression of certain faces and the extension of others.

Since the suppression of faces is always a *symmetrical* suppression, it seems advisable to substitute the suffix *-symmetric* for the suffix *-hedral*. Thus we have holosymmetric, merosymmetric, hemisymmetric, etc. (Symmetry is the key-note in the study of crystals.)

These terms were introduced by Story-Maskelyne in 1875 and elaborated upon in his classic, "Crystallography, a Treatise on the Morphology of Crystals" (1895). Story-Maskelyne's nomenclature of the crystal classes, however, is unnecessarily complicated.

A simple set of names based upon merosymmetry was presented as a list supplementary to class names based upon general forms.

QUARTZ WITH PINAKOID FACES FROM NATHROP,
CHAFFEE COUNTY, COLORADO

BY AUSTIN F. ROGERS AND LAZARD CAHN

Minute α -quartz crystals of prismatic habit with the forms $\{10\bar{1}0\}$, $\{20\bar{2}1\}$, $\{02\bar{2}1\}$, $\{10\bar{1}1\}$, $\{01\bar{1}1\}$, $\{2023\}$, $\{0223\}$, and $\{0001\}$ from Ruby Mtn., Chaffee County, Colorado,

show very prominent pinakoidal faces. This is one of the very few authentic occurrences of the pinakoid on quartz.

**AN OPTICAL ANALYSIS OF IMMERSION METHODS WITH REFERENCE
TO THE SENSITIVITY OF THE DOUBLE-DIAPHRAGM METHOD**

BY CHARLES P. SAYLOR

Employing monochromatic light and the double-diaphragm method of oblique illumination, a difference of 0.00015 between the refractive index of a particle and an immersion liquid can be seen without difficulty (*J. Research NBS* 15, p. 277 (1935); RP 829). This results in a sensitivity in the determination of refractive indexes that cannot be attained in practice with the ordinary method of oblique illumination or with central illumination. An analysis of the optical mechanisms involved in image formation under these circumstances makes clear the reasons for the greater sensitivity and emphasizes the importance of adjusting the condenser diaphragm vertically so that its image is strictly in the plane of the objective diaphragm.

AN OCCURRENCE OF LARGE HALITE CRYSTALS

BY CHESTER B. SLAWSON

Rock salt is mined at Detroit from a continuous seam of horizontally stratified salt. Large masses of clear transparent halite crystals are occasionally encountered. These masses average from ten to fifteen feet across and are associated with lenses of fine dense dolomite which generally lie beneath the halite crystals. Single crystals two feet or more in diameter are not uncommon. In many instances blasting has caused the separation of crystals along the dodecahedral gliding plane to be more extensively developed than separation along the cubical cleavage. While these masses occur throughout the mine they are most frequently found along two zones of alignment.

**MODELS TO AID IN VISUALIZING THE OPTICAL
PROPERTIES OF CRYSTALS**

BY HAROLD T. U. SMITH

By means of transparent celluloid models, the following relations are illustrated: (1) orientation of the uniaxial indicatrix in hexagonal and tetragonal crystals, as shown by wooden ellipsoids inclosed in crystal models; (2) orientation of the biaxial indicatrix in orthorhombic and monoclinic crystals, similarly shown; (3) vibration directions in an orthorhombic crystal; (4) the uniaxial indicatrix in skeleton form; (5) the biaxial indicatrix in skeleton form; (6) the relation of the uniaxial indicatrix to the ray-surfaces, in three mutually perpendicular cross sections; (7) the relation of the biaxial indicatrix to the ray-surface, in the three principal sections.

**ORIGIN OF FIBROUS GYPSUM VEINS IN THE LYKINS AND
MORRISON FORMATIONS OF COLORADO**

BY LINCOLN R. THIESMEYER

Near Table Mountain, eighteen miles southwest of Colorado Springs, veins of fibrous gypsum are locally abundant in the Lykins and Morrison formations. Three types of veins are distinguished, as follows: one group of cross-fiber veins forms subparallel networks within a massive alabaster member of the Morrison, and roughly parallel to its bedding; another set of cross-fiber veins crosses these and extends downward into lower members of the Morrison and into the Lykins redbeds; a third set follows the bedding-planes of arenaceous red shales in the Lykins. The gypsum of this third set varies from fibrous to

lamellar, but the elongation of the crystals is roughly parallel to the dip of the beds, so that the grains lie almost parallel to the vein walls. The veins contain partings of shale and display most of the features common to fibrous veins elsewhere. Their restriction to the central portions of small, local, anticlinal structures indicates that they were formed subsequent to the regional deformation and followed fractures resulting from it. Limitation of the veins to a stratigraphic position everywhere within or below massive beds of gypsum in the Morrison suggests that the latter supplied the vein material to downward-migrating groundwaters. Several lines of evidence indicate that the fibrous structures are not a result of lateral secretion through the wallrocks, as has been proposed for many fibrous mineral occurrences. Similar phenomena and conclusions were reported for fibrous gypsum veins observed near Rapid City, South Dakota.

**HEAVY MINERAL METHODS APPLIED TO THE PRE-CAMBRIAN
ROCKS OF THE SOUTH SHORE OF LAKE SUPERIOR***

BY STANLEY A. TYLER AND RALPH W. MARSDEN†

On the south shore of Lake Superior, pre-Huronian and Keweenaw igneous rocks may be readily distinguished by the variety of zircon present. A third period of intrusion, post-Huronian-pre-Keweenaw, is postulated and it is thought that rocks of this age may be distinguished from those of the other two periods. The pre-Huronian rocks are characterized by a purple zircon similar to those described by Mackie from the pre-Cambrian of Scotland. The post-Huronian-pre-Keweenaw rocks are characterized by a weakly birefringent zircon, and those of Keweenaw age by a euhedral, colorless to yellow zircon. The date of unroofing of these batholithic intrusions is clearly shown in the associated sediments.

The study of the heavy accessory minerals in the Keweenaw igneous rocks shows that the relative percentage of the minerals change with the rock type and for this reason relative percentages cannot be used as a basis for correlation. The variety of zircon remains essentially constant regardless of the composition, or the crystallization and cooling history of the rock.

The detrital heavy mineral suite in the Huronian sediments remains remarkably constant throughout, therefore individual formations cannot be distinguished by heavy mineral methods. However, a heavy mineral study may be used to distinguish Huronian sediments from those of Keweenaw age in this area.

A re-study of the Upper Keweenaw series of Wisconsin has been made and a revision of the sequence advanced, which is conformable with the field occurrence and the heavy mineral studies. The heavy minerals may be used to distinguish the Oronto from the Bayfield group.

* Presented under the auspices of the Geological Society of America.

† Introduced by A. N. Winchell.

**A PYROPHYLLITE DEPOSIT IN SOUTHEASTERN
NEWFOUNDLAND*†**

BY J. S. VHAY‡

Quartz-pyrophyllite schists occur in an area near Manuels, on the south side of Conception Bay, southeastern Newfoundland. The pyrophyllite has been formed by the hydrothermal alteration of sheared and silicified rocks of the pre-Cambrian Harbour Main volcanics, near a granite contact; the volcanics here consist of rhyolite flows and some clastic material.

The schists consist of various proportions of quartz and pyrophyllite, and grade into large masses of nearly pure pyrophyllite; they exhibit a variety of textures, depending

upon the structures of the original rocks. The typical quartz-pyrophyllite schist has quartzose nodules in a matrix of pyrophyllite. Thin sections show coarse pyrophyllite along fractures, and a mat of fine pyrophyllite replacing both the original minerals and the secondary quartz. The flakes of pyrophyllite have a random orientation, and the schistosity is an inherited structure preserved by differential replacement on the planes of schistosity.

Three factors influenced the localization of the pyrophyllite, (a) the acidic composition of the host rock, (b) the sheared condition of the rock, which itself depended in part upon the original structures of the flows; the schistosity was best developed in the flow-banded, spherulitic, and flow-brecciated types of rhyolite rather than in the massive type; because of these factors the schists high in pyrophyllite tend to lie in elongated areas parallel to the strike of the flows, (c) proximity to fissures near the granite contact, which acted as channelways for the hydrothermal solutions.

* Published by permission of the Government Geologist, Newfoundland Department of Natural Resources.

† Presented under the auspices of the Society of Economic Geologists.

‡ Introduced by T. B. Nolan.

OPTICAL METHODS OF MEASURING IN REFLECTED POLARIZED LIGHT (M. BEREK)

BY H. W. ZEILER

Microscopical analysis of opaque ores and minerals in reflected polarized light is generally confined to qualitative observations such as the color of the reflected light or the degree of anisotropism. M. Berek, a few years ago, developed a method of measuring photometrically the power of reflection of opaque minerals. However, a general method for determining optical "parameters" of such minerals—similar to the methods available for transmitted polarized light where optical character, birefringence, angle between the optical axes, etc., can be determined—did not exist for reflected polarized light. Even determinations of the directions of vibration were subject to grave errors because the equipment available did not produce sufficiently well-defined, homogeneous, plane polarized light.

Recently the equipment was improved, so that plane polarized light of the highest purity and of one single azimuth can be produced in the plane of the specimen. These improvements permitted the development of methods of determination of the effects of anisotropism in reflected polarized light. The measurements are carried out with a rotating mica compensator and a rotating analyzer. M. Berek succeeded in defining various optical "parameters" of opaque minerals which show sufficient differentiation for diagnostic purposes. Berek has published various articles and one booklet about this subject and the speaker presented a brief review of the contents of these publications and demonstrated the new equipment.

The basic principle of these measurements in reflected polarized light is as follows: Due to the optical character of the mineral, the light which is reflected from its surface becomes elliptically polarized with a simultaneous rotation of the main axis of vibration in respect to the plane of vibration of the incident polarized light. The mineral is brought into two successive diagonal positions, whereupon the mica compensator measures the ellipticity of the reflected polarized light and the analyzer measures the angle of rotation of the main axis of vibration. These measurements are utilized for certain computations and lead to the determination of the optical symmetry (uniaxial or biaxial), the complex optical character, and other "parameters" pertaining to the mineral under investigation which lead to its diagnosis.

ATOMIC PACKING MODELS OF SOME COMMON SILICATE STRUCTURES

BY J. E. DORRIS, CLIFFORD FRONDEL, W. C. GÜSSOW, V. M. LOPEZ,
C. S. LORD, WILLIAM PARRISH, J. A. SHIMER
(See *Am. Mineral.*, vol. **23**, pp. 65-84, 1938)

Data was presented for the construction of atomic packing models of zircon, olivine, diopside, muscovite and sanidine structures. Pertinent structural facts needed in calculating atomic bonding directions, together with instructions for assembling the models were outlined. Figures illustrating the various types of oxygen-sharing in the silica chains were given. Atomic packing models are helpful in the study of gliding, coordination, exsolution, isomorphism, cleavage, the relation between crystal structure and habit, and other problems in which a knowledge of the atomic positions, relative sizes and packing are essential. The "nuclear" models are largely restricted to show the symmetry and point positions and convey no idea of the relative atomic radii.

THE UNIT CELL AND SPACE GROUP OF TOURMALINE (AN EXAMPLE OF THE INSPECTIVE EQUI-INCLINATION TREATMENT OF TRIGONAL CRYSTALS)

BY M. J. BUERGER AND WILLIAM PARRISH
(See *Am. Mineral.*, vol. **22**, pp. 1139-1150, 1937)

The inspective equi-inclination treatment of hexagonal crystals was outlined. The lattice type may be easily determined by inspecting an appropriate n -level equi-inclination photograph. Two previous investigations have assigned tourmaline to space groups based upon a hexagonal lattice, but this study shows it to be based upon a rhombohedral lattice. Cell data for tourmaline from the Etta Mine, South Dakota, are as follows:

Diffraction symbol:	32/m R3 — —	
Lattice:	rhombohedral	
Crystal class:	C_{3v}	
Space group:	C_{3v}^5 , R3m	
Cell dimensions:	rhombohedral	referred to simplest hexagonal cell
	$a = 9.500 \text{ \AA}$	$A = 15.928 \text{ \AA}$
	$\alpha = 66^\circ 15'$	$C = 7.151 \text{ \AA}$
		$\frac{C}{A} = 0.4490$
Formula weights per cell:	1	3

It is estimated that more than 250 attended the various sessions of the Society. The following were present at the annual meeting:

L. H. Adams	William S. Bayley	W. W. G. Bryant
Henry R. Aldrich	A. P. Beavan	A. F. Buddington
Olaf Andersen	Harry Berman	M. J. Buerger
Charles A. Anderson	R. J. Bernhagen	W. S. Burbank
T. G. Andrews	L. G. Berry	E. M. Burwash
	Marland Billings	Edward R. Bush
George W. Bain	Norman L. Bowen	R. D. Butler
Robert Balk	Oliver Bowles	
Richard L. Barrett	Alice L. Brown	Eugene Callaghan
Alan Bateman	John S. Brown	Eugene N. Cameron
W. T. Baxter	E. L. Bruce	Grace M. Carhart

C. A. Chapman	J. B. Hanley	Benjamin Miller
R. W. Chapman	Frances Harlan	F. S. Miller
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	A. L. Howland	Charles Palache
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R. K. Doten	Earl Ingerson	Martin A. Peacock
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Frank C. Foley	Adolph Knopf	L. S. Ramsdell
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