PROCEEDINGS OF THE TWENTY-SIXTH ANNUAL MEETING OF THE MINERALOGICAL SOCIETY OF AMERICA AT PITTSBURGH, PENNSYLVANIA

C. S. HURLBUT, JR., *Secretary*

The twenty-sixth annual meeting of the Society was held at the Hotel William Penn, Pittsburgh, Pennsylvania, on December 27–29, 1945. The registration figures show that 74 fellows and 56 members attended. Four scientific sessions were held, two in the afternoon of December 27th and two in the afternoon of December 28th. Because of lack of time the routine business of the Society was not presented at a general session. The luncheon of the Mineralogical Society, which was held on December 27th, was attended by 108 fellows, members and guests. After the luncheon the Society was addressed by Past Presidents R. C. Emmons on "The Shift in Emphasis" and A. F. Buddington on "Some Mineralogical Reflections."

The report of the election of officers and fellows for 1946 and the reports of the officers for the year 1945 are given on the following pages.

ELECTION OF OFFICERS AND FELLOWS FOR 1946

The secretary reports that 343 ballots were cast for the officers of the Society as nominated by the Council.

The officers for 1946 are:

President: Paul F. Kerr, Columbia University, New York City.
Vice-President: S. B. Hendricks, Bureau of Plant Industry, U. S. Department of Agriculture, Beltsville, Maryland.
Secretary: C. S. Hurlbut, Jr., Harvard University, Cambridge, Mass.
Treasurer: Earl Ingerson, Geophysical Laboratory, Washington, D. C.
Editor: Walter F. Hunt, University of Michigan, Ann Arbor, Michigan.
Councilor (1946–49): Joseph Murdoch, University of California at Los Angeles, Los Angeles, California.

The secretary reports that according to the provisions of the constitution the following have been elected to fellowship:

Cannon, Ralph S., Jr., U. S. Geological Survey, Washington, D. C.
Gabriel, Alton, U. S. Bureau of Mines, College Park, Maryland.
Haff, John C., Colorado School of Mines, Golden, Colorado.
Heyl, George R., U. S. Geological Survey, Washington, D. C.
Larsen, Esper S., 3rd, U. S. Geological Survey, Washington, D. C.
Lausen, Carl, U. S. General Land Office, Albuquerque, New Mexico.
Macdonald, Gordon Andrew, U. S. Geological Survey, Honolulu, Hawaii.
Mason, Brian Harold, Canterbury College, Christchurch, New Zealand.
Moneymaker, Berlen C., Tennessee Valley Authority, Knoxville, Tennessee.
Pecora, William Thomas, U. S. Geological Survey, Washington, D. C.

CHANGE IN THE BY-LAWS OF THE SOCIETY

The following change in Article IV, Section 2 of the By-Laws of the Society was approved by the general membership:

From

The list of nominations for fellowship in the Society shall be sent to the fellows at the

same time as the nominations for officers. Five opposing votes shall be considered as render-
ing a candidate ineligible for fellowship.

To

The list of nominations for fellowship in the Society shall be sent to the fellows at the
same time as the nominations for officers. If ten per cent of the fellows voting on a given
candidate cast opposing votes, the candidate shall be considered ineligible for fellowship.

REPORT OF THE SECRETARY FOR 1945
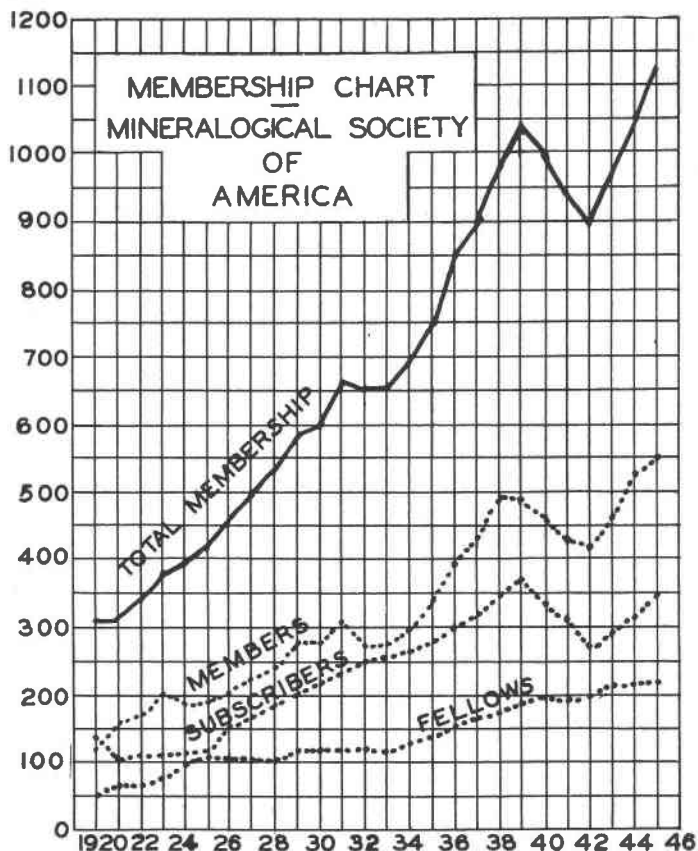
To the Council of the Mineralogical Society of America:

MEMBERSHIP STATISTICS

	1944	1945	*Gain*	*Loss*
Correspondents	6	5	—	1
Fellows	211	218	10	3
Members	522	549	127	100
Subscribers	313	344	39	8
	1052	1116	176	112

The above figures show a loss of one correspondent and a net gain of 7 fellows, 27 members and 31 subscribers, giving a total gain for 1945 of 64. This brings the grand total to 1116, and thus for the second consecutive year a new high record is set. The chart showing the trend in membership in the Society has been brought up to date and accompanies this report.

The Society lost through death in 1945 two fellows, Florence Bascom and Edward Wigglesworth, as well as A. E. Fersman, a correspondent from the Soviet Union.

Respectfully submitted,

C. S. HURLBUT, JR., *Secretary*

REPORT OF THE EDITOR FOR 1945

To the Council of the Mineralogical Society of America:

Despite diversion of manpower to efforts pertaining either directly or indirectly to the war, and restrictions imposed by shortages of labor and materials, the bi-monthly journal has appeared quite regularly, and the overall accomplishments for the year 1945 seem very satisfactory, especially when the various handicaps referred to are taken into consideration.

Slight delays in the appearance of the issues and in the distribution of the reprints have no doubt caused some annoyance to a number of our readers and contributors. Even though the war is now over, the printer informs me that the young men formerly in their employ are not returning as rapidly as had been expected. Some of them are availing themselves of the educational program which the government is offering ex-servicemen, and it is impossible to secure new experienced workers. Also, the mechanical equipment is offering difficulty. For the past four years, printing establishments have been unable to replace worn machinery according to a carefully worked out annual replacement program which was in effect before the war. The rate of recovery is bound to be slow for some months to come. However, in time, these various difficulties will be surmounted.

Before attempting an analysis for the year 1945, it may be in order to call attention to two special features of the current volume. As you recall, the May-June number was devoted exclusively to a 264-page symposium of fourteen articles on quartz oscillator-plates. These valuable and timely contributions on the geology of quartz crystal deposits, on the inspection, grading, cutting and testing of thin quartz wafers, were made possible largely through the efforts of Drs. Frondel, Parrish, Gordon, and their associates, to whom the Editor is greatly indebted for assembling the material and reading proof. Likewise, substantial financial assistance was received from the Reeves Sound Laboratories and North American Philips Company to help defray the heavy expense involved in the printing of this unusually large and highly illustrative number. This special issue was very well received, as indicated by the demand for copies from individuals and organizations not on our regular mailing list.

A second feature of interest relates to the insertion of a colored plate in connection with the description of the new mineral brazilianite, that appeared in the September-October issue. In the past, due mainly to the high cost of this type of reproduction, the Society's limited finances did not seem to justify this luxury. However, with some additional assistance from the Geological Society of America, it may be possible in the future to include a very limited number of these plates each year when the subject matter is such as to definitely require and justify such expensive treatment. Recognition and appreciation is here again expressed for financial assistance received during the year from the Geological Society of America to help defray publication costs.

In some quarters the question has been raised, of late, as to when the Journal would again be issued on a monthly basis. Manuscripts are not being received with any degree of regularity or in sufficient numbers to make the change desirable at the present time. Until conditions become more normal, it is the Editor's opinion that a bi-monthly journal of a substantial size creates a far more favorable impression than a thin, anaemic monthly of very limited content.

The current year concludes the thirtieth volume of *The American Mineralogist*. During the past twenty-six years of its existence, the Journal has served as the official publication of the Society. A graph indicating the growth of the Journal during this thirty-year period is not a smooth curve, but the general overall trend is in the desired direction (Fig. 1). The special "Palache Number," financed largely by friends of Harvard University, was responsible for the very high peak reached in 1937.
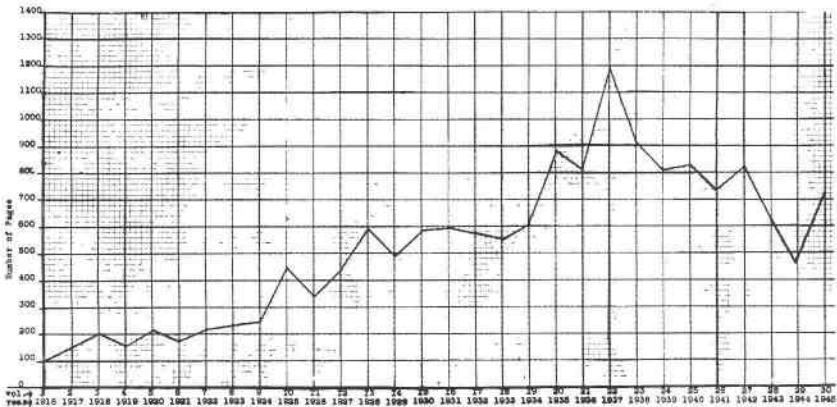
It may be of some interest to note that during this thirty-year period the Journal has published over 15,700 pages of mineralogic literature. If this total be broken down into five-year periods, we find:

Vols. 1–5 (1916–1920)	....	816 pages
Vols. 6–10 (1921–1925)	....	1,318 pages
Vols. 11–15 (1926–1930)	....	2,448 pages
Vols. 16–20 (1931–1935)	....	3,216 pages
Vols. 21–25 (1936–1940)	....	4,552 pages
Vols. 26–30 (1941–1945)	....	3,364 pages
		15,714 pages

In a detailed analysis of the Journal for 1945, we find that Volume 30 contains 724 pages, exclusive of index. This represents an increase of 268 pages compared with the volume of the previous year. In fact, the present volume compares very favorably with the size of the Journal issued in 1941. Leading articles, which number 51, occupy exactly 90% of the total space. Table 1 which accompanies this report indicates the distribution of the leading articles in the various fields listed. The average length of the main articles is 12.8 printed pages.

If to the leading articles we add 11 shorter papers appearing under the heading of "Notes and News," we obtain a total of 62 published manuscripts for the calendar year. These contributions were received from 62 contributors associated with 41 different universities, research bureaus, and technical laboratories.

The Journal for 1945 carries detailed descriptions of three new minerals: cattierite, vaesite, and brazilianite. Three hundred and three illustrations of various types assist in clarifying the descriptive portions of the text. As in previous years, a number of manuscripts were received from sources beyond our borders, and in 1945 seven such contributions were printed.

The accompanying table of contents summarizes in detail the subject matter of Volume 30.

TABLE 1. DISTRIBUTION OF SUBJECT MATTER IN VOLUME 30

Subjects	Articles	Pages	Per Cent of Total
Leading articles*			
Descriptive mineralogy	4		
Chemical mineralogy	7		
Structural crystallography	5		
Geometrical crystallography	1		
Petrography	3		
Optical mineralogy	2		
Mineralography	2		
Memorials	8		
Miscellaneous	5		
Quartz oscillator-plates (Symposium)	14		
	51	652	90.0
Shorter articles	11	20 ⎫	
Notes and news	11	$4\frac{1}{2}$ ⎪	
Abstracts of new mineral names	19	$4\frac{1}{2}$ ⎬	10.0
Proceedings of Societies	20	$38\frac{1}{2}$ ⎪	
Book reviews	7	$4\frac{1}{2}$ ⎭	
Total entries	119	724	100.0
Illustrations	303		
Index, Title page, Table of contents		12	
Grand Total		736	

* Leading articles average 12.8 printed pages.

Respectfully submitted,

WALTER F. HUNT, *Editor*

REPORT OF THE TREASURER FOR 1945

To the Council of the Mineralogical Society of America:

Your treasurer submits herewith his annual report for the year beginning December 1, 1944, and ending November 30, 1945.

RECEIPTS

Cash on hand December 1, 1944	$ 5,170.64
Dues and subscriptions	3,565.23
Sale of back numbers	399.11
Authors' charges on separates	117.49
Interest and dividends from endowment	2,599.52
Partial payments on principal of Trenton Mortgage Service Company's preferred stock	367.57
Advertisements	205.04
Geological Society of America Grant for 1945	1,508.49
Refund on postage	4.78
Sale of 20-volume index	3.00
Sale of extra copies of the May-June issue	353.26
	$14,294.13

DISBURSEMENTS

Printing and distribution of the Journal (6 issues)	$ 4,539.03
Printing and distribution of separates	645.72
To the Editor, Secretary, and Treasurer	830.00
Postage	91.90
Clerical help	289.88
Refunds on subscriptions	6.41
Returned check	6.00
Office equipment	1.30
Telephone and telegraph	9.13
Safety deposit box	9.60
Printing and stationery	184.30
Committee expenses	3.54
Expenses of 25th Anniversary Meeting	11.85
Insurance on Roebling Medal	5.00
Exchange charge on check	.50
New securities purchased	4,987.50
Broker's commission on securities	19.97
Tax on new securities	4.80
	$11,646.43
Cash balance November 30, 1945	2,647.70
	$14,294.13

The endowment funds of the Society as of November 30, 1945, consist of the following securities:

BONDS

5M U. S. Treasury, 2½%.............	$ 5,190.63
5M Illinois Central, 4%.............	3,887.50
5M Southern Railway, 5%.............	5,743.75
5M Cleveland Union Terminal, 5%.............	5,068.75
6M Atlantic Coast Line, 4½%.............	5,257.50
4C Great Northern, 5½%.............	400.00

PREFERRED STOCKS

50 shares, Virginia Electric & Power Co., 5%.............	5,942.50
55 shares, U. S. Steel, 7%.............	6,946.20
50 shares, Union Pacific, 4%.............	4,570.25
60 shares, Jones & Laughlin, A, 5%.............	4,987.50
10 shares, Consolidated Edison.............	1,066.64
5 shares, Public Service of New Jersey.............	702.00
37 514/1000 shares, Trenton Mortgage Service Company.............	#1,884.62

COMMON STOCKS

50 shares, Chesapeake & Ohio Railway.............	2,368.75
50 shares, Pennsylvania Railroad.............	1,468.75
25 shares, Standard Oil of New Jersey.............	1,356.25
25 shares, American Telephone & Telegraph Company.............	3,369.32

$60,210.91

Residual value

Respectfully submitted,
EARL INGERSON, *Treasurer*

REPORT OF THE AUDITING COMMITTEE

To the President of the Mineralogical Society of America:

The Auditing Committee has examined and verified the accounts of the Treasurer of the Mineralogical Society of America for the fiscal year ending November 30, 1945. The securities listed in the Treasurer's report, with all future coupons on the coupon bonds attached, are in the safety deposit box at the Friendship Branch of the Riggs National Bank of Washington, D. C.

Respectfully submitted,
JOSEPH J. FAHEY, *Chairman*
WILLIAM T. PECORA
CHARLOTTE MARSH

DANA FUND

No disbursements made during the fiscal year 1945. Interest received = $9.32. Available balance, November 30, 1945 = $943.39.

Respectfully submitted,
WALDEMAR T. SCHALLER

ABSTRACTS OF PAPERS PRESENTED AT THE TWENTY-SIXTH ANNUAL
MEETING OF THE MINERALOGICAL SOCIETY OF AMERICA

Presidential Address

GEOLOGICAL MINERALOGY

KENNETH K. LANDES

Mineralogy has by tradition been mainly a laboratory science. But except for further refinements in measurements and analyses we can go but little farther in laboratory mineralogy. Major opportunities for contribution exist in geological mineralogy (paragenesis). This involves combined mineralogical and geological studies in both field and laboratory. Mining geologists have made valuable paragenetic studies of ore deposits. Equally good opportunities for research in geological mineralogy are to be found in other types of deposits including pegmatites, clastic sediments, and chemical sediments.

MANSFIELDITE, A NEW ALUMINUM ARSENATE, AND THE MANSFIELDITE-SCORODITE SERIES

VICTOR T. ALLEN AND JOSEPH J. FAHEY

The name, mansfieldite, in honor of Dr. George R. Mansfield, retired chief of the Areal and Non-metalliferous Section, Geological Survey, U. S. Department of the Interior, is given to a new mineral with the formula $Al_2O_3 \cdot As_2O_5 \cdot 4H_2O$. Mansfieldite constitutes the aluminous end member of an isomorphous series, of which scorodite is the ferric iron end member. Mansfieldite and intermediate members of the series were formed at Hobart Butte, Lane County, Oregon, probably in Miocene time by hydrothermal solutions that reacted with Eocene kaolinitic clay. The arsenates of aluminum and iron form colloform crusts along open cavities in the clay and are associated with realgar, stibnite, pyrite, quartz, siderite, and kaolinite-dickite.

Mansfieldite is white to pale gray, has a vitreous luster, a hardness of about 3.5, a spherulitic or axiolitic structure, and occurs as porous, cellular masses ranging in length from a few centimeters to 20 centimeters. Its specific gravity is 3.031. Its optical properties are: indices of refraction, $\alpha = 1.622$, $\beta = 1.624$, $\gamma = 1.642$; 2V = medium small; optical character, positive; dispersion, $r > v$.

The x-ray patterns of the mansfieldite-scorodite series by Joseph M. Axelrod are strikingly similar and undoubtedly represent isostructural minerals. The optical and x-ray data together with the similar structure of mansfieldite and aluminous-scorodite at Hobart Butte indicate that mansfieldite is orthorhombic. A curve, in which the indices of refraction of mansfieldite and scorodite are plotted with reference to Al_2O_3 and Fe_2O_3, indicates that the chemical composition of any member of the mansfieldite-scorodite series can be determined from its optical properties.

The possibilities of isomorphism between mansfieldite-variscite, mansfieldite-strengite, variscite-strengite, variscite-scorodite, and strengite-scorodite are also discussed.

NONTRONITE IN THE PACIFIC NORTHWEST*

VICTOR T. ALLEN AND VERNON E. SCHEID

Several new occurrences of nontronite have been discovered in Washington, Idaho, and Oregon during the investigation of high-alumina clay by the Geological Survey, U. S. Department of the Interior. The nontronite forms from basaltic glass, palagonite, iddingsite, and augite under conditions of poor drainage in the presence of alkalies or alkaline earths, especially magnesium. Under conditions of thorough drainage in the presence of

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neutral or slightly acid solutions kaolinite and halloysite form from plagioclase feldspar while nontronite migrates and fills vesicles as well as cracks ranging from a fraction of an inch to six inches in width. From large veins near Spokane, Colfax, and Garfield, Washington, three new nontronites have been analyzed and their optical properties and geologic relationships have been determined.

INVESTIGATION OF THE MICACEOUS MINERALS IN SLATE

THOMAS F. BATES

A mineral of the illite group has been found in the slates from the Lehigh-Northampton district of northeastern Pennsylvania. Identification of the material has necessitated a careful investigation of each of the other micaceous minerals, namely sericite and chlorite.

Froth flotation and supercentrifuge techniques were used to separate the fine-grained micaceous particles from the other minerals in the slate. Pure concentrates of each of the micas could not be obtained.

Optical investigation showed the relation of the micas to the textures and to the other minerals of the slate but did not furnish proof of the presence of an illite mineral.

X-ray diffraction methods served to distinguish chlorite from the other two micaceous minerals but were not satisfactory in differentiating between sericite and illite.

Differential thermal analyses gave endothermal peaks characteristic of an illite mineral and also yielded information as to the nature of the chlorite.

Electron micrographs were used to advantage in the study.

CORNETITE AND PSEUDOMALACHITE

L. G. BERRY

New observations combined with the existing chemical analysis on cornetite from Bwana Mkubwa, Northern Rhodesia, lead to the following description of the mineral: Orthorhombic, dipyramidal with space group $D_{2h}^{15} - Pbca$; the unit cell with $a = 10.86 \pm 0.04$, $b = 14.05 \pm 0.05$, $c = 7.11 \pm 0.02$ kX, $a:b:c = 0.7730:1:0.5061$; contains $24CuO \cdot 4P_2O_5 \cdot 12H_2O = 8[Cu_3PO_4(OH)_3]$; calculated specific gravity 4.10. Crystals commonly dipyramidal, showing forms $d(210)$, $v(121)$, $n(021)$, $p(221)$; with $(021):(0\bar{2}1) = 90°42'$ (calc.). No cleavage observed. Specific gravity 4.10 (Hutchinson and MacGregor). A single crystal of cornetite from Katanga, Belgian Congo, yielded lattice constants in good agreement with the values given above.

Pseudomalachite from Rheinbreitinbach, Germany, dihydrite from Ehl, Germany, and ehlite from Nizhni Tagilsk, Russia, give identical x-ray powder patterns which are distinct from the pattern of cornetite.

ARTIFICIAL METAMORPHISM OF MINERALS

M. J. BUERGER

Metamorphic textures imply grain growth. Theoretically, this can be experimentally produced by heating a mineral aggregate containing grains of high energy. Such grains can be provided by plastic deformation. Guided by this theory, many monomineralic aggregates have been experimentally metamorphosed by treating them in the following steps: (1) the aggregate is first plastically deformed by application of intense pressures, (2) the deformed aggregate is heated above a certain critical temperature. Above this temperature, which varies with the crystal species, the aggregate recrystallizes. The grain size increases with the time and temperature of heat treatment. The whole process has been followed by x-ray studies, which demonstrate the reality of strain in the plastically deformed aggregate, followed by release of strain and grain growth in the heated aggregate.

INTERNAL STRUCTURE OF GRANITIC PEGMATITES*

E. N. CAMERON, R. H. JAHNS, A. H. MCNAIR, AND L. R. PAGE

It has long been recognized that many pegmatite bodies are divisible into lithologic and structural units of contrasting composition or texture, but no classification of these units applicable to large groups of pegmatites has appeared. Recent investigations of pegmatite mineral deposits by the Federal Survey during a period of unusually widespread mining operations gave an exceptional opportunity for detailed structural analysis of pegmatite bodies. Some forty geologists were engaged in this work, chiefly in South Dakota, Colorado, Wyoming, Idaho, New Mexico, the Southeastern States, and New England. Comparisons of findings indicate that certain types of lithologic and structural units are common in pegmatites studied in all districts. The various types will be described and illustrated, and a general classification of pegmatite units will be discussed.

LINEAR ANALYSIS OF A MEDIUM-GRAINED GRANITE

FELIX CHAYES

The design and results of an experimental evaluation of the precision of linear analysis are described. It is shown that no systematic error is introduced by duplicate or multiple measurements of the same grain, providing the traverses are evenly spaced throughout. The precision error, whether of a single linear analysis or of a mean based on a group of such analyses, varies directly with the traverse interval. The mean of a large number of linear analyses will not differ from a true Rosiwal analysis of the same group of slides.

Numerical statements of these conclusions are given for the Woodstock, Maryland, granite as analyzed by the writer on the Hurlbut and Wentworth-Hunt micrometers. The precision error of a single analysis is small in comparison to differences between thin sections; in this case it may be neglected. It is shown by comparison of Hurlbut- and Wentworth-stage results that the precision of the two instruments is of the same order.

MICROANALYSIS BY X-RAY DIFFRACTION

J. D. H. DONNAY

Good x-ray powder patterns have been obtained from polycrystalline samples of low-quartz weighing only a few micrograms. The weight of the smallest sample thus identified was about 0.003 or 0.004 milligram.

CONTROLLED LOW VOLTAGE DRILLING AND REAMING OF DIAMONDS

W. B. EMERSON

An electrolytic method for drilling secondary cones of wire-drawing diamond dies of .0005–.0015″ diameter is described. Excellent cones of .006–.008″ depth and having the correct contour are produced with applied potentials of 90–120 volts in much less time than is required to drill similar cones by customary mechanical procedures. Likewise, the sharp edges formed at the intersection of the bearing and cup cones of a die may be relieved by electrolytic drilling.

MAXIMUM ERROR IN SOME MINERALOGIC COMPUTATIONS

H. W. FAIRBAIRN AND C. W. SHEPPARD

The notable lack of quantitative information regarding errors in many mineralogic computations has prompted the writers to construct a series of diagrams from which such information can be readily obtained. These include various determinative methods for

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density, refractive index, birefringence, and optic angle. Assuming a skilled operator and good working material, maximum values of the error in single observations are assigned to each procedure, so that the diagrams depict "worst" values of error rather than "probable" error as determined by standard methods from a series of observations. Comparison of the various procedures is based on this maximum expected error.

STRIKING CASE OF PEGMATITIC ALBITIZATION

D. JEROME FISHER

At the High Climb pegmatite (six miles north of Custer, S. Dak.), vein-like masses of quartz-cleavelandite rock invade large crystals of microcline microperthite. Specimens of the latter from the contact show the development of chess-board albite by replacement for a distance of an inch or two. This is well brought out in a 3 by $3\frac{1}{2}$-inch thin-section made from this material. Kodachromes of most of the whole thin-section, and also of selected portions of it, will be shown and described. Some of these views (in black and white) appear in Report of Investigations No. 50 (1945) of the South Dakota Geological Survey. In addition this large thin section carries many tiny poikilitic cleavelandites, generally as anhedral individuals or pairs. In other thin sections these are aggregated into vein-like masses. The evidence showing these formed early in the paragenetic sequence will be summarized. A kodachrome of a giant beryl crystal at the Ingersoll Mine near Keystone will also be presented.

BASTINITE, A NEW PEGMATITE PHOSPHATE

D. JEROME FISHER

Bastinite occurs as tiny triclinic crystals of modified parallelopipedal habit, very rarely appearing along fractured surfaces of lithiophilite of the Custer Mountain Lode, two miles east of Custer, South Dakota It is transparent, nearly colorless, brittle, without cleavage, H. 4, F. 1. It is non-pleochroic, with $\alpha=1.649$, $\beta=1.655$, and $\gamma=1.658$; $(-)2V=73°$. It is a phosphate of lithium, with iron and manganese; it is readily soluble in dilute mineral acids. Along the lithiophilite fractures are found lilypad-shaped films of sicklerite or its alteration products; the bastinite occurs as drusy aggregates fringing but not overlapping these, and is thought to be of very late hydrothermal origin. The name is after Edson S. Bastin, a long-time colleague of the writer, who made significant contributions to the study of pegmatites.

PROJECTIONS AND ZONES

D. JEROME FISHER

The quadruple primitive gnomonogram (QPG) is the quadrilateral in the gnomonic projection joining the face poles {111} (except in the hexagonal); a similar figure in the stereographic projection is the quadruple primitive stereogram (QPS). The quadruple primitive enthygram (QPE) is the quadrilateral in the gnomonic projection plane joining the zone-poles ⟨111⟩ (except in the hexagonal); the corresponding figure in the stereographic constitutes the quadruple primitive cyclogram (QPC). Each of these figures may be divided into four portions by "bisectors," lines joining the "middles" of their sides. The QPG and QPE are reciprocal quadrilaterals; they coincide only in the isometric. Relations among these various figures, as well as their uses in crystallography (with examples) are pointed out.

THE OCCURRENCE OF TUNGSTEN AND VANADIUM IN MANGANESE OXIDE ORES AND MINERALS*

MICHAEL FLEISCHER, S. K. NEUSCHEL, AND J. M. AXELROD

The occurrence of tungsten in manganese oxide ores was first noted by Penrose in 1890 and since has been discussed by several authors. Vanadium has been reported in four analyses of manganese oxides. New analyses in the Chemical Laboratory of the Federal Geological Survey have shown that these elements occur commonly in manganese oxide ores, especially in those from the southwestern United States. Over fifty new occurrences have been noted and many more will doubtless be found by systematic chemical testing.

In some deposits, the tungsten and vanadium content of the ore varies directly with the manganese content, indicating that the tungsten and vanadium are in the manganese oxide mineral. This is not true of a few deposits, including that at Golconda, Nevada. *X*-ray study and chemical analysis show that tungsten and vanadium occur most frequently in manganese oxides that contain barium. Over three-fourths of the tungsten-bearing samples studied are the barium manganate psilomelane. Over two-thirds of the vanadium-bearing samples studied are either psilomelane or hollandite.

No generalizations can yet be made as to the origin of the tungsten-bearing and vanadium-bearing manganese oxide ores. Many are of hydrothermal origin, but some appear to be secondary.

MINERALOGY OF CONCRETIONS FROM PITTSBURGH COAL SEAM, MONONGALIA COUNTY, WEST VIRGINIA

WILDER D. FOSTER AND FLORENCE L. FEICHT

Four concretions were found in the Pittsburgh coal bed at Pursglove, Monongalia County, West Virginia, and were collected for study to get a better understanding of acid formation in the mine. Three of the concretions were mainly pyrite and the fourth was mainly dolomite. Associated with one or more of these concretions were these minerals: analcite, brammallite, calcite, dolomite, kaolinite, melanterite, pyrite, and an unknown mineral. The Pittsburgh coal bed is of Pennsylvanian age, and the base of the Monongahela formation. Analcite has been found in sedimentary rocks, identified as a constituent of boiler scale, and synthesized under hydrothermal conditions. In all cases it has been formed under alkaline conditions; it is decomposed by acid. It is supposed that alkaline solutions containing sodium reacted with a clay to form the analcite. Acids in the coal bed could have been neutralized by ground water passing through a limestone bed a few feet above the coal.

Analcite was synthesized at atmospheric pressure and 90°C. by allowing NaOH solution to react on kaolinite for 29 days. Only a small amount was formed; most was unidentified material.

MINERAL SHAPE FACTORS FOR USE IN QUANTITATIVE MICROSCOPIC ANALYSIS

WILFRID R. FOSTER

The problem of correcting for grain shape differences among the various constituents of granular mineral mixtures has been approached in a somewhat different manner than heretofore. Shape factors have been derived directly from the following equation relating grain volume to the projected grain area as viewed under the microscope: $V = KA\sqrt{A}$. A simple and rapid method for deriving the shape-factor of any desired mineral has been

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developed. It has been found that such factors, when used in the analysis of standard mineral mixtures are capable of yielding accurate results.

SECONDARY DAUPHINÉ TWINNING IN QUARTZ PRODUCED BY SAWING

CLIFFORD FRONDEL

Instances are described in which Dauphiné twinning has been formed artifically in quartz by sawing. The secondary twinning occurs as a very thin surface layer, usually on one side of the saw cut only, and seems to have been produced by frictional heat developed at the cutting edge of the saw blade. The twinning often is restricted to particular growth zones in the quartz. The tendency to twin is related to the tendency of the quartz to become smoky in color when irradiated with x-rays, easily twinned quartz being relatively little affected, and not to the original smoky color. The frequency-thickness constant, K, of easily twinned quartz is relatively low; and that of natural deep smoky quartz increases when the color is baked out. These observations and the apparently significant variations reported in the density, cell dimensions, rotatory power and indices of refraction may stem from a defect structure in the substance.

The boundaries of some natural Dauphiné twins in quartz correspond with natural smoky color zones. In these specimens the original boundary of the twin is returned more or less exactly when the crystals are reinverted at 573°C., and a differential smoky coloration opposite to that existing initially is effected across the original twin boundary by radiation. Brazil and natural Dauphiné twins of colorless quartz sometimes also are differentially colored by radiation.

FREQUENCY OF TWINNING IN QUARTZ CRYSTALS*

H. R. GAULT

More than 900 singly and doubly terminated quartz (low) crystals from five different geologic and geographic locations were etched with HF acid to show external twin boundaries. Most observations were made on the terminal faces.

In addition to untwinned crystals, twins of the Dauphiné, Brazil, combined Dauphiné-Brazil, and Liebisch types were observed.

The proportions of untwinned and twinned crystals and of twin types vary considerably from locality to locality. At each locality untwinned and Dauphiné crystals are about equally divided between right- and left-handed quartz. Any crystal twinned according to (1) the Brazil law, (2) the Dauphiné-Brazil laws combined, or (3) the Liebisch law shows both right and left quartz but one or the other generally predominates. The number of crystals with right quartz predominating is about equal to the number with left quartz predominating.

At least 100 crystals from a given locality should be examined to determine the frequency of twinning.

Further work is in progress to determine if in some cases twin boundaries are confined to the interior of a crystal.

OCCURRENCE OF MICA-BEARING PEGMATITES IN THE SOUTHEASTERN STATES*

W. R. GRIFFITTS, E. WM. HEINRICH, R. H. JAHNS, J. C. OLSON,
AND J. M. PARKER III

Mica-bearing pegmatite has been mined extensively in the southeastern United States, particularly in eleven well-defined districts. The Spruce Pine and Franklin-Sylva districts in the Blue Ridge province of North Carolina, and the Alabama and eastern Virginia Pied-

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mont areas are geologically representative of the entire group. Nearly all the deposits occur in mica and hornblende gneisses and schists, and appear to be genetically related to near-by leucocratic intrusive rocks that range in composition from quartz monzonite to quartz diorite. About four-fifths of the pegmatites in the Alabama and Spruce Pine districts are sills or concordant tongues and lenses; most of the others in the Spruce Pine district are dikes in coarse-grained granodiorite and quartz diorite. In contrast, most of the Franklin-Sylva and Virginia pegmatites are steeply dipping dikes, discordant lenses, and more complex bodies.

Plagioclase, quartz, microcline, and muscovite are the dominant pegmatite constituents. Biotite, garnet, and apatite are common accessories; beryl, tourmaline, and sulfide minerals are sparse but widespread in some districts; and lithium, tantalum-columbium, tin, and uranium minerals are rare except in a few Virginia deposits. Nearly all the pegmatite bodies appear to have formed from the walls inward, perhaps by crystallization from liquid. Definite evidence for or against their development by large-scale, complete or nearly complete replacement of pre-existing pegmatite is almost lacking. Although some of the minerals and mineral aggregates plainly were formed by replacement, only a small proportion of material can be assigned such an origin with assurance.

HIGH TEMPERATURE THERMAL EFFECTS OF CLAYS AND RELATED MATERIALS*

R. E. GRIM AND W. F. BRADLEY

A selected series of clay minerals and related silicates are examined by thermal, optical, and x-ray diffraction methods with a view toward establishing the significance of the various observed thermal effects. The heating range for the thermal curves is extended to 1300°C., and the study of specimens so fired is supplemented by the examination of the various materials after firing to several intermediate temperatures.

Detailed hypotheses are presented for the mechanisms of several of the structural changes observed as new phases are developed and the influence of types of structures upon the nature and rapidity of such changes is discussed.

DICKITE AND CHROMIUM SILICATE IN THE IRON ORES OF THE MARQUETTE AND GOGEBIC RANGES, MICHIGAN

JOHN W. GRUNER

Dickite has been found in the Mather and Cambria Jackson mines on the Marquette Range. It is a massive variety cementing soft earthy hematite breccia. It is white and has silky luster. Under the microscope it is fibrous. Its optical constants agree with published ones. It gives a very fine x-ray pattern.

Some earthy hematite in the Mather Mine contains a waxy, emerald green mineral which gives a poor x-ray pattern of a mica-like substance. It has parallel extinction and fairly high birefringence. Its indices are similar to muscovite. It contains at least 12.7% Cr_2O_3. Similar chromium-bearing silicates, though more like kaolinite and chlorite, have been found in the Sunday Lake and Montreal mines on the Gogebic range. At Montreal they occur in the ore. At Sunday Lake they are associated with the "footwall slate."

ISOSTRUCTURAL RELATIONSHIP OF AlPO$_4$ AND SiSiO$_4$

JOHN W. GRUNER

Huttenlocher (1935) has shown that the structure of AlPO$_4$ and α quartz are very closely related. Their optical properties, densities and hardnesses are also surprisingly similar. Their unit cells are almost identical in size except for a doubling of the c axis. Struntz has shown (1942) that berlinite found in Sweden and listed in mineralogy texts as AlPO$_4 \cdot$ H$_2$O is identical with AlPO$_4$, possessing the quartz structure. The author has confirmed the experiments of Huttenlocher and has been able to grow needles of AlPO$_4$ on sand grains of quartz in oriented patterns, also on some faces of quartz crystals.

In other experiments with AlPO$_4$ in bombs between temperatures of 150–250°C. microscopic snowflake-like crystals of α tridymite structure were formed. These have indices close to 1.46. Their density is in neighborhod of 2.30. Wavellite and variscite when heated in a crucible to low redness for a short time also assume the structure of tridymite. Under certain conditions in bomb experiments between 300° and 480°C. AlPO$_4$ forms cristobalite structures. The very small almost microscopic aggregates have indices of $1.465 \pm .002$ and a density of 2.28–2.29. The AlPO$_4$ α quartz structure (berlinite) will slowly invert to the cristobalite structure at 850° to 1000°C. Amorphous chemical precipitates of AlPO$_4$ when heated to 675°C., or above, give the cristobalite x-ray pattern. The writer does not believe that a β tridymite structure of AlPO$_4$ exists.

CHROMITE DEPOSITS OF CAMAGUEY PROVINCE, CUBA*

PHILIP W. GUILD AND DELOS E. FLINT

The chromite-bearing ultramafic complex near Camaguey, Cuba, mapped as a part of the program of mineral investigations of the Federal Geological Survey, consists chiefly of serpentinized peridotite (harzburgite) and dunite, with minor amounts of the feldspathic rocks gabbro, troctolite, and anorthosite. This complex and the overlying Cretaceous tuffs and limestones were severely deformed in an orogeny which culminated in extensive thrust faulting, probably in late middle Eocene time. The sedimentary rocks now occur in two synclinal arcs extending across the district parallel to the trace of the thrust. The feldspathic rocks of the complex flank the tuffs along the limbs of the syncline, indicating that they were concentrated in the upper part of the complex.

The chromite occurs as tabular or lenticular bodies of massive, coarse-grained, or occasionally fine-grained disseminated ore. Virtually all the known deposits are near the base of the feldspathic zone, but with an irregular lateral distribution which distinguishes them from the layered chromitites of the Bushveld-Stillwater type. Two possible modes of origin are discussed: (1) segregation of the deposits near the feldspar-peridotite boundary after emplacement of the magma through some process of gravity separation and magmatic flow; (2) differentiation of chromite at great depth before intrusion and transportation of the ore bodies as solid masses to their present position. The grouping into clusters, as though near feeders, and the massive texture and sharp contacts of many of the deposits suggest that the latter hypothesis is more probable.

BERYLLIUM AND TANTALUM PEGMATITES OF COLORADO*

JOHN B. HANLEY

The beryllium and tantalum minerals of Colorado pegmatites are found together in the same structural units of the pegmatites, but in a variety of mineralogical associations. Beryllium-tantalum pegmatites are particularly abundant in Larimer, Fremont, and Gunnison counties, although a few occur in other parts of the state.

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During detailed mapping in 1942–44 by geologists of the U. S. Geological Survey, 51 individual pegmatites containing concentrations of beryl, chrysoberyl, columbite-tantalite, or microlite were studied. The largest concentrations of these minerals are in the intermediate zones of the pegmatites, although minor concentrations occur in all zones.

Beryl, the most common beryllium mineral, occurs in subhedral to euhedral crystals with a high beryllia content. It is associated chiefly with albite, muscovite, and quartz, as at the Devil's Hole, Mica Lode, and Hyatt Ranch pegmatites, or with lepidolite, cleavelandite, and quartz, as at the Brown Derby and the Meyers' mine pegmatites. Chrysoberyl appears to be most abundant at the Wisdom Ranch pegmatite, but is not very abundant in any pegmatite.

Columbite-tantalite is the most widespread tantalum mineral. Commonly it is associated with beryl, albite, muscovite, and quartz, and occurs particularly in the intermediate zone, for example at the Devil's Hole, Bigger, and Meyers' Ranch pegmatites. Microlite is common in the pegmatites of the Quartz Creek District, where it occurs with beryl, lepidolite, cleavelandite, topaz, and quartz. The Brown Derby and White Spar No. 1 pegmatites show examples of this association.

LITHIA PEGMATITES OF THE BROWN DERBY MINE, GUNNISON COUNTY, COLORADO*

JOHN B. HANLEY

Three parallel, elongate lithia pegmatites crop out at the Brown Derby mine in sec. 3, T. 49 N, R. 3 E., Gunnison County, about 17 miles by airline due east of the town of Gunnison, Colorado. These pegmatites were studied and mapped at various times in 1942, 1943, and 1944 by geologists of the U. S. Geological Survey.

The three pegmatite bodies, designated the No. 1, No. 2, and No. 3 dikes, strike N. 56° E., across the schistosity of the meta-diorite wall rock, and have a general dip of 30° to 35° SE. The No. 1 dike has an exposed length of about 900 feet and a maximum thickness of 20 feet. The other dikes are not as long but are as thick or thicker. The general plunge of the No. 1 dike probably is 22° S. 28° E., and so far as is known the ore concentrations beneath structural rolls in the hanging-wall contact are parallel to this plunge.

Well-defined mineralogical and textural zones, recognized by contrasts in kinds and proportions of component minerals, are characteristic of these pegmatites. The zones are nearly parallel to the walls, and in general conform to the structure of the pegmatite bodies.

Lepidolite and microlite are the economically important minerals. These commonly are associated with quartz, cleavelandite, topaz, and beryl. Lithia, tourmaline, microcline, muscovite, zinnwaldite, biotite, fluorite, gahnite, betafite, garnet, columbite, and monazite also occur in these pegmatites, but in different zones.

COMPOSITE PEGMATITES OF THE FRANKLIN-SYLVA MICA DISTRICT, NORTH CAROLINA*

E. WM. HEINRICH

Granite occurs in eleven mica-bearing pegmatites in the Franklin-Sylva district, North Carolina. In some it is flanked by later pegmatite, but in others it appears to have been intruded along the central part of the pegmatite during the final stages of pegmatite consolidation. Granite also occurs as inclusions and as narrow dikes that cut across the mica deposits. Both rocks appear to be related in origin to the large masses of Whiteside granite that lie along the southeast side of the mica district.

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BISMUTH MINERALS IN COLORADO AND NEW MEXICO PEGMATITES*

E. WM. HEINRICH

Bismuth carbonates occur in pegmatites in Fremont, Park, and Gunnison counties, Colorado, and in the Petaca district, Rio Arriba County, New Mexico. In many deposits they appear to be alteration products of late-stage fracture-filling bismuth sulfides or sulfosalts. The most common species is bismutite (Bi_2CO_5), but beyerite, a carbonate of bismuth and calcium, was identified by x-ray powder methods from two localities.

PORTABLE DIFFERENTIAL THERMAL ANALYSIS UNIT FOR BAUXITE EXPLORATION†

STERLING B. HENDRICKS, SAMUEL S. GOLDICH, AND REUBEN A. NELSON

A small differential thermal analysis unit that embodies the fundamental features of larger laboratory models is designed for field exploration for bauxite and related materials. The apparatus, requiring only a source of electrical power, combines portability with ease of operation and rapid analysis. The portable unit is suitable for quantitative work and has been successfully applied in bauxite exploration on the island of Hispaniola.

THE WHITE ARSENIDES OF NICKEL AND COBALT OCCURRING AT FRANKLIN, N. J.

RALPH J. HOLMES

Koenig, in 1889, described a white arsenide of nickel and cobalt from Franklin, noting that although isometric crystals were present, the material was "generally prismatic." Nevertheless, he regarded the massive prismatic material and the encrusting isometric crystals as a single homogeneous mineral, chloanthite.

Several specimens agreeing with Koenig's description were studied. X-ray and microscopic data show this material to be a complex mineral instead of the single isometric arsenide, as assumed by Koenig. An isometric arsenide, skutterudite, containing both cobalt and nickel is present but is a minor constituent encrusting large nodular masses of rammelsbergite intergrown with pararammelsbergite (Koenig's prismatic material). The orthorhombic nickel arsenides are in part rimmed with gersdorffite.

Data on the properties and relations of the several minerals are presented. The study shows that the orthorhombic minerals rammelsbergite and pararammelsbergite are the principal white arsenides of cobalt and nickel in the specimens observed. It confirms the presence of an isometric arsenide, skutterudite, but shows it to be a minor component. Pararammelsbergite and gersdorffite, not previously reported, are added to the ever growing list of species found at this locality. The presence of rammelsbergite has already been pointed out by the writer. The recognition of skutterudite does not add to the total list of species since it merely replaces Koenig's term chloanthite for the isometric arsenide.

THE PREPARATION AND STANDARDIZATION OF DIAMOND POWDERS

HERBERT INSLEY AND B. L. STEIERMAN

A brief account is given of the methods used and the results obtained in a study of grain size separation of diamond dusts with a view to recommending an adequate and practical apparatus for separating size fractions of diamond dusts commercially.

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BAUXITE "EGGS"

PAUL F. KERR

More or less spheroidal aggregates of bauxite are found at Poços de Caldas, Brazil, and in Surinam. These egg-like shapes are believed produced by gel-shrinkage at a final stage in lateritization. The forms are at times hollow or may be filled with white gibbsite powder and exceed by several inches the usual diameters of pisolites. At Poços de Caldas joint blocks in phonolite are considered to have altered in situ, first to laterite, subsequently to bauxite "eggs." In Surinam relict outlines of earlier rock are retained in the spheroids. The interpretation of the significance of the forms is based upon field observations at Poços de Caldas and laboratory study of both sets of materials. Microscopic, x-ray, and chemical methods of investigation have been employed.

BONDED DIAMOND WHEEL APPLICATIONS

A. A. KLEIN AND C. R. VAN RIPER

The use of bonded diamond wheels is briefly considered, the fields of application being: precision and off-hand grinding of cemented carbides and the grinding of quartz, sapphire, ophthalmic lenses, plate glass, glass prisms, granite and marble.

OCCURRENCE AND DISTRIBUTION OF IRON MINERALS IN PENNSYLVANIA FIRE CLAYS

EARL LEATHAM

Millions of tons of flint fire clay occurring in Clearfield and adjoining countries of Pennsylvania are of no industrial value because of the high content of iron minerals. The amount of iron minerals expressed as Fe_2O_3 usually varies between 8 and 15 per cent. A study of the occurrence and distribution of the iron minerals was made to evaluate the possibility of removing the iron by beneficiation.

The contact print method, as described by Gregorie Gutzeit, was used because it was simple and rapid. Gelatin-coated white paper treated with the proper reagents was pressed against a polished surface of clay. A colored iron compound was formed opposite each iron mineral.

It was found that most of the iron occurred as siderite with minor amounts of pyrite or marcasite. There was marked variation in the size of the siderite crystals from different parts of the area. In one relatively small area, the siderite crystals averaged 0.5 millimeters in diameter. Probably this clay could be beneficiated. Throughout the greater part of the area, the diameter of the siderite crystals averaged less than 0.02 millimeters. It is doubtful if such clay could be beneficiated commercially.

OCCURRENCE OF BROMINE IN CARNALLITE AND SYLVITE FROM UTAH AND NEW MEXICO

MARIE LOUISE LINDBERG

Both carnallite and sylvite from Eddy County, New Mexico, contain 0.1 per cent of bromine. The bromine content of these minerals from Grand County, Utah, is three times as great. No bromine was detected in halite, polyhalite, langbeinite, or anhydrite from New Mexico. Iodine was not detected in any of these minerals.

On the basis of the bromine content of the sylvite from New Mexico, it is calculated that 7,000 tons of bromine were present in potash salts mined from the Permian basin during the period 1931 to 1945.

CONSTRUCTION AND STUDY OF FLOW STRUCTURE MODELS FROM FIELD DATA

KURT E. LOWE

Investigators of intrusive rocks on a regional or reconnaissance scale frequently lack

both time and facilities for petrofabric study with the universal stage. Limited or inadequate exposures may add to the difficulty of ascertaining flow structures in the field. The construction of transparent models based on field measurements has proven helpful in the study of the Storm King granite of the Hudson Highlands and is suggested as a useful laboratory and training device.

Field measurements are made on 8 to 10 exposure surfaces of varying orientation including strike and dip of surface, pitch of lineation, mineral pattern (field sketches), fracture systems, etc. A plan of the model is laid out on graph paper, starting with a top horizontal plane bounded by lines of intersection (strike lines) with the measured inclined surfaces suitably grouped by parallel translation. For a given model height, auxiliary scales are prepared for the vertical projection (A) and true length (B) of planes dipping 0° to 90°. The ground plan is drawn (using A) and the cut-out pattern constructed (using B) by rotating each surface into the top plane about its top edge. An ink tracing is made on transparent cellulose acetate (.015″ thick) and mineral lineation, distribution pattern fracture traces, etc. are added from field notes. The acetate is cut, folded and bonded to form the model.

Orientation of the model on a compass rose provides a means of determining flow structures with a degree of accuracy within limits of error inherent in the original field measurements.

A GRAPHIC SOLUTION FOR CERTAIN LINEATION PROBLEMS

KURT E. LOWE

The coordinates of linear flow structure can be determined graphically from field measurements provided it is not complicated by the presence of flow layers and the linear elements are minerals possessing prismatic habit with essentially equi-dimensional cross-section (e.g. quartz, hornblende, pyroxene).

The method is based on a simple geometric relationship involving an ideal, cylindrical linear element cut by a plane (=exposure surface). The long axis of the cutting-ellipse (=direction of surface lineation) and the cylinder axis (=orientation of linear structure) lie in a plane normal to the cutting plane. Two such normal planes derived from two different cutting planes intersect in the sought axis of the cylinder.

Strike and dip of an exposure surface and pitch of its mineral lineation are measured in the field and plotted on a Wulff net in the conventional manner. By rotating the net a plane (N) is found which contains both the line of lineation and the plane-normal to the surface. This procedure is repeated for at least 8 surfaces of different orientation. In the ideal case all resulting N-planes intersect in a single line. Actually multiple answers for the linear orientation result, depending on the approach of field conditions to the theoretical ideal. The problem is solved by statistical determination of the arithmetical median from all the possible bearings and plunges arranged in numerical order.

Encouraging results have been obtained by application of this method to the hornblende orientation in the Storm King granite of the Hudson Highlands.

AN UNRECORDED ALTERED PERIDOTITE DIKE IN SYRACUSE, NEW YORK

JAMES E. MAYNARD AND LOUIS W. PLOGER

The rock investigated occurs near the intersection of Salt Springs Road and East Genesee Street, Syracuse, New York. Where exposed, it intrudes the nearly horizontal Camillus Formation as a dike-like mass approximately 51 inches wide. The material, largely altered, consists of small grains, small composite fragments and greenish brown, friable, masses that occasionally are porphyritic in appearance. Geologic, petrographic and chemical stud-

ies show that this material has resulted from the alteration of a rock of the peridotite family.

The altered peridotite consists, primarily, of serpentine, pyroxene (probably hypersthene), vermiculite, iron oxides and perofskite. In addition there are small quantities of olivine, hypersthene, phlogopite, apatite, andesine, quartz and carbonates. Including the secondary minerals with the minerals from which they were derived, preliminary investigation suggests that hypersthene, olivine and phlogopite are the essential minerals of the unaltered rock. According to Johannsen's classification, therefore, the unaltered rock may be tentatively classified as a hypersthene-phlogopite peridotite (417).

PETROLOGY OF THE NEPHELINE AND CORUNDUM-BEARING ROCKS OF SOUTHEASTERN ONTARIO

LOUIS MOYD

Southeastern Ontario is noted for its great variety of unusual rocks and rare minerals. However, there appears to have been no concerted effort to develop a clear and logical picture of the genetic relations of such diverse types as the foliated nepheline and corundum-bearing rocks, rare element-rich pegmatites, calcite-rich "vein-dikes," dark gneisses, and marbles.

After several years in the field, a distinct pattern became apparent to the author. Field evidence indicates that most of the nepheline and corundum-bearing rocks, among others, are migmatites, formed from pre-existing rocks of the Grenville Series. Since many other regions have been invaded by granitic magmas without development of similar migmatites, some factor peculiar to this region must be considered. The author believes that paucity of silicious rocks and superabundance of marbles in the Grenville provide the key.

The genetic sequence would be first, the intrusion of granitic masses into the silica-poor Grenville terrain. These for the most part would crystallize normally, giving rise to usual silicious pegmatites and emanations and granitizing the gneissic country rocks. However, some of the magma would react with the dolomitic marbles, releasing emanations rich in carbon dioxide. These emanations, while traversing the silica-poor country rocks would lose much of their silica, forming granitic and syenitic migmatites and finally, impoverished in silica, would form more unusual migmatites. These mineralizer-rich emanations could convert the high lime feldspars of the dark gneisses to alkali feldspars, releasing alumina to form nepheline or corundum, and lime to produce the ubiquitous pockets of calcite, accompanied by fluorite, apatite, sphene, scapolite, and other minerals containing lime in combination with mineralizers.

STUDIES OF MINERAL SULPHO-SALTS: XI—WITTICHENITE (KLAPROTHITE)

E. W. NUFFIELD

Wittichenite and klaprothite were undistinguished under the name Kupferwismutherz, later wittichenite, until Petersen (1868–1869) restricted wittichenite to the mineral with the composition $3Cu_2S \cdot Bi_2S_3$, and proposed klaprothite for a mineral resembling emplectite $(Cu_2S \cdot Bi_2S_3)$ which gave a composition near $3Cu_2S \cdot 2Bi_2S_3$. X-ray examination of numerous specimens labelled wittichenite or klaprothite from the Wittichen mines, Baden, gave only wittichenite and emplectite. The wittichenite pattern is identical with that given by the homogeneous fusion product $3Cu_2S \cdot Bi_2S_3$. A crystal, part of which gave the wittichenite pattern, yielded the orthorhombic unit cell with $a = 7.66$, $b = 10.31$, $c = 6.69$ kX; space-group $P2_12_12_1$; contents $2[3Cu_2S \cdot Bi_2S_3]$. Many published observations on "klaprothite" evidently refer to wittichenite and it appears that Petersen's analyzed "klaprothite" was a mixture of wittichenite and emplectite.

NOTES ON THE STRUCTURE OF DELAFOSSITE

A. PABST

In a previous report it was shown that delafossite probably has the same structure as artificial $CuFeO_2$. The density corresponding to this structure, 5.52, agrees closely with the best measured value, 5.41, reported in the 7th edition of Dana's System of Mineralogy.

Published accounts of powder patterns of delafossite cannot be fully reconciled with the requirements of the structure. It is recommended that even patterns intended only for identification should be indexed and checked against the literature.

The valence state of copper and iron in delafossite has been considered by Rogers. From a consideration of the intensities of powder diffraction lines it is possible to choose rather closely the single parameter of the delafossite structure. This determines the interionic distances Cu–O and Fe–O. From these one can draw conclusions as to the valence state of the copper and iron by comparison with corresponding interionic distances in other compounds of these metals. Such a comparison leads to the conclusion that delafossite is cuprous metaferrite, $Cu'Fe'''O_2$, as surmised by Rogers.

It is shown that it is a matter of indifference whether ionic or atomic f values are used in making the necessary intensity calculations since the calculated intensities vary much more with moderate changes in interionic distance than with change in the scattering power of the ions.

Incidentally it is also shown that certain ambiguities still remain in the stucture of delafossite. These cannot be relieved by the study of powder patterns alone which do not allow the discrimination of a parameter x from $\frac{1}{2} - x$.

CONTACT METAMORPHIC DEPOSITS OF CASSITERITE IN CALIFORNIA*

LINCOLN R. PAGE

Small quantities of cassiterite have been produced at the Evening Star mine in the Cima district, San Bernardino County, and from the Meeks mine in the Gorman district, Kern County, California. These deposits are of the contact metamorphic type and were investigated by the Geological Survey in 1940–1944.

The Evening Star deposit is in dolomite and dolomitic marbles near an intrusive body of quartz monzonite. Cassiterite occurs with scheelite, chalcopyrite, sphalerite, pyrite, and magnetite as disseminated grains, euhedral crystals, and massive aggregates in tremolite-serpentine-calcite rock. Near the surface hematite, limonite, malachite, chrysocolla, melaconite, calamine, and other secondary zinc minerals are common. Talc is associated with brecciated cassiterite along shear zones that cut the ore.

The irregular, lenticular ore bodies of the Evening Star deposit were formed by replacement of favorable beds along and outward from a mineralized zone which is 120 feet long and up to 20 feet wide.

In the Gorman district cassiterite has been identified in six small, irregular bodies of iron-rich tactite and limonitic gossan that occur in recrystallized limestone at the margin of a granite intrusive. The primary ore contains cassiterite, scheelite, powellite, pyrite, chalcopyrite, arsenopyrite, molybdenite, magnetite, epidote, tourmaline, ludwigite, amphibole, garnet, phlogopite, calcite, and quartz, though not all of these minerals occur in each deposit. The gossanin deposits such as the Neeke also contain malachite, chrysocolla, jarosite, gypsum, chalcedony, opal, cuprite, native copper, and clay minerals.

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STRUCTURAL AND MINERALOGICAL CHARACTERISTICS OF SOUTH DAKOTA PEGMATITES*

LINCOLN R. PAGE

Detailed structural and economic investigations of over one hundred and forty South Dakota pegmatites by members of the Geological Survey in 1939–1945 have shown that many of the pegmatites exhibit similar structural and mineralogical characteristics. These characteristics have a direct bearing on the origin of pegmatites as well as on mining practice.

The important structural features of these pegmatites are: (1) external shape, (2) zoning, (3) gneissic banding, (4) orientation of minerals, and (5) internal cross structures. These structural features show a definite relation to the planar and linear structures of the wall rocks. In most pegmatites concentrations of minerals can be related to these structures.

The distribution of minerals in all the pegmatites studied seems to follow a general sequence related to the internal zoning, but the abundance of any particular mineral is controlled by the composition of the liquid from which the pegmatite formed and the history of crystallization. Variations in the chemical composition of plagioclase, beryl, and columbite-tantalite have been noted in different parts of a pegmatite and appear to be systematic when related to zonal structure. These variations in chemical composition may be accompanied by differences in physical form and color. The alteration of spodumene and the consequent decrease in lithia content appear to be related in part to its structural position in a pegmatite. Preliminary investigations suggest that perthite and microcline, as well as flat and "A" books of muscovite also have a preferred structural position.

CLINOCLASITE

CHARLES PALACHE AND L. G. BERRY

Clinoclasite, $Cu_3AsO_4(OH)_3$, is described from a new locality, Majuba Hill, Nevada, from Cornwall, and from Utah, with complete revision of its morphology. Monoclinic; prismatic—$P2_1/a$. $a:b:c=1.9109:1:1.1223$, $\beta=99°\ 22'$; $p_0:q_0:r_0=0.5873:1.1073:1$, $\mu=80°38'$; $a_0=12.36$, $b_0=6.45$, $c_0=7.23$Å, $\beta=99°30'$. Forms: $c(001)$, $a(100)$, $m(100)$, $g(\overline{2}01)$, $o(111)$, $q(\overline{1}11)$, and others less certain. The relations of the new elements to those hitherto used are explained. There are 4 units of the formula given above in the unit cell. An x-ray powder photograph is given.

GNOMONIC AND LINEAR HEPTAXIAL TWO-CIRCLE CALCULATION

A. L. PARSONS

Referring an hexagonal crystal to three sets of orthorhombic axes and taking $\phi_{(1-3)}$ and $\phi'_{(1-3)(=90°-\phi)}$ alternatively, gnomonic calculation yields the following:
$\cos \phi_{1-3}$(or ϕ'_{1-3}) $\cdot \tan \rho =$

$$\frac{k}{l} \cdot \frac{c}{a} : \frac{(h+2k)c}{l\sqrt{3}a} : \frac{(h+k)c}{la} : \frac{(2h+k)c}{l\sqrt{3}a} : \frac{h}{l} \cdot \frac{c}{a} : \frac{(h-k)c}{l\sqrt{3}a}.$$

Linear calculation yields the following:
$\tan (90°-\rho)/\cos \phi_{(1-3)}$(or ϕ'_{1-3}) $=$

$$\frac{l}{k} \cdot \frac{a}{c} : \frac{l}{h+2k} \cdot \frac{\sqrt{3}a}{c} : \frac{l}{h+k} \cdot \frac{a}{c} : \frac{l}{2h+k} \cdot \frac{\sqrt{3}a}{c} : \frac{l}{h} \cdot \frac{a}{c} : \frac{l}{h-k} \cdot \frac{\sqrt{3}a}{c}.$$

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The linear constants are a/c and $\sqrt{3}a/c$ and the reciprocal gnomonic polar constants are c/a and $c/\sqrt{3}a$, which, as they may be interchangeable, might be indicated as p_0 and π_0. The gnomonic polar representation of the facts shown in the linear projection of a face ($hki\bar{l}$) is a circle with tan ρ as diameter, which is used for the graphical determination of the polar constants. The linear projection is shown to be well adapted for use in two-circle calculation.

The calculation of the reciprocal (polar) constants depends on two sets of triangles (not polar) which are homopolar, with one common angle, and with the sides adjacent to this angle having reciprocal tangents.

MONTBRAYITE, A NEW GOLD TELLURIDE

M. A. PEACOCK AND R. M. THOMPSON

Triclinic; $a=12.08$, $b=13.43$, $c=10.78$ kX, $\alpha=104°30\frac{1}{2}'$, $\beta=97°34\frac{1}{2}'$, $\gamma=107°53\frac{1}{2}'$; cleavages $(1\bar{1}0)$, $(0\bar{1}1)$, $(1\bar{1}1)$; $(0\bar{1}1):(1\bar{1}1)=41°20'$, $(1\bar{1}1):(1\bar{1}0)=46°45'$, $(1\bar{1}0):(0\bar{1}1)$ $=69°31'$. Cleavages perfect but difficult. Fracture flat conchoidal. Very brittle. Hardness $2\frac{1}{2}$. Specific gravity 9.94. Luster metallic. Color tin-white to palest yellow. Polished sections white, moderately anisotropic, and homogeneous except for sparse ovoid inclusions of intergrown tellurbismuth and altaite. Analysis by Williams: Au 44.32, Te 49.80, Bi 2.81, Pb 1.61, Sb 0.90, Ag. 0.55, Fe trace; total 99.99. Cell content, after subtracting Bi as Bi_2Te_3, Pb as PbTe: $(Au, Sb, Ag)_{24}Te_{37}$ or nearly $12[Au_2Te_3]$. Occurs with gold, tellurbismuth, altaite, petzite, melonite, chalcopyrite, pyrite, sphalerite, chalcocite, and marcasite, in the Robb-Montbray mine, Montbray Township, Abitibi County, Quebec, Canada.

ON MELONITE FROM QUEBEC AND THE CRYSTAL STRUCTURE OF NiTe₂

M. A. PEACOCK AND R. M. THOMPSON

Melonite is associated with tellurides, sulfides, and gold, in rich ore from the Robb Montbray mines, Montbray Township, Abitibi County, Quebec. The mineral is structurally identical with $NiTe_2$ obtained by fusing the elements in vacuum, and x-ray powder photographs lead to the following structure (C6-type):hexagonal; space-group $D_{3d}^3—C\bar{3}m$ (ditrigonal scalenohedral class—$\bar{3}$ $2/m$); $a=3.835$, $c=5.255$ kX; cell content $NiTe_2$ giving the calculated specific gravity 7.73, measured 7.72 (Hillebrand); Ni at 000, 2Te at $\frac{1}{3}$ $\frac{2}{3}z$, $\frac{2}{3}$ $\frac{1}{3}\bar{z}$, with $z=0.250\pm0.005$. The distances Ni-Te$=2.58$. Te-Te$=3.44$ kX, agree with the sums of the appropriate predicted radii of Pauling. The previously published x-ray powder data for melonite include lines due to free gold. Melonite would be appropriately attached to the Molybdenite Group in systematic mineralogy.

APPLICATION OF THE HIGH VOLTAGE ARC TO THE CUTTING, SAWING, AND DRILLING OF DIAMONDS

CHAUNCEY G. PETERS

The method universally employed for cutting facets on diamonds has been to place the diamond in contact with a flat cast-iron lap charged with diamond powder and rotated at about 2000 revolutions per minute. For sawing, the edge of a thin metal disk charged with powder and rotated at high speed is brought in contact with the diamond. For drilling, the point of a hardened steel needle immersed in oil on diamond powder is vibrated against the diamond.

In the work described in this paper it was found that by applying a high voltage electric arc the rate of cutting is materially increased for all orientations of the diamond and rapid drilling is obtained without the aid of diamond powder.

EXPERIMENTS IN X-RAY IRRADIATION OF GEM STONES

F. H. POUGH AND T. H. ROGERS

The alteration of color in minerals as the result of irradiation by various rays of wavelengths shorter than those of visible light is a well-known phenomenon. However, previous experiments have been but casually mentioned in the literature and the possibility has not been recognized in many minerals because of the slowness with which the alteration takes place with ordinary radiators. The perfection by the Machlett Laboratories of a new and concentrated beam x-ray tube, with a beryllium window transparent to a wide spectrum suggested the possibility of performing some experiments which might lead to results observable in a matter of minutes, rather than hours or days. A large series of gem stones were tested, with the expected results in some cases and unanticipated changes in others. The most notable was the golden discoloration of white and pale yellow sapphires. None of the effects appear to be permanent, all of the colors reverting to the original in a short time, either with exposure to ordinary light or upon the application of a low degree of heat. The preliminary study suggests further steps which might be tried, and some possible economic applications.

THE CRYSTAL STRUCTURE OF α-SiC, Type V

LEWIS S. RAMSDELL

α-SiC, type V, originally discovered by Ott, has a rhombohedral unit cell, space group $R3m$, with $Z=17$. Referred to hexagonal axes, $a_0=3.073A$, $c_0=128.15A$, $Z=51$. Even with simplifying assumptions based on known types, the number of geometrically possible structures is large. However, by means of an extrapolation of what appears to be a definite series in the known types, a structure is predicted which agrees excellently with the observed data. This structure is as follows:

Hexagonal unit cell—

17 Si atoms at 000, 00 $2z$, 00 $6z$, 00 $8z$, 00 $12z$, 00 $14z$, 00 $18z$, 00 $21z$, 00 $24z$, 00 $27z$, 00 $30z$, 00 $33z$, 00 $37z$, 00 $39z$, 00 $43z$, 00 $45z$, 00 $49z$.

17 C atoms at 00 p, 00$2z+p$, 00 $6z+p$, 00 $8z+p$, 00 $12z+p$, 00 $14z+p$, 00 $18z+p$, 00 $21z+p$, 00 $24z+p$, 00 $27z+p$, 00 $30z+p$, 00 $33z+p$, 00 $37z+p$, 00 $39z+p$, 00 $43z+p$, 00 $45z+p$, 00 $49z+p$.

17 Si and 17 C at $\frac{2}{3}$, $\frac{1}{3}$, $\frac{1}{3}$+the above coordinates.

17 Si and 17 C at $\frac{1}{3}$, $\frac{2}{3}$, $\frac{2}{3}$+the above coordinates.

$$z=1/51; \; p=1/68.$$

Certain unifying principles covering all 7 known types of SiC are evident, and there seems to be no reason why additional types, both hexagonal and rhombohedral, may not be found.

BRAUNITE FROM SNOWMASS, PITKIN COUNTY, COLORADO

AUSTIN F. ROGERS

Braunite, tetragonal, with the probable composition $3Mn_2O_3 \cdot MnSiO_3$, a comparatively rare mineral in this country, is recorded from a new locality in Pitkin County, Colorado.

It is a massive, somewhat granular, black metallic mineral which shows in cavities the pseudo-octahedral crystals so characteristic of it.

Associated minerals are calcite, barite, manganophyll (manganian biotite), muscovite, quartz, microcline, and plagioclase, the three latter and probably the muscovite being detrital.

Calcite and barite are persistent minerals and thus give no clue to the type of deposit, but the presence of manganophyll points to a distinctly hydrothermal origin.

Attention is called to the importance of plane angles of crystals in the determination of minerals. Plane angles may be expressed as interzonal angles since edges of crystal faces are parallel to the corresponding zone-axes.

SAND FULGURITES WITH ENCLOSED LECHATELIERITE FROM RIVERSIDE COUNTY, CALIFORNIA

AUSTIN F. ROGERS

Sand fulgurites from the vicinity of Indio, Riverside County, California, produced by the incomplete fusion of sand derived from granodiorite contain fragments of lechatelierite formed by the more or less complete melting of some of the quartz grains. Some cristobalite is also present. The biotite grains are completely fused to a dark brown glass and feldspars are for the most part melted.

SAUCONITE—THE ZINC CLAY MINERAL

CLARENCE S. ROSS

Zinc clay materials, commonly called tallow clays, have been found to include hemimorphite-bearing clays, and zincian montmorillonite; but the characteristic member of the group is a definite zinc mineral analogous to saponite. Comparison of samples from three regions with type sauconite from Friedensville, Pennsylvania, shows that all are similar. Therefore the validity of the name sauconite for a definite zinc clay mineral has been verified.

DEVELOPMENTS AND TRENDS IN THE USE OF INDUSTRIAL DIAMONDS

CHESTER B. SLAWSON

Only in the last decade has an appreciable percentage of diamonds been used in industry except in the same form in which they were when mined. Research and technical development on industrial diamond tools were confined to methods of mounting the natural crystal and little or no attention was paid to processing the diamond. In the last ten years the application of scientific principles to the diamond itself has given rise to major developments in its industrial use. The crystallographic properties of the diamond applicable to its use industrially are reviewed.

MODERN ASPECTS OF GEOCHEMISTRY AND THEIR APPLICATION TO ECONOMIC GEOLOGY

TAISIA STADNICHENKO

Previous to the development of atomic physics and the knowledge of the laws of crystal chemistry, geochemistry depended mostly on descriptive mineralogy and the data derived from the chemical analyses of the rocks and minerals collected in the different parts of the lithosphere, hydrosphere, and atmosphere. The recognition of the reality of the concept of the atom-elements, systematic studies of their structures, and the laws of crystal chemistry gave a new impetus to the examination of the geochemical processes. While the frequency of occurrence of an element in the Cosmos depends on the structure of its atomic nucleus, the distribution, migration, accumulation and dispersion of the chemical elements and their compounds are determined by the electrons of the outer shells. The behavior of the atom-element in the crystal lattice is governed by the laws of geometric equilibrium and a crystal represents a complex electromagnetic field which is determined by the energy of the system.

The laws of atomic lattices explain such well known associations as: Cu, Co, Ni, and especially Cu and Fe; Zn, Fe, Mn; constant presence of Au in Ag; also less familiar series

of Cd and In; Pt group with Fe, Cu, As and Mo; presence of Re in Pt ores and Mo compounds. The geochemical processes leading to the separation of Co from Ni and Fe is a complex function including such variables as: atomic weight, atomic number, coordination number, energy of the crystal lattices, and ionic radii.

In the last 20 years, particularly in Russia, the application of the new principles to the study of geochemical processes helped to formulate the important rules of geochemical associations, to forecast the distribution and accumulation of the various elements, and to suggest better means in solution of prospecting, mining, and technological problems.

PETROGRAPHIC COMPARISON OF PLIOCENE AND PLEISTOCENE VOLCANIC ASH FROM WESTERN KANSAS

ADA SWINEFORD AND JOHN C. FRYE

Lenticular, discontinuous deposits of volcanic ash occur in western Kansas in at least two stratigraphic positions within the Pliocene Ogallala formation and in one or more within the Pleistocene strata. The ash, which is extensively mined, attains a known maximum thickness of more than 20 feet. In an attempt to determine the feasibility of stratigraphic correlation by minor petrographic differences in the volcanic ash, a study was made of 30 samples from eight Pliocene localities and 24 samples from ten Pleistocene localities. Sieve analyses showed no consistent difference among the several samples even though a few zones of Pliocene ash were coarser than any sample of Pleistocene age. A color comparison of the fraction finer than 62 microns showed a consistent difference. Color differences are less pronounced in the coarser grades. A refractive index of about 1.501 is common to all Kansas samples studied except those from one Pliocene locality (R. I. ca. 1.506). The most prominent difference between the ash of the two ages is the presence of numerous elongated fluid inclusions in many shards in the Pleistocene samples. These are rare in the Pliocene ash, most of the particles of which are either clear or clouded with mineral and small equidimensional fluid inclusions. Chemical analyses of 27 samples show the Pliocene ash to be generally higher in iron. A sample of Pliocene ash from Hemphill County, Texas, showed most characteristics typical of Kansas Pliocene samples, but had a refractive index of about 1.496.

PRELIMINARY CHEMICAL CORRELATION OF CHROMITE WITH THE CONTAINING ROCKS*

T. P. THAYER

Chromite investigations of the Geological Survey since 1939 indicate that economic deposits of chromite rich in normative spinel $((Mg, Fe)Al_2O_4)$ occur in peridotites which are closely associated with gabbro; high-chrome chromites occur in feldspar-free peridotites; and chromites rich in both normative chromite $((Mg, Fe)Cr_2O_4)$ and magnetite (Fe_2O_4) are found in the pyroxene-rich stratiform complexes. Reaction of high-alumina chromite with diopsidic gabbro to form anorthite, olivine, and enstatite is described, and some probable equilibria between chromite and silicate minerals are discussed.

A plot of 60 complete analyses on a triangular prism of composition shows that chromites from different geologic provinces in the Western Hemisphere vary consistently and fall in overlapping, but distinct, fields. The chromites of the Caribbean Province, which occur in dunite and troctolite, have the general formula $Cr_{25-80} Al_{15-75} Mt_{1-5} (Mg_{65-75})$ and average about $Cr_{50}Al_{47}(Mg_{70})$. The chromites of the Pacific Coast, which occur in dunite and saxonite, average about $Cr_{70}Al_{24}(Mg_{60})$ in the range $Cr_{60-77}Al_{16-35}Mt_{3-12}(Mg_{45-75})$. The chromites of the Stillwater complex, like the stratiform Bushveld ores, occur in bronzite-rich rocks and are richer in iron; they average about $Cr_{60}Al_{32}(Mg_{52})$, and cover the range $Cr_{52-69}Al_{26-39}Mt_{5-10}(Mg_{45-61})$.

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RUTILE IN HARFORD COUNTY, MARYLAND

W. HAROLD TOMLINSON

Prospect pits have been sunk for rutile along the contact of a serpentine belt west of Pylesville in Harford County, Maryland. The ultra-basic rock has been injected into Wissahickon schist.

The formation is a chlorite rock with slightly schistose structure. Accessory minerals, magnetite, rutile, apatite, talc, biotite, ilmenite and zircon. The first six of these occur in pockets.

The rutile occurs as sagenite in groups through the chlorite rock and as stouter crystals in the pockets containing apatite. Pockets show 10% to 16% rutile by areal measurement in sections.

Origin of the deposit. There are in the vicinity large bodies of hypersthene gabbro which grade into pyroxenite. Apatite occurs freely in this gabbro and has been reported as forming 12% of the rock in certain pockets. Ilmenite has been reported as occurring in pockets in the pyroxenite. The author believes this rutile-bearing formation represents an ilmenite-bearing pyroxenite derived from the gabbro, which has undergone regional metamorphism. Specimens were found at the locality showing ilmenite partly altered to rutile.

MAGNESIUM MINERALIZATION IN THE CURRANT CREEK DISTRICT, NEVADA*

CHARLES J. VITALIANO

The Currant Creek District is in White Pine and Nye Counties, Nev., 35 miles southwest of Ely, Nev.

The host rock for the magnesium mineralization is a bedded calcareous tuff of late Miocene or early Pliocene age, overlain by quartz latite and underlain in the western part of the area by basaltic andesite and dacitic rock, and in the eastern part of the area by dacite. The thickness of the tuff is variable, but averages 300 feet. Unaltered tuff may contain as much as 80 per cent carbonate. All beds dip gently eastward from the summit of the Horse Range, but they are broken by a number of northeasterly-trending major faults and several minor faults of variable trend.

Magnesite replaces the calcareous tuffs and occurs as nodules, as veins or lenses, and as disseminated grains in masses of unaltered tuff. The associated minerals are dolomite, an unnamed magnesium silicate which may be a member of the serpentine group, calcite, and silica in the form of chalcedony, opal and quartz. The hard, dense, white nodules are distributed in zones, commonly a hundred or more feet in length. The lenses or veins may reach a length of 100 feet and a width of 12 feet, but are generally much smaller.

The silica minerals are late and transgress the others. Magnesite is earlier than the silica minerals. Its relation to the other carbonates is not always clear, but it is probably later than most of the dolomite.

The alteration is believed to have been due to ascending hot spring waters, rich in magnesia, that first formed the magnesium silicate and dolomite, and later replaced them by magnesite. Later solutions deposited various forms of silica which cut or replaced earlier minerals.

VECTOR HARDNESS IN DIAMOND TOOLS

HARRY WHITTAKER AND CHESTER B. SLAWSON

Diamonds varying from gem quality to opaque, irregularly shaped stones were used in abrasive tests against Al_2O_3 and SiC grinding wheels. It was found that, by weight, one part of diamond will abrade four million parts of the grinding wheel under the average conditions encountered in industrial practice. In the past, variations in the efficiency of

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the diamond, other than those attributable to structural failure, have been explained as due to the color, transparency or opaqueness, size, shape, or geographical origin of the diamond.

These variations are shown to be due to the vector hardness of the diamond. Those directions that wear most rapidly develop a high lustrous polish often with an optical finish while the harder directions develop a fine matte finish. Points of the octahedron, either natural or lapped, are most suitable for dresser tools. The low esteem in which all forms of the diamond, other than the octahedron, are held in industry is chiefly due to the improper crystallographic orientation of the diamond in the tool. The harder directions have an average efficiency twice that of the average of the softer directions.

MINERAL OXIDATION

A. N. WINCHELL

Mineral oxidation is of two radically different kinds; one is the well-known oxidation during weathering which involves addition of oxygen and the other is the little known oxidation during anamorphism which involves elimination of hydrogen (but no addition of oxygen). The first destroys the primary mineral and forms new ones; the second merely modifies the primary mineral but does not destroy it. Examples of the second process are described and illustrated by diagrams.

HARDNESS VARIATIONS AND ORIENTATION
IN DIAMOND

HORACE WINCHELL

The resistance of a crystal surface to abrasion varies with the orientation of the surface, and also with the direction of abrasion in it. Two independent coordinates (e.g., longitude and latitude) are necessary to specify the orientation of the surface tested, and a third coordinate (azimuth) is required to indicate the direction of abrasion. If desired, Miller indices (hkl) may be used to indicate the orientation of the surface, and zone symbols [pqr], to show the direction in it. Observations of hardness in selected directions on certain planes may be used to map out the systematic variations; remaining hardness values may then be estimated.

Experiments were conducted at the Hamilton Watch Company to measure the hardness variations in diamond. These measurements were made in terms of the number of pieces a certain production tool can finish satisfactorily before repolishing is needed. Some of the results are as follows:

Approximate Orientation		*Hardness*
Surface (hkl)	Direction [pqr]	Average
100	011	700*
210	1$\bar{2}$0	1600*
	$\bar{1}$20	2000*
110	1$\bar{1}$0	2700
	001	200
322	4$\bar{3}\bar{3}$	2000
	011	640
	$\bar{4}$33	10600
332	1$\bar{1}$0	3750
	$\bar{1}\bar{1}$3	11500
	11$\bar{3}$	250*

* Preliminary observation.

The maximum orientational hardness variation is at least 30:1, may be 150:1.

LUMINESCENT PHENOMENA AS AIDES IN THE LOCALIZATION OF MINERALS IN POLISHED SECTIONS

HERMAN YAGODA

On exposure to ultraviolet light a considerable number of minerals become readily discernible as a result of fluorescence or phosphorescence. The resultant optical activity is usually associated with the presence of minor constituents. The fluorescent pattern can on occasion be utilized for the estimation of the trace element causing the activity, a notable example being the estimation of the molybdenum content of scheelites. An annular cold quartz ultraviolet illuminator is described which permits the microscopic examination of fluorescing minerals in polished sections. Photomicrographs up to 150 X magnification can be secured which are serviceable for aerometric analysis and for the study of mineral intergrowths.

The phosphorescence of minerals is best studied by direct contact printing avoiding the use of optical equipment. After irradiation the polished section is immediately placed on fast panchromatic film for about two minutes. On development a permanent record is secured showing the distribution of the phosphorescing constituents. This autoluminograph will often reveal constituents emitting radiations not visible to the eye but which activate the emulsion. By utilizing color-sensitive film a true color replica is recorded of the evanescent phosphorescence. Such patterns have proven useful in the study of the Franklin, N. J. mineral deposits. The autoluminographs localize the willemite (green), clinohedrite (orange), and hardystonite (purple); the accompanying calcite, franklinite and zincite are non-luminescent and are depicted as voids in the autoluminographic pattern.

The thermoluminescence of hackmanite and certain varieties of fluorite can be recorded photographically by warming the thin section on a hot stage beneath the camera.

These luminescent properties are being employed in the study of the distribution of dust particles in lung tissue, utilizing fluorescent hyalite opal and willemite as tracers for free and combined silica, respectively.

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1921 Amherst, Massachusetts
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1923 Washington, D. C.
1924 Ithaca, New York
1925 New Haven, Connecticut
1926 Madison, Wisconsin
1927 Cleveland, Ohio
1928 New York, N. Y.
1929 Washington, D. C.
1930 Toronto, Canada
1931 Tulsa, Oklahoma
1932 Cambridge, Massachusetts
1933 Chicago, Illinois
1934 Rochester, New York
1935 New York, N. Y.
1936 Cincinnati, Ohio
1937 Washington, D. C.
1938 New York, N. Y.
1939 Minneapolis, Minnesota
1940 Austin, Texas
1941 Boston, Massachusetts
1942 No meeting held
1943 No meeting held
1944 No meeting held
1945 Pittsburgh, Pennsylvania

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Leonard James Spencer, December 1940
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