PROCEEDINGS OF THE TWENTY-SEVENTH ANNUAL MEETING OF THE MINERALOGICAL SOCIETY OF AMERICA AT CHICAGO, ILLINOIS

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

The twenty-seventh annual meeting of the Society was held at the Stevens Hotel, Chicago, Illinois, on December 26–28, 1946. The registration figures show that 122 fellows and members attended. The scientific sessions were held in the morning and afternoon of December 27th and in the morning of December 28th, at which 36 papers were presented. The annual luncheon of the Society, which was held on December 27th, was attended by 107 fellows, members, and guests. Following the luncheon Waldemar T. Schaller presented the Roebling medal to Clarence S. Ross. Dr. Ross thus becomes the sixth recipient of this award. The address of the retiring President, Paul F. Kerr, on *Alteration Studies*, was presented in the evening of December 26th.

On the following pages are given the reports of the officers for the year 1946 and the report of the election of officers and fellows for 1947.

ELECTION OF OFFICERS AND FELLOWS FOR 1947

The secretary reports that 399 ballots were cast in the election of officers for 1947; 275 by members, 124 by fellows of the Society. The officers as nominated by the Council were elected and are:

President: Martin J. Buerger, Massachusetts Institute of Technology, Cambridge, Massachusetts.
Vice-President: Carl Tolman, Washington University, St. Louis, Missouri.
Secretary: C. S. Hurlbut, Jr., Harvard University, Cambridge, Massachusetts.
Treasurer: Earl Ingerson, Geophysical Laboratory, Washington, D. C.
Editor: Walter F. Hunt, University of Michigan, Ann Arbor, Michigan.
Councilor (1947–1950): Harry H. Hess, Princeton University, Princeton, New Jersey.

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

John S. Brown, Saint Joseph Lead Company, Balmat, New York.
John Roberts Cooper, U. S. Geological Survey, Washington, D. C.
Isidor Fankuchen, Polytechnic Institute of Brooklyn, Brooklyn, N. Y.
Walter Pearson Kelley, University of California, Berkeley, California.
Kiguma Jack Murata, U. S. Geological Survey, Washington, D. C.
William Parrish, Philips Laboratories, Inc., Irvington-on-Hudson, New York.
Lester William Strock, Saratoga Springs Commission, Saratoga Springs, New York.
Newman William Thibault, Norton Company, Worcester, Massachusetts.
Charles Robinson Toothaker, Commercial Museum of Philadelphia, Philadelphia, Pennsylvania.
Lawrence Rickard Wager, Durham Colleges in the University of Durham, Durham, England.
William Albert Waldschmidt, Argo Oil Corporation, Midland, Texas.
Aaron Clement Waters, Stanford University, California
Kenneth DePencier Watson, University of British Columbia, Vancouver, British Columbia.
Robert W. Webb, University of California, Los Angeles, California.
Cutler DeLong West, Polaroid Corporation, Cambridge, Massachusetts.
Horace Winchell, Yale University, New Haven, Connecticut.

REPORT OF THE SECRETARY FOR 1946

To the Council of the Mineralogical Society of America:

MEMBERSHIP STATISTICS

	1945	1946	Gain	Loss
Correspondents	5	6	1	—
Fellows	218	237	20	1
Members	549	625	193	117
Subscribers	344	535	217	26
	1116	1403	431	144

The above figures show a net gain of 19 fellows. Sixteen members were elected to fellowship; four fellows were reinstated and one, G. F. Loughlin, was lost through death. A net gain of 76 members and 191 subscribers gives a total gain of fellows, members and subscribers for 1946 of 287. This brings the grand total to 1403, again a new high record.

The large gain in subscribers and to a lesser extent the gain in members was brought about by the increase in foreign subscriptions and the reinstatement of foreign members, particularly from the Soviet Union.

Respectfully submitted,

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

REPORT OF THE EDITOR FOR 1946

To the Council of the Mineralogical Society of America:

During the current year, practically all colleges and universities have experienced unprecedented student enrollments. The teaching staffs, on the other hand, have not been increased in the same ratio. This unbalanced adjustment has resulted in large classes and heavy teaching assignments which have consumed much of the spare time and energy that under more normal conditions might have been spent in planning research in new fields or continuing projects already begun.

However, in spite of these handicaps, a sufficiently large number of papers have been received to insure a volume for 1946 of slightly more than 600 pages, or an average of about 100 pages for each of the six bimonthly issues. This accomplishment might be considered as fairly satisfactory under the present prevailing conditions.

The current volume is somewhat smaller than that of a year ago, but it should be recalled that the previous volume contained a special symposium number of 14 papers on quartz oscillator-plates. The inclusions of this 264-page special issue was largely responsible for the enlarged size of the volume for 1945. In this connection, it might be noted that the demand for this symposium number has been so great as to require a reprinting of 150 copies of that issue by a lithoprinting process.

The Geological Society has continued its generous financial support for defraying a substantial portion of the publication costs of our journal. This past year, this aid amounted to $2500 with an additional appropriation, not to exceed $500, for the cost of colored plates if and when such illustrations were deemed desirable. Recognition and deep appreciation is here expressed for this generous and timely assistance, by virtue of which it was possible to include two colored inserts during the year. A colored plate is also planned in connection with an article by F. H. Pogue and T. H. Rogers on "Experiments in x-ray irradiation of gem stones," which will appear in the January-February number, now in press. In this instance, however, the colored insert is being furnished by the Machlett Laboratories, Inc., of Springdale, Connecticut, without cost to our Society.

During the summer of the current year, our publishers served notice that due to the increased cost of labor and materials, it would be necessary to terminate our old printing contract and enter upon a new one which would step up our printing bill about 16–18%. This action was not entirely unexpected, as we were all aware of the present trend in prices. The executive committee of our Council, after a careful study, considered the new rates reasonable, under present conditions, and voted to continue our cordial relations with the George Banta Publishing Company. This company has served our Society without interruption since 1922.

From time to time, inquiries have been received as to whether a single index will be available covering the ten-year period from 1936 through 1945. Through the efforts of Drs. Ingerson and Fleischer, who have jointly undertaken this task, it can be stated that the decennial index is in preparation and probably will be available sometime during 1947.

In a detailed analysis of the Journal for 1946, we find that volume 31 contains 606 pages, exclusive of index. Leading articles, which number 46, occupy 78.4% 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 each of the main articles is only 10.4 printed pages.

If to the 46 leading articles we add 17 shorter papers appearing under the heading of "Notes and News," we obtain a total of 63 published manuscripts for the calendar year. These contributions were received from 80 contributors associated with 38 different universities, research bureaus, and technical laboratories.

The Journal for 1946 carries detailed descriptions of two new minerals: tinticite and montbrayite. One hundred and eighty-seven 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 outside the States, and in 1946 eight such contributions were printed from the following countries: Canada 4, and one each from Netherlands, England, South Africa, and Australia.

The accompanying Table 1 summarizes in detail the distribution of subject matter in volume 31.

TABLE 1. DISTRIBUTION OF SUBJECT MATTER IN VOLUME 31

Subjects	Articles	Pages	Per Cent of Total
Leading articles*			
Descriptive Mineralogy	9		
Chemical Mineralogy	9		
Structural Crystallography	6		
Geometrical Crystallography	5		
Petrography	11		
Optical Mineralogy	2		
Memorials	3		
Miscellaneous	1		
	46	475	78.4
Shorter articles	17	$43\frac{1}{2}$	
Notes and news	16	10	
Proceedings of Societies	14	70	21.6
Book reviews	2	2	
New mineral names	18	$5\frac{1}{2}$	
Total entries	113	606	100.0
Illustrations	187		
Index, Title page, Table of contents		14	
Grand total		620	

* Leading articles average 10.4 printed pages each.

Respectfully submitted,
WALTER F. HUNT, *Editor*

REPORT OF THE TREASURER FOR 1946

To the Council of the Mineralogical Society of America:

Your treasurer submits herewith his annual report for the year beginning December 1, 1945, and ending November 30, 1946.

RECEIPTS

Cash on hand December 1, 1945	$ 2,647.70
Dues and subscriptions	4,187.32
Sale of back numbers	1,656.86
Authors' charges on separates	570.31
Interest and dividends from endowment	3,132.00
Payments on principal of Trenton Mortgage stock	130.14
Geological Society of America grant for 1946	2,891.40
Advertisements	310.85
Aid in publishing special articles	952.00
Sale of extra May–June, 1945, numbers	302.79
Sale of 20-volume index	5.00
	$16,786.37

DISBURSEMENTS

Printing and distribution of the Journal	$ 6,020.35
Printing and distribution of separates	499.16
To the Editor, Secretary, and Treasurer	1,390.00
Postage	463.48
Clerical help	487.37
Office equipment	8.68
Printing and stationery	247.91
Safety deposit box	9.60
Telegram	.90
Committee expenses	7.44
Society luncheon (1945)	4.00
Exchange on foreign checks	1.80
Returned check	3.00
Work on index (Vols. 21–30)	240.50
Rights for A. T. & T. debentures	9.36
	$ 9,393.55
Cash balance November 30, 1946	7,392.82
	$16,786.37

The endowment funds of the Society as of November 30, 1946, consist of the following securities:

BONDS

5M U. S. Treasury, $2\frac{1}{2}\%$	$ 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, $4\frac{1}{2}\%$	5,257.50
4C Great Northern, $5\frac{1}{2}\%$	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	1,754.48#

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	3,369.32
	$60,080.77

Residual value.

DANA FUND

Disbursements are made to needy mineralogists in war areas, and to needy families of deceased mineralogists in war areas.

RECEIPTS

Available balance, November 30, 1945	$943.39
Interest	6.34
	$949.73

DISBURSEMENTS

Disbursed	$334.00
Available balance, November 30, 1946	615.73
	$949.73

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, 1946. 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,
ALTON GABRIEL
WILLIAM T. PECORA
EDWARD P. HENDERSON, *Chairman*

ABSTRACTS OF PAPERS PRESENTED AT THE TWENTY-SEVENTH ANNUAL MEETING OF THE MINERALOGICAL SOCIETY OF AMERICA, CHICAGO, ILLINOIS, DECEMBER 26–28, 1946

SOME UNITED STATES BOEHMITE LOCALITIES*

VICTOR T. ALLEN

U. S. Geological Survey, Washington, D. C.

The only boehmite locality in the United States listed in the Seventh Edition of Dana's Mineralogy is incorrectly reported to be the Linwood-Barton district, Georgia. More than 200 samples of bauxite and clay from Alabama and Georgia, including some from Linwood, Bartow County, Georgia, were examined by x-ray and optical methods and found to contain gibbsite but no boehmite.

Investigation of alumina hydrates of the United States was started with a grant from the Geological Society of America in 1941 and continued during 1942 to 1946 in connection with the high-alumina clay project of the Geological Survey, U. S. Department of the Interior. The boehmite occurrences reported by H. S. McQueen near Swiss and Stolpe, Gasconade County, Missouri, associated with flint and diaspore clays of Pennsylvanian age, were verified, and the following new localities for boehmite were established: associated with Paleocene gibbsite in black pisolites on the Townsend 40 property, about 2 miles east of Bauxite and near Berger, Pulaski County, Arkansas; as ooliths in Pennsylvania flint clay at the Burnt House mine, Olive Hill, Carter County, Kentucky; with kaolinite in the Puget shales of Eocene age at Durham, Kanaskat, and Kummer, King County, Washington; with diaspore at the Cle Elum iron deposit, Kittitas County, Washington; with gibbsite in ooliths associated with Paleocene clay at Alberhill, Riverside County, California.

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* Published by permission of the Director, Geological Survey, U. S. Department of Interior.

SOME EXAMPLES OF THE DISTRIBUTION OF FLUORINE IN ROCKS

TOM F. W. BARTH

University of Chicago, Chicago, Illinois

New data of fluorine in rocks and thermal emanations are presented. They corroborate the earlier conclusions of E. S. Shepherd (1940) that fluorine is not an insignificant constituent of the earth's crust; he thinks that about 0.04 per cent F is characteristic of plutonic rocks, lavas run lower, alkaline rocks run higher.

In the plutonic rocks of the (alkaline) Oslo province the average concentration of fluorine is 0.075 per cent (the range is from 0.063 to 0.090). In basalts from Iceland the fluorine content ranges from 0.002 to 0.040, average 0.017 per cent F. In the Oslo kauaiites (formerly erroneously called essexites) the average is 0.070 per cent F.

In the Oslo plutonics fluorine shows no relationship to any other rock-forming element. But in the basaltic rocks very constantly the weight percentage of F is one-tenth that of P_2O_5, suggesting that apatite in these rocks is the chief carrier of F.

Fluorine in thermal waters of Iceland ranges from zero to 1.45 parts per million. This is about the same as one finds in river waters, but much lower than the figures given by Allen and Day from hot-spring waters of Yellowstone.

Sinter deposits in Iceland contain 0.003 per cent F. Rocks altered by thermal waters are low in fluorine both in Iceland and in the Yellowstone Park. But one rock (from Hverarönd, Iceland) highly altered by fumarole gases has as much as 0.480 per cent F.

Many more analyses are necessary before the geochemical cycle of this freakish element will be understood.

EUCHROITE AND CHALCOPHYLLITE

L. G. BERRY AND H. R. STEACY

Queen's University, Kingston, Ontario

New observations on euchroite from Libethen, Hungary, and on chalcophyllite from Braden Mine, Chile, combined with existing chemical analyses yield the following data on these minerals:

Euchroite: orthorhombic; disphenoidal—D_2^4—$P2_12_12_1$; the unit cell, with $a=10.05$, $b=10.50$, $c=6.11$ kX, $a:b:c=0.957:1:0.582$, contains $Cu_8As_4H_{28}O_{32}=4[Cu_2AsO_4(OH)$ $\cdot 3H_2O]$. Specific gravity, measured 3.41; calculated 3.45. Haidinger (1825) obtained orthorhombic elements which, transformed to our setting by interchange of axes, give $a:b:c$ $=0.9635:1:0.5866$. Optical characters: biaxial, positive, $Z=b$, optic plane $\|(001)$, $2V=31°$.

Chalcophyllite: hexagonal; scalenohedral, possible space group D_{3d}^5—$R\bar{3}m$; the unit cell, with $a=10.75$, $c=57.40$ kX, $a_{rh}=20.49$ kX, $\alpha=30°40'$, $a:c=1:5.351$, contains $Cu_{18}Al_3As_3S_3H_{99}O_{87}=Cu_{18}Al_2(AsO_4)_3(SO_4)_3(OH)_{27}\cdot 36H_2O$ in the rhombohedral cell. Specific gravity, measured 2.67; calculated 2.60. Palache (1909) obtained elements in hexagonal notation which, with c doubled, give $a:c=1:5.343$. The museum specimen of chalcophyllite studied here is partially dehydrated with $\omega=1.68$. After exposure to a moist atmosphere for two weeks ω had changed to 1.62, agreeing closely with the observations of Shannon (1924) on fresh material. The partially dehydrated material has a well marked pseudo-cell with $a'=a$ and $c'=c/2$.

LIROCONITE

L. G. BERRY AND T. DAVIS

Queen's University, Kingston, Ontario

X-ray and density measurements on liroconite from Cornwall, England, combined with the existing chemical analyses lead to the following description of this mineral.

Liroconite: monoclinic; prismatic—C_{2h}^5—$I2/a$; the unit cell, with $a=12.67$, $b=7.55$, $c=9.86$ kX, $\beta=91°23'$, $a:b:c=1.679:1:1.306$, contains $Cu_8Al_4(As,P)_4H_{48}O_{48}=4[Cu_2Al$ $(As,P)O_4(OH)_4\cdot 4H_2O]$ with As:P in the ratio 3:1. Specific gravity, measured 3.01; calculated 3.08. Des Cloizeaux (1859) obtained monoclinic elements which, transformed to our setting by interchange of a and c, give: $a:b:c=1.6808:1:1.3191$; $\beta=91°27'$. Observed forms $m(110)$, $e(011)$.

GRANITES OF THE FRONT RANGE: PEGMATITES ASSOCIATED WITH THE LONGS PEAK-ST. VRAIN BATHOLITH

MARGARET FULLER BOOS

Denver, Colorado

Pegmatites are abundant in some areas and very scarce elsewhere in the Longs Peak-St. Vrain batholith and the enclosing metasedimentary formations. At least 90 per cent, by volume, of the pegmatitic material is concentrated in marginal parts of the complex mass of thick granite sheets and cupolaed stocks of the batholith and in contiguous schists. Large bodies of pegmatites show a definite relationship between their size, shape, structure, distribution and certain environmental conditions in and around the batholith.

The parent magma (Silver Plume type) produced granite with marked trachytoid arrangement of the numerous potash feldspar crystals. Locally this habit extended to the offspring pegmatites. Longs Peak pegmatites carry chiefly potash feldspar, glassy to gray quartz, and muscovite. The satellitic Mt. Olympus granite and pegmatite contain original plagioclase feldspar (albite-oligoclase), smoky quartz, and biotite. None of the many hundred pegmatites examined show replacement minerals or hydrothermal textures. The pegmatites of Longs Peak or Mt. Olympus origin did not develop much beyond the magmatic stage.

THE STRUCTURE OF NEPHELINE

M. J. BUERGER, GILBERT E. KLEIN, AND GABRIELLE HAMBURGER

Massachusetts Institute of Technology, Cambridge, Massachusetts

A Weissenberg study of nepheline shows that it belongs to space group $H6_3$ and has cell edges, $a = 10.05$ Å and $c = 8.38$ Å. The unit cell contains $8NaAlSiO_4$.

The intensities of all reflections which can be recorded with filtered copper radiation were determined using a modified Dawton method. From these data Harker syntheses were prepared and studied in the implication diagrams $I3(xy0)$ and $I6(xy\frac{1}{2})$. This permitted location of all the metal atoms, but the oxygen atoms were insufficiently defined to be located by this method.

Assuming that the metal atoms alone determined the $hk0$ phases, a preliminary electron-density map, $\rho(xy0)$, was prepared. This roughly revealed the oxygen locations. Employing the new atomic locations, the signs of $F(hk0)$ were recomputed and a new electron-density map was prepared. By successive approximations the x and y parameters were arrived at.

The z parameters have been studied first by one-dimensional Harker syntheses, $P(x_1y_1z)$, and later by a series of non-centrosymmetrical electron-density projections through planar sections, such as $\rho(x\ 2/3\ z)$ and $\rho(x0z)$. The parameters arrived at are as follows:

		x	y	z (approximate)
$Na_1 (=K)$	in 2a:	0	0	0
Si_1	in 2b:	1/3	2/3	.82
Al_1	in 2b:	1/3	2/3	.18
O_1	in 2b:	1/3	2/3	0
Na_2	in 6c:	.01	.43	0
Si_2	in 6c:	.09	.33	.33
Al_2	in 6c:	.09	.33	.67
O_2	in 6c:	.09	.33	.50
O_3	in 6c:	.17	.52	.75
O_4	in 6c:	.17	.52	.25
O_5	in 6c:	.25	.28	.25
O_6	in 6c:	.25	.28	.75

The structure of nepheline proves to be based upon the tridymite structure, with NaAl substituted for half of the Si atoms, as originally predicted by Schiebold. The $Na_1(=K)$ atoms occupy large holes, and the Na_2 atoms occupy smaller holes produced by collapse of voids in the tridymite structure. Chemical analyses bear out the view that two of the eight alkali atoms are potassium and not sodium, so that the formula of nepheline is really $KNa_3Al_4Si_4O_{16}$.

The implication diagram $I6(xy\frac{1}{2})$ provides evidence for assuming that the atoms on the three-fold axes are in motion.

CRYSTALLIZATION PHENOMENA IN VOLCANIC EJECTA FROM KILAUEA, HAWAII

RANDOLPH W. CHAPMAN

The Johns Hopkins University, Baltimore, Maryland

The eruption of Kilauea volcano in Hawaii in May 1924 was of particular interest because it involved many violent explosions, phenomena not common to Kilauean activity. During the eruption a large number of angular blocks of lava were expelled from the volcano's orifice and scattered over the floor of the caldera around the great firepit, Halemaumau.

One particular rock type is a glass-bearing basalt consisting of microphenocrysts of olivine and augite set in a groundmass of labradorite, augite, and basaltic glass, with minor accessories. The labradorite and most of the augite are arranged radially, forming variolitic structures about 3 millimeters in diameter. Glass fills the interstices between mineral grains.

The texture of the basalt and the paragenesis of its minerals suggest that the normal basaltic magma, from which it was apparently derived, passed through 3 distinct stages in the process of cooling. During Stage 1 the magma cooled slowly and developed microphenocrysts of olivine and augite. Stage 2 began when the magma was intruded as a sill-like mass into the hot walls of the Halemaumau firepit. The magma, now cooling more rapidly, precipitated crystals of labradorite and augite as radial intergrowths. In Stage 3 portions of the intrusion were torn violently from the wall of Halemaumau firepit and hurled high into the air, causing the residual liquid in the pore spaces to be chilled to a glass.

DIFFERENTIAL THERMAL ANALYSIS OF SOME CARBONATE MINERALS

F. L. CUTHBERT

National Lead Company, Los Angeles, California

AND

R. A. ROWLAND

Shell Oil Company, Houston, Texas

Differential thermal analysis curves are presented for ten of the more common carbonate minerals of known purity. The characteristic curves given should aid in detecting the presence of these minerals when they occur in clays or soils being analyzed by this method. The use of differential thermal analysis is suggested for industries utilizing carbonate minerals or their by-products.

SEARLESITE FROM THE GREEN RIVER FORMATION OF WYOMING*

JOSEPH J. FAHEY (with x-ray analysis by JOSEPH M. AXELROD)

U. S. Geological Survey, Washington, D. C.

Searlesite has been found in the drill core of the John Hay, Jr., Well #1 at a depth of 1,480 feet and in the Union Pacific drill core #4 at 1,706 feet, approximately 18 and 20 miles, respectively, west of the City of Green River. This is the third recorded occurrence of searlesite.

Searlesite occurs in low grade oil shale associated with shortite and an undetermined fibrous mineral. Large anhedral crystals 5 cm. across and up to 3 mm. thick lie parallel to the bedding of the shale.

The optical properties of the searlesite from Wyoming agree with those already determined. The indices of refraction were measured in sodium light: $\alpha = 1.525$, $\beta = 1.531$, and $\gamma = 1.535$. X-ray diffraction photographs and chemical analysis identify the Wyoming mineral as searlesite.

* Published by permission of the Director, Geological Survey, U. S. Department of the Interior.

A SIX-TARGET COLD-CATHODE X-RAY DIFFRACTION UNIT

H. W. FAIRBAIRN

Massachusetts Institute of Technology, Cambridge, Massachusetts

Using basic designs described by Buerger and Chesley a cold-cathode diffraction unit has been built which, by rotation of a taper sleeve in the side of the tube, gives Cu, Fe, Co, Ni, Cr, or Mo radiation as desired, without disturbance of the operating gas pressure. This feature increases many times the efficiency of work where more than one target is

essential, such as (1) identification by the powder method of crystalline compounds of wide compositional range, (2) precision determination of lattice constants by the single-crystal method. Additional features of this improved equipment are, (1) elimination of auto-transformers and rectification valves, (2) use of a transformer instead of a resistor to control the primary current, (3) permanent seals for the windows (beryllium) and for the glass insulating cylinder, (4) adjustable target-cathode distance, and air-cooling of cathode without a blower, (5) unusually short evacuation line direct to a mechanical pump, with the air intake valve mounted directly on the tube, (6) short target-collimator distance and rigid attachment of camera base to frame of tube.

THERMAL ANALYSIS OF THE MAGNESIUM MINERALS OF THE CURRANT CREEK MAGNESITE DEPOSITS, CURRANT CREEK, NEVADA*

GEORGE T. FAUST

U. S. Geological Survey, Washington, D. C.

Thermal analysis methods were used in connection with the study of the mineralogy and petrology of the Currant Creek magnesite deposits of Nevada. The minerals present are carbonates, hydroxides and basic carbonates and of the hydrous magnesium silicates. Some relationships with other occurrences of related minerals are outlined.

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* Published with the permission of the Director, Geological Survey, U. S. Department of the Interior.

THE UNIT CELL OF GLAUCODOT

R. B. FERGUSON

University of Toronto, Toronto, Ontario

A large typical crystal of glaucodot (Co, Fe)AsS, from Hakansbö, Sweden, shows a good prismatic cleavage (110) and a poor pinakoidal cleavage (001), in the preferred original setting. Rotation and Weissenberg photographs on a cleavage fragment turned about [001] show no significant departure from orthorhombic symmetry and lead to a C-type cell with $a=6.63$, $b=28.33$, $c=5.63$ kX, $Z=24$, $G=6.15$ (calc. for Co:Fe$=1:1$), 6.06 ± 0.05 (meas. Frondel). Additional abnormal systematically missing spectra indicate, however, that this is an apparent lattice due to two coexisting rectangular lattices: I, P-type, with $a'=a/2$, $b'=b/2$, $c'=c$, $Z'=6$; II, C-type, with $a''=a$, $b''=b/3$, $c''=c$, $Z''=8$. The lattice II, which is the weaker, compares with that of arsenopyrite ($a=6.42$, $b=9.51$, $c=5.65$ Å, Buerger) and is clearly reflected in the morphology. The only existing cell dimensions for glaucodot are $a=6.67$, $b=4.81$, $c=5.73$ Å (de Jong, powder method).

THREE-DIMENSIONAL PROJECTION IN GEOLOGICAL TRAINING

D. JEROME FISHER

University of Chicago, Chicago, Illinois

In November 1940 the writer built a twin projector* using 500-watt bulbs, each objective carrying a polaroid plate. This was fitted to take 2 by $4\frac{3}{4}$-inch glass slides in which were mounted a stereoscopic pair of photographs made on standard (double frame) 35 mm. film, either black and white or colored. Later a simple stereoviewer, with which students could individually study the stereoslides was described†. Brief directions for taking stereophotographs with a single-lens camera and for mounting stereopairs in slides to be used for projection purposes were included.

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* Fisher, D. Jerome, Projector for Stereoscopic Pictures, *Amer. Jour. Physics*, **10** (1), Feb. 1942, 46–49.

† ———, Stereoscopic Projection and Map Reading. *Amer. Jour. Sci.*, **240**, Sept. 1942, 642–648.

The writer now has nearly 500 stereoslides, many in color. A small selection from these will be shown on the University of Chicago campus to limited groups on Saturday, December 28, as noted in the program. Besides illustrating various subjects by means of vertical aerial photographs, some of which are accompanied by matching contour maps or terrestrial stereophotos, slides will be shown of applications to morphological, optical, physical, and structural crystallography. This occasion will also be taken to demonstrate a simple (non-stereoscopic) projection of the famous Mitscherlich experiment on a modified piece of standard apparatus; this presents in color the decrease of optic axial angle (to uniaxiality) in gypsum with rise in temperature.

There is need for cooperation in preparing stereoslides for use in the various phases of geological instruction. Block diagrams and structural interpretations are obvious fields. There should be many possibilities for phantom stereopairs, such as would show an indicatrix properly placed inside a crystal drawing. These may also be made by photography—for instance, the photograph of an armature and then the motor casing to fit around it (double exposure stereophotography). The writer would like to hear from those interested in stereoscopic work as applied to the geological sciences, and would be glad to exchange copies of suitable stereophotographs.

TOURMALINE PRESSURE GAUGES

CLIFFORD FRONDEL
Harvard University, Cambridge, Massachusetts

During the war years, single crystals of tourmaline were an important industrial raw material for use in piezoelectric gauges for the measurement of blast pressures in air and under water. The gauges comprise thin discs of tourmaline from $\frac{1}{4}$ inch up to several inches in diameter cut perpendicular to the c-axis and used singly or in stacks. The design and construction of the gauges is described in detail. The piezoelectric response of the tourmaline to the transient pressure wave is amplified and recorded on associated electronic equipment and both the magnitude of the pressure and the wave-form deduced thereby. Transient gauge-pressures of less than an ounce to over 40 tons per square inch have been investigated by such means.

The sources of supply, price, and factors determining the usability of raw tourmaline for the purpose are discussed. Tourmaline for radio oscillator-plates must be entirely free from imperfections, and requires crystals of gem quality, but material for gauges can contain a considerable amount of cracking. Most of the tourmaline employed was of low-iron, high-alkali types from Brazil and Madagascar and the domestic production was negligible. Black tourmaline is generally unsuitable. Crystals over two inches or so in cross section were in particularly short supply. Such crystals are used in the construction of air-blast gauges, in which the relatively low incident pressure, at most only a few hundred psi, must be compensated by increased surface area of the discs in order to obtain an adequate signal. Tourmaline is responsive piezoelectrically to hydrostatic pressure and because of this and its high mechanical strength and chemical stability is used in preference to quartz and various water-soluble salts such as ADP and Rochelle salt.

MINERALS OF STEAMBOAT SPRINGS, NEVADA

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AND
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U. S. Geological Survey

Recent studies at Steamboat Springs have brought to light many features of interest to geologists. Many minerals have been found that have not been previously reported from

the area. Deposition of stibnite and gold at the surface is of freqeuent occurrence and mercury has been detected in the gases. Cinnabar, notwithstanding published statements to the contrary, is found abundantly in the siliceous sinter. Sulfides, deposited in granodiorite have been oxidized with the formation of sulfuric acid and numerous sulfates of copper and iron. The descending sulfate-bearing meteoric water encounters heated vapors with the resulting deposition of supergene sulfides. The dombined action of the meteoric water and the hot vapors causes intense alteration of granodiorite and basalt. The resulting end product consists largely of quartz, opal, chalcedony, and clay minerals.

SODIUM BICARBONATE (NAHCOLITE) FROM GARFIELD COUNTY, COLORADO*

JEWELL J. GLASS

U. S. Geological Survey, Washington, D. C.

A notable occurrence of colorless, transparent, crystalline sodium bicarbonate, nahcolite ($NaHCO_3$) has been found in the Mahogany oil-shale bed in the Green River formation (Eocene), Garfield County, Colorado. The nahcolite was found in cavities in pods or pockets of "salt crystal" masses in the shale at a depth of 412 feet. The pockets range in size from 6 inches to 2 feet in diameter. Nahcolite occurs as crystalline masses which break easily into tabular cleavage pieces many of which show rhombic outline similar to calcite. Nahcolite is monoclinic. It has a vitreous luster. Brittle; fracture conchoidal. Cleavage in three directions; one (010) perfect, two good.

Optically the mineral is biaxial negative, $2V = 77°$ (Ca.). Dispersion is distinct, v greater than r. Cleavage pieces parallel to the perfect cleavage give a well centered biaxial figure, showing that the acute bisectrix X is normal to, or nearly normal to, the cleavage. The plane of the optic axes is parallel to the perfect cleavage. The indices of refraction are: $\alpha = 1.374$, $\beta = 1.499$, $\gamma = 1.583$. B = .209.

This is the second verified occurrence of free sodium bicarbonate as far as is known, the first being at Searles Lake, California.

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CHALCOSIDERITE AND TURQUOISE

A. R. GRAHAM AND L. G. BERRY

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An x-ray study of chalcosiderite from Wheal Phoenix, Cornwall, and turquoise from Campbell County, Virginia, combined with existing analyses, yields the following descriptive data:

Chalcosiderite: triclinic-pinacoidal; unit cell, with $a = 7.66$, $b = 10.18$, $c = 7.88$ kX, $\alpha = 112°29'$, $\beta = 115°18'$, $\gamma = 69°00'$, $a:b:c = 0.7525:1: 0.7741$, contains $CuFe_6(PO_4)_4(OH)_8$ $\cdot 4H_2O$. Specific gravity, measured 3.22; calculated 3.26. Maskelyne (1875) obtained elements which, transformed to our setting, give $a:b:c = 0.7505:1:0.7703$, $\alpha = 112°18'$, $\beta = 115°18'$, $\gamma = 68°32'$.

Turquoise: triclinic-pinacoidal; unit cell, with $a = 7.47$, $b = 9.93$, $c = 7.67$ kX, $\alpha = 111°39'$, $\beta = 115°23'$, $\gamma = 69°26'$, $a:b:c = 0.7523:1: 0.7724$, contains $CuAl_6(PO_4)_4(OH)_8 \cdot 5H_2O$. Specific gravity, measured 2.84; calculated 2.95. Schaller (1912) retained Maskelyne's chalcosiderite elements for turquoise.

IMPROVED APPARATUS FOR DOUBLE-VARIATION PROCEDURE

CORNELIUS S. HURLBUT, JR. AND DONALD M. HENDERSON

Harvard University, Cambridge, Massachusetts

In working with the double variation method for refractive index determination as proposed by Emmons, several difficulties are encountered which somewhat complicate the

procedure. These are chiefly the inability to control the temperature accurately; the collection of bubbles in the water cell on the stage; and the necessity of using an arc light for illumination. The first two difficulties have been eliminated by constructing a simple recirculating system in which a small volume of water free from air is used continuously. The temperature of this water is controlled by a thermostat that can be adjusted for any predetermined value.

An arc has been necessary so that monochromatic light of sufficient intensity could be obtained with a monochromator. A new type of transmission interference filter is now available which enables one to obtain light of a given wave length of high intensity using a lamp with an incandescent element.

LIQUID INCLUSIONS IN GEOLOGIC THERMOMETRY

EARL INGERSON

Geophysical Laboratory, Washington, D. C.

Most vein minerals and many of those in igneous rocks contain liquid inclusions. A satisfactory method of determining temperatures of crystallization from the liquid inclusions would aid in the solution of many problems of geologic thermometry.

Recent data on the specific volume of water at high temperatures and pressures allow much more accurate determination of the effect of pressure than has been possible before, and data on the critical temperatures of aqueous solutions of alkali halides provide the basis for better evaluation of the effect of concentration.

Curves have been prepared showing the relation of degree of filling of inclusions and temperature of disappearance of the vapor phase, both for pure water, and for a 10 per cent solution. A series of curves shows the relation between the temperature of disappearance of the vapor phase, pressure at the time of formation and temperature of formation.

For vein and pegmatite quartz studied, where pressures can be estimated from the amount of overburden at the time of formation, pressure corrections range from about 45° to 90°C.

THERMAL ANALYSIS OF MISSOURI FIRE CLAYS

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Mineralogical determinations by the thermal analysis method were made of a wide variety of Missouri fire clays and the clay fractions of several other argillaceous sediments. The common hard flint fire clay gives a typical kaolinite curve, but the so-called "soft flints" show both endothermic and exothermic reactions at slightly lower temperatures than does kaolinite. Some plastic fire clay is dominantly kaolinite but curves of other varieties indicate mixtures, possibly montmorillonite with kaolinite. The high alumina clays contain kaolinite, diaspore, gibbsite, and boehmite.

A clay from loess is illite, and clays from shale suspensions give illite and kaolinite reactions. Comparative curves of the clays are shown.

"ALTERATION STUDIES"

PAUL F. KERR

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Leaders in mineral industry are becoming aware of the need for improvement in the methods of mineral exploration. Among different techniques which have appeared from a variety of sources, the so-called "alteration studies" provide one avenue along which to approach the problem of enlarging our known mineral reserves.

The technique of alteration study is one of combined field and laboratory investigation. The laboratory work is based to a considerable degree upon the methods and results of in-

vestigations of the clay minerals. These studies have accumulated data and methods now proving generally applicable.

Alteration studies have been undertaken in a number of the more important mining districts of the west of late. Investigations to date are more or less experimental in scope, but results secured in certain localities suggest that the transition to a stage of broader application may be near at hand.

CLINOHUMITE AND ASSOCIATED MINERALS FROM DILLON, MONTANA*

MARIE LOUISE LINDBERG

U. S. Geological Survey, Washington, D. C.

Clinohumite from Dillon, Montana, occurs as aggregates several centimeters thick of red anhedral grains in an enstatite rock associated with actinolite, anthophyllite, spinel, magnetite, clinochlore, phlogopite, and forsterite. Its indices of refraction with sodium light are: $\alpha = 1.655$, $\beta = 1.678$, $\gamma = 1.700$. 2V is very close to 90°. The dispersion is strong. The pleochroism is X=orange, Y=pale orange, Z=yellow.

The earliest minerals to form are spinel, forsterite, and enstatite. Spinel is poikilitically enclosed in enstatite. Phlogopite, actinolite, and anthophyllite invade the forsterite and enstatite. Spinel is greatly attacked when actinolite was introduced. Clinohumite is one of the latest minerals to form, and replaces forsterite almost completely. Excess iron from the formation of actinolite and clinohumite is found as magnetite. Clinochlore is associated with the clinohumite and magnetite.

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THE PEÑA BLANCA METEORITE, BREWSTER COUNTY, TEXAS

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The Peña Blanca meteorite fell August 2, 1946, in the swimming pool at the headquarters of the Gage Ranch near Marathon in Brewster County, Texas. Twenty-four people were within a few hundred feet of the point of fall, and one person saw the meteorite in flight.

Approximately 70 kg. (152 lbs.) of the meteorite was recovered consisting of one fragment of 47 kg. (104 lbs.), one fragment of 13 kg. (29 lbs.) and many smaller pieces down to mere grains. Reconstruction of the shape indicates that all but a few pounds of the stone have been recovered.

The meteorite is a white achondrite with a cream colored crust and remarkable porphyritic texture. One phenocryst of pyroxene is $10 \times 6 \times 6$ cm., another is $6 \times 3 \times 3$ cm., and a number are larger than $3 \times 3 \times 3$ cm. The groundmass shows considerable variation in grain size with abundant smaller grains 0.15 mm. in size.

Orthorhombic pyroxene is the principal constituent of the meteorite. Monoclinic pyroxene and olivine are of secondary importance. A very small amount of metal and sulfide is present, and there is a trace of plagioclase feldspar.

AN IMPROVED METHOD OF COUNTING OUT PETROFABRIC DIAGRAMS

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College of the City of New York

In place of the conventional center and peripheral counters, a single sheet of millimeter graph paper is used on which a small number of suitably arranged 1 per cent counting circles (1 cm. diameter) are drawn in ink. The point diagram is plotted on transparent cellulose acetate and provided with a tracing paper overlay upon which the contour diagram is drawn. Counting out involves successive 360° rotations of the superposed point diagram about a few appropriate centers marked on the grid. The counting circles and their centers

are readily visible through the overlays and indicate the desired 1 per cent counting areas for all positions of rotation. Percentage figures appear in circular arcs $\frac{1}{2}$ cm. or $\frac{1}{4}$ cm. apart, depending upon accuracy required, and concentric about the center of the diagram. Peripheral counts are made by utilizing opposing pairs of complementary circle segments drawn on the same grid. Similar provisions are made for azimuth counts.

This procedure is not only more rapid than the present method, but also reduces fatigue resulting from constant shifting and centering of the conventional counters. Its particular advantage lies in greater accuracy of contouring, since continuous rotation of the point diagram permits determination of the critical loci of change in percentage figures.

THE USE OF KODACHROME SLIDES IN TEACHING ELEMENTARY MINERALOGY AND LITHOLOGY

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During the past year the number of students taking elementary mineralogy and lithology at the University of Toronto has become so great that the author has found it impracticable to continue illustrating his lectures with actual specimens. Instead, a library of Kodachrome slides has been built up and these are projected on the screen. This method has the advantage of placing before the students specimens of the finest quality on a scale where the details may be observed clearly by all simultaneously and without damage to the specimens.

FUSED WOOD-ASH STONES: FAIRCHILDITE (n.sp.) $K_2CO_3 \cdot CaCO_3$, BUETSCHLIITE (n.sp.) $3K_2CO_3 \cdot 2CaCO_3 \cdot 6H_2O$, AND CALCITE, $CaCO_3$, THEIR ESSENTIAL COMPONENTS

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U. S. Geological Survey, Washington, D. C.

Stones found in the trunks of standing partially burned forest trees are produced by fusion and subsequent crystallization of the ash of the wood. Freshly formed stones consist essentially of fairchildite; on wetting, or by atmospheric hydration this is converted to buetschliite and calcite. On further leaching, the buetschliite is decomposed to calcite and water-soluble potassium carbonate. The presence of the first three carbonates in wood-ash stones is established, and a general account of these with a review of pertinent literature is given in this paper. The artificial compounds corresponding to fairchildite and buetschliite were prepared and analyzed by Otto Buetschli, in 1901–1905, but have not hitherto been found in nature. Fairchildite is hexagonal, $\epsilon = 1.48$, $\omega = 1.530$, and buetschliite is probably also hexagonal, with $\epsilon = 1.455$, $\omega = 1.595$.

NUEVITE, A NEW RARE-EARTH MINERAL FROM CALIFORNIA

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University of California at Los Angeles

A heavy black mineral from the Southern Pacific Silica quarry near Nuevo, Riverside County, California, is shown to be a titano-niobate of yttrium and iron, with an additional fractional per cent of tantalum. Spectroscopic analysis fails to show other rare elements, even in traces. The mineral thus appears to be a very simple member of the eschinite, samarskite, polycrase-euxenite group. It differs notably from any of the known species of this group, and thus seems to be a new mineral, for which the name "nuevite" is proposed.

Its properties are as follows: crystals prismatic in habit, square or rectangular, with orthorhombic (?) symmetry. Color black, highly brilliant on fresh fracture. Nearly opaque, but transparent brown in very thin flakes. No cleavage. Fracture flat conchoidal. H 6.5, G 6.4. Optically isotropic, index 2.23. Fusible, yielding a little water in closed tube.

It occurs in grains and crude crystals in quartz, associated with a little cyrtolite and black tourmaline.

ZONES AND REPLACEMENT BODIES IN THE HUGO PEGMATITE, KEYSTONE, SOUTH DAKOTA

JAMES J. NORTON AND LINCOLN R. PAGE

U. S. Geological Survey, Washington, D. C.

The Hugo pegmatite, one mile south of Keystone, South Dakota, crops out as an irregular body about 580 feet long and 480 feet wide. It consists of two zoned segments separated in part by quartz mica schist. The long axis of the outcrop trends northwest, but the individual segments strike east-northeast and dip north. Apparently the northern segment thickens and the southern segment thins with depth.

Three types of structural units of pegmatite are recognized: zones, fracture fillings, and replacement bodies. The essential minerals of the zones from the pegmatite contact inward are: (1) oligoclase and quartz; (2) quartz, oligoclase-albite, and muscovite; (3) quartz, albite, and perthite; (4) quartz, cleavelandite, perthite (and microcline), and amblygonite; (5) quartz, microcline, and spodumene; (6) quartz and microcline; and (7) a core of cleavelandite, microcline, and lithia mica. Zone 3 is divided into three sub-zones on a basis of the proportion of perthite. The northern segment contains only zones 1 through 4.

Fracture fillings and replacement bodies of quartz-cleavelandite-perthite (and microcline), cleavelandite-quartz-lithia mica, and cleavelandite-quartz-microcline-lithia mica pegmatites cut all zones except the core. The largest replacement body is an offshoot of the core and crosses three zones that can be recognized by relict textures and minerals. Textures of the replacement bodies are distinguishable from the earlier replacement textures formed as the zones were first becoming consolidated.

Variations in composition of individual minerals and the abundance of replacement textures are correlated with the sequence of structural units.

RELATION OF PARAVAUXITE AND GORDONITE

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Paravauxite was described by Gordon as a triclinic mineral with the composition $FeO \cdot Al_2O_3 \cdot P_2O_5 \cdot 11H_2O$ (1922) or $FeO \cdot Al_2O_3 \cdot P_2O_5 \cdot 10H_2O$ (1944). Gordonite is the name given by Larsen & Shannon to the crystallographically similar mineral with the composition $MgO \cdot Al_2O_3 \cdot P_2O_5 \cdot 9H_2O$ (1930). Determinations of the unit cells of these two minerals, from sharp rotation and Weissenberg photographs, gave the following results in comparison with previous crystallographic data:

	a	b	c				
Paravauxite	5.23	10.52	6.955 kX	107°16½′	111°24′	72°29′	(1)
	0.4966 :	1 :	0.6609				
	0.4840 :	1 :	0.6882	107°32′	110°23′	72°09′	(2)
Gordonite	5.22	10.49	6.95 kX	107°29′	110°55½′	72°32½′	(3)
	0.4975 :	1 :	0.6628				
	5.25	10.49	6.97	107°20′	111°12′	72°12′	(4)
	0.5004 :	1 :	0.6644				
	0.5192 :	1 :	0.6942	109°27′	110°57½′	71°40½′	(5)

(1) E.W.N., x-ray. (2) Gordon, gon., preliminary values (1944), transformed. (3) E.W.N., x-ray. (4) Larsen III, x-ray (1942). (5) Pough, gon. (1937).

With $FeO \cdot Al_2O_3 \cdot P_2O_5 \cdot 9H_2O$ in the unit cell, G (calc.) for paravauxite is 2.375 compared to 2.358 (meas., Gordon) and this composition is also consistent with the recent analyses.

ELLIPSOIDAL STRUCTURES IN GLASS

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Some novel optical glasses made recently contain ellipsoidal structures similar in many respects to pillow lava structures. The structures are shaped by convection currents in the liquid. The border of the ellipsoidal structures is schistose and commonly remains a glass even though the interior crystallizes. The difference in rate of crystallization of border and interior is a result of a difference in chemical composition and rate of cooling.

TWO SIMPLE TRANSFORMATIONS OF BRAVAIS SYMBOLS

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Simple transformation of Bravais symbols demands two zero points. Of the 144 possible simple transformations of Bravais symbols from $a_1\ a_2\ a_3$ axes to a_1', a_2', a_3' axes, referred to all possible zero points, with clockwise and counter clockwise succession of axes, there are twelve types, one of which is in simple accord with the transformation equation

$$\tan^2 \rho\ -3x^2 \cdot c/3a^2 = y^2 \cdot c^2/3a^2$$

where

$$\tan^2 \rho = \frac{4h^2 + 4hk + 4k^2}{l^2} \cdot \frac{c^2}{3a^2}$$

and

$$x = h/l \text{ or } k/l \text{ or } (h+k)/l$$

and

$$y = (h+2k)/l \text{ or } (2h+k)/l \text{ or } (h-k)/l$$

This type transforms $(hk\bar{i}l)$ to $([h+2k] \cdot [2h+k] \cdot [h-k] \cdot l)$ or $(h'k'k'l)$.

Another type transforms $(hk\bar{i}l)$ to $(h'k'\bar{i}l)$. The other ten types are only briefly discussed. All are in accord, graphically, with the transformation equation, but, in general, the assignment of the transformed indices to the proper axes requires reference to the gnomonic projection.

CONTACT METAMORPHIC MINERALS IN THE MELTING OF OPTICAL GLASS

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AND

HERBERT INSLEY

Bureau of Standards, Washington, D. C.

Petrographic studies made at the National Bureau of Standards on the attack by various optical glasses on refractory clay pots revealed the presence of crystalline compounds analogous in composition and properties to several natural minerals. The description of the compounds found, together with data on the conditions and associations in which they were found, may give clues as to the source of the corresponding minerals. With barium glasses, celsian formed as bladed crystals at the pot-glass interface and also was abundant within the corroded refractory. Sanbornite was present sparingly with the celsian but was more commonly found as devitrification stones in the glass itself. Zinc spinel developed in the refractory as small, perfect octahedrons. Nephelite-kaliophillite and carnegieite solid

solutions were present as reaction rims at the pot-glass interface. Mullite occurred abundantly in needles, corundum in thin, pleochroic plates, and cristobalite in skeletal crystals.

The formation of corundum by the action of a melt containing silica and alkalies on an aluminum silicate wall material is explained by the phase relationships in the system $Na_2O-Al_2O_3-SiO_2$ and may be similar to the origin of corundum at the contact of synenite with aluminum silicate country rock. The presence of celsian and sanbornite in the refractory may also parallel natural occurrences in contact zones. Nephelite and carnegieite solid solutions occur together only at high temperatures under known equilibrium conditions. The formation of zinc spinel by glasses with only 3 per cent of zinc is in accordance with the large field of zinc aluminate in the system $SiO_2-ZnO-Al_2O_3$.

INDEXED X-RAY POWDER SPECTRA OF THE ORE MINERALS

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A satisfactory standard x-ray powder spectrum consists of good reproductions of powder films made on authentic natural and, if possible, artificial material with Cu/Ni or Fe/Mn radiation, accompanied by a table giving the unit cell constants (corrected if necessary), the observed intensity of each powder ring on a scale of 10, the measured glancing angle, the measured interplanar spacing, the indices (*hkl*) of the reflecting planes, and the calculated spacing. A full set of such spectra is being prepared in Toronto to supplement existing röntgenographic data for the identification of the ore minerals.

NEW CHARTS FOR TEACHING CRYSTALLOGRAPHY

TERENCE T. QUIRKE

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Charts have been prepared on the basis of Maugin's system as used in the International Tables. One chart is drawn to illustrate forms characteristic of the 32 classes, indicating the elements of symmetry for each class. Another chart lists in parallel rows, names of classes according to three representative nomenclatures, the number of faces in the form, the elements of symmetry, the symmetry notations, with the addition of the space lattice groups pertaining to each crystal class and point group. These charts make a very convenient reference and have proved to be a great aid in teaching crystallography.

PREPARATION OF RUTILE TITANIUM DIOXIDE

TERENCE T. QUIRKE AND ROBERT STEINMAN

University of Illinois, Urbana, Illinois

Rutile occurs in nature in low temperature quartz, but seems not to be stable synthetically below 1040°C. By heating anatase intimately ground with another compound of the rutile lattice structure to 900°C. for two hours part conversion to rutile was achieved within the brookite range. However, with the addition of SiO_2 almost perfect conversion to rutile was accomplished in nearly every case. Germanium dioxide was also found to be efficacious.

The use of silica to coerce the formation of the rutile structure differs from the common use of seed crystals in that it involves the mutual packing effects of lattices which are not isomorphous. In this respect the procedure is thought to be unique.

THE COMPOSITION AND UNIT CELL OF HYDROZINCITE

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Specimens of hydrozincite from Goodsprings, Nevada, show tiny crystals projecting from fine-grained massive material. The crystals are blade-like, and taper to a sharp point.

They are up to 2 mm. in length, slender, and very thin. The only well-developed form is the pinacoid (100). Edge faces give very indistinct reflections on the goniometer, and no measurable terminal faces were observed. Weissenberg photographs confirm the previous assignment to the monoclinic system. The space group is either C_2/m, C_m or C_2, the characteristic missing hkl reflections being those with $h+k$ odd. Unit cell dimensions, derived from 0-level, b- and c-axis rotations, are: $a=13.452$ kX, $b=6.307$, $c=5.357$; $\beta=95°30'$ (x-ray). The volume of the unit cell, together with the values of d given in the literature, 3.6–3.8, do not give any simple proportions of $Zn(CO_3)$ and $Zn(OH)_2$. Tests in Clerici solution indicate a d close to 4.0, and this agrees well with a unit cell composition of $4Zn(CO_3) \cdot 6Zn(OH)_2$.

Crystals of aurichalcite from the Magdalena district, New Mexico, closely resemble those of hydrozincite, except for their pale green color. However, Weissenberg photographs indicate that, although closely related, aurichalcite is not isomorphous with hydrozincite.

URANINITE CRYSTALS WITH A NEW FORM FROM PORTLAND, CONNECTICUT

AUSTIN F. ROGERS

Stanford University, California

Euhedral crystals of uraninite from one of the pegmatites at this locality are octahedra modified by the cube, the dodecahedron, and a new form, the tetrahexahedron {520}. The latter is determined on a matrix specimen by measurement on the microscope stage of the plane angle formed on the (520) face by its intersections with (111) and (11$\bar{1}$), which may be expressed as the interzonal angle [2$\bar{5}$3]$\wedge$[$\bar{2}$53].

The uraninite crystals occur on a matrix of feldspar which proves, on optical examination, to be albite with the approximate composition $Ab_{95}An_5$. The albite is a replacement of microcline, which is present in very small amounts as a relict mineral.

Besides the usual cleavages parallel to {001} and {010}, the albite shows fair cleavage parallel to {110}, and both albite and pericline twin-lamellae, as well as pericline parting.

URANINITE AND PITCHBLENDE

AUSTIN F. ROGERS

Stanford University, California

It is proposed to use the name uraninite for the crystalline (isometric), essentially uranium dioxide (UO_2) mineral, with specific gravity varying from about 8.0 up to about 10.5 and low water content, and the name pitchblende for its massive or colloform amorphous equivalent (mineraloid) with a specific gravity varying from about 6.8 up to about 8.5 and a water content varying from about 2 per cent up to 5 per cent.

PRELIMINARY DATA ON IRON-BEARING MELILITES IN THE QUATERNARY SYSTEM Ca—FeO—MgO—SiO$_2$

J. F. SCHAIRER AND E. F. OSBORN

Geophysical Laboratory, Washington, D. C.

A few compositions have been studied in a small portion of the join $CaSiO_3$—MgO—FeO in the quaternary system CaO—FeO—MgO—SiO_2. Compositions between akermanite ($Ca_2MgSi_2O_7$) and its iron analogue ($Ca_2FeSi_2O_7$) and between monticellite ($CaMgSiO_4$) and its iron analogue ($CaFeSiO_4$) lie in this join. The phase relations for the join have been roughly outlined and the optical properties of the melilites have been determined. There is a continuous series of melilites between akermanite (optically uniaxial and positive) and its iron analogue (optically uniaxial and negative). The intermediate member containing approximately 72 weight per cent of akermanite is isotropic for sodium light.

HYDROTHERMAL ALTERATION IN THE "PORPHYRY COPPER" DEPOSITS*

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The hydrothermal alteration which was accompanied by the introduction of copper sulfides in the disseminated copper deposits is considerably more complex than is generally recognized.

Detailed microscopic study of selected porphyry specimens from the important producing deposits in the United States, together with a review of published data, leads to the recognition of four main types of alteration which may be characterized as follows:

1. Quartz-orthoclase.—Alteration to and/or introduction of quartz and orthoclase with a fairly favorable ratio of chalcopyrite to pyrite. Ajo, Ely, Bagdad, Utah Copper (in part).
2. Quartz-sericite-pyrite. Inspiration-Miami, Ray, Sacramento Hill, Castle Dome (in part), Utah Copper (in part).
3. Sericitic and argillic alteration with quartz subordinate. Morenci, Chino, Castle Dome (in part), San Manuel.
4. Biotitic alteration. Utah Copper (in part) and Ely (in part).

No district is a simple example of one kind of alteration but shows a dominance of one or two of the above types. Most districts show a rather long list of alteration products when studied in detail.

The argillic alteration has been little emphasized in earlier work but is now found to be very important in several districts of which Morenci is an outstanding example. The clay minerals are found in the sulfide ore and are characteristically earlier than sericite.

The more important clay minerals include: hydromuscovite, kaolinite, allophane, halloysite and beidellite. Less common are: potash clay, montmorillonite, and dickite.

Available chemical data indicate that calcium and sodium are usually removed from the rock to a significant degree, and potassium remains constant or increases. Silica is gained in a few deposits but usually shows minor changes. Quartz, no doubt, is often formed by the freeing of silica during alteration.

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PUMICE FROM HAYLMORE, BRIDGE RIVER, BRITISH COLUMBIA

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Pumice of Recent age from Haylmore's placer mine, Bridge River district, British Columbia, is highy vesicular and also shows pronounced fluidal structure. The pumice is vitrophyric; the volcanic glass of the groundmass has a refractive index of 1.497. The principal phenocrysts are plagioclase feldspars (Ab_{70} An_{30}) characterized by an abundance of glass inclusions. Glistening black hornblende phenocrysts are also found. A chemical analysis of the pumice and results of x-ray studies are given.

GEOLOGY OF THE RED ROSE TUNGSTEN MINE HAZELTON, BRITISH COLUMBIA*

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The Red Rose mine was British Columbia's largest producer of tungsten during World War II.

Scheelite occurs in a shear-zone that cuts Mesozoic Coast Range intrusives and hornfelsed tuffs within 750 feet of the Rocher Déboulé batholith.

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The minerals include scheelite, some ferberite and, in order of abundance: quartz, orthoclase, albite, apatite, biotite, hornblende, chalcopyrite and molybdenite. Cobaltian arsenopyrite, pyrrhotite, chalcopyrite, quartz and tourmaline occur in the shear beyond the scheelite.

Spectrographic analyses of 30 specimens of wall and nearby rocks and of specimens of vein and rock minerals showed variations of the trace elements in groups in which the range in atomic radii was within the 15 per cent limit allowed by Goldschmidt in his rule for isomorphism of elements. Tungsten was absent in all the rock analyses; apparently it did not wander as a trace element into the wall rocks.

The scheelite ore occurs in 2 shoots where the shear cuts a 400-foot diorite sill but is not found where the shear cuts hornfelsed tuffs. The stress diagram of the vein-shear and related breaks shows that the 2 ore shoots pitch in the same direction as the pitch of the intersection of potential tension openings within the vein.

The lenticular form, coarse to pegmatitic texture, and mineralogy of the tungsten vein imply formation at high pressure and temperature (the hypothermal class of veins). As a producing property, the Red Rose is unique in a class of scheelite deposits that does not ordinarily include commercial deposits of tungsten.

QUARTZ CRYSTALS WITH CLAY AND FLUID INCLUSIONS

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At several places in a narrow belt extending through Iredell, Alexander, Catawba, and Burke counties, North Carolina, quartz crystals with fluid and red-clay inclusions have been found. The rare and complex forms shown by the quartz, the inclusions of red clay, the large volume of water present in some cavities, and the presence of associated carbonate minerals, all indicate an origin not far from the surface under conditions of relatively low temperature and pressure.

Since the crystals with fluid-filled cavities are destroyed by freezing and since they are found close to the surface in areas that have suffered practically no erosion since the Pleistocene, it is concluded that soil in the upper Piedmont of North Carolina was not subjected to deep freezing during the glacial stages.

FROHBERGITE, $FeTe_2$, A NEW MEMBER OF THE MARCASITE GROUP

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This new mineral was found associated with altaite, tellurbismuth, montbrayite, melonite, petzite, chalcopyrite, pyrite, marcasite, sphalerite, chalcocite, covellite, and free gold, in polished sections of the rich telluride ore from the Robb-Montbray Mine, Montbray Township, Abitibi County, Quebec. It appears in fringes surrounding chalcopyrite, also as inclusions in gold, petzite, or chalcopyrite. Color purplish pink, against the yellowish pink of melonite; reflection pleochrosim not perceptible; anisotropism strong with polarization colors orange-red to inky blue; hardness C; negative to standard etch-reagents except HNO_3 (1:1) which etches black with strong effervescence. Micro-samples show only Fe and Te by chemical tests; and x-ray powder photographs give a pattern identical to that of $FeTe_2$, the only known compound in the Fe-Te system, which was prepared for comparison by pyrosynthesis. Natural and artificial $FeTe_2$ give an orthorhombic unit cell with space-group *Pmnn*, $a=3.85$, $b=5.28$, $c=6.26$, $Z=2$, and observed intensities in good agreement with the marcasite-type of structure determined on $FeTe_2$ by Tengnér (1938). Named after Dr. M. H. Frohberg, mining geologist, Toronto.

PRE-FOUNTAIN WEATHERING ON FLAGSTAFF MOUNTAIN NEAR BOULDER, COLORADO

ERNEST E. WAHLSTROM

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On the slopes of Flagstaff Mountain near Boulder, Colorado, the Fountain formation, a conglomeratic arkose of Pennsylvanian probably post Des Moines age, rests unconformably on pre-Cambrian Boulder Creek gneissoid granite. A weathered zone approximately 90 feet in thickness and having many of the characteristics of a laterite lies beneath the unconformity and was formed prior to the deposition of the Fountain formation. A deep red, iron-rich rock at the top of the zone grades at depth into a mottled, light gray to pinkish gray, friable rock. This rock in turn, grades into fresh granite or, locally, into a brown-stained rock which has acquired its color as a result of recent weathering. The recent weathering has not affected the thoroughly decomposed rocks in the pre-Fountain weathered zone.

Chemical and mineralogical analyses of twelve samples of fresh and altered granite are presented in tabular and graphical form to show changes resulting from pre-Fountain and recent weathering.

ON THE GEOCHEMISTRY OF FLUORINE

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A semi-quantitative spectrographic method circumvents the chemical difficulty of obtaining much needed data on the distribution of fluorine in rocks. A systematic examination of South African rock-types has been undertaken to trace the sources of fluorine in underground waters, and so help those studying the incidence of endemic dental fluorosis, a disease attacking man and beast. About 250 spectrographic determinations have been made.

Fluorine appears to be a good indicator element for some petrological problems. As expected, marginal granites show high fluorine content (0.1 to 0.3%), whereas the centers of well eroded batholiths give low figures (0.05% and less). Bushveld felsites ($\pm 0.04\%$) contain less than their associated granites (0.1%). Investigation of sediments and soils has also increased our knowledge of the geochemical cycle of the element.

The conclusion is reached that fluorine is more common than is recognized and that the abundance figure accepted by present day authorities for the lithosphere, viz. 0.03%, should be doubled---and possibly trebled. This work has not yet been completed.

DISPERSION-BIREFRINGENCE RATIO AS A DIAGNOSTIC

A. N. WINCHELL AND W. B. MEEK

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The ratio between the dispersion of the birefringence ($B_F - B_C$) and the birefringence (B_D) is an optical property which is almost unknown; but it may be useful in certain cases. For example, a three (or four) component system may have physical properties such that "contour" lines for the commonly used physical characters, such as specific gravity, refringence, and birefringence, are all nearly parallel, but the lines of the dispersion-birefringence ratio seem to be far from parallel with the other lines in some cases. A few examples are given.

LUDLAMITE FROM NORTH GROTON, NEW HAMPSHIRE

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Ludlamite, hydrous iron phosphate, has been found as crystals in small veins in triphyllite at the Palermo Mine, North Groton, New Hampshire. *Habit:* platey {001}. *Forms:* c{001}, a{100}, m{110}, l{011}, q{$\bar{1}$11}.

X-ray data: Powder pictures of the Palermo material are identical with those of the type Cornwall material and of the Hagendorf, Bavaria *lehnerite.* Rotation and Weissenberg pictures about [010] and [001] give: Space group P $2_2/a$; $a_0 10.48 \pm 0.06$, b_0 4.63 ± 0.05, c_0 9.16 ± 0.06, $\beta = 100°36'$; $a_0:b_0:c_0 = 2.26:1:1.98$. Analysis by Flight on type ludlamite gives irrational cell contents. From cell volume and G. $= 3.08$ measured on one crystal $M_0 = 815.6$. If cell contents were $Fe_6(PO_4)_4 \cdot 6H_2O$, a molecular weight of 817.1 would be obtained, and this composition is tentatively assigned the mineral. An analysis of the Palermo ludlamite is forthcoming.

Opt.: Biaxial positive; 2V 80°; α 1.650, β 1.667, γ 1.688. $r > v$ slight.

Occurrence: Transparent green crystals of ludlamite line narrow veinlets in triphyllite. Later minerals deposited in the cavities are, in order of deposition; *fairfieldite* in sheaf-like aggregates; vivianite in crystals coated with unknown white fibrous mineral; reddingite in orange brown crystals; stewartite (?) in platey orange brown crystals; and a biaxial white fibrous mineral with 2V about 80°, with positive optic sign, and with high birefringence, the indices ranging between 1.615 and 1.71. Only one specimen of the ludlamite has been found to date from Palermo, although another specimen from the Smith Quarry in Alexandria, New Hampshire, has been definitely established.

SPATIAL ORIENTATION OF URANIUM IN SAMARSKITE

HERMAN YAGODA

National Institute of Health, Bethesda, Maryland

Alpha ray patterns of polished samarskite sections prepared from crystals occurring in the Wiseman's mica mine, Mitchell Co., N. C. reveal marked variations of uranium content in symmetric growth zones which outline crystal faces. The polished sections appear to be optically homogeneous and show no evidence of foreign radioactive inclusions or internal alteration. Measurement of the photographic density of the alpha ray patterns show variations of about 25 per cent between zones of maximum and minimum blackening. Chemical analysis of the massive material reveals the presence of 0.8 per cent ThO_2 and 11.3 per cent U_3O_8. Assuming a homogeneous distribution of the minor amount of thorium, the variation in photographic density indicates variations in the uranium content of extreme zonal layers ranging between 10 to 13 per cent U_3O_8. Potential mechanisms for these unusual compositional variations are discussed.

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1920 Chicago, Illinois	1934 Rochester, New York
1921 Amherst, Massachusetts	1935 New York, N. Y.
1922 Ann Arbor, Michigan	1936 Cincinnati, Ohio
1923 Washington, D. C.	1937 Washington, D. C.
1924 Ithaca, New York	1938 New York, N. Y.
1925 New Haven, Connecticut	1939 Minneapolis, Minnesota
1926 Madison, Wisconsin	1940 Austin, Texas
1927 Cleveland, Ohio	1941 Boston, Massachusetts
1928 New York, N. Y.	1942 No meeting held
1929 Washington, D. C.	1943 No meeting held
1930 Tonroto, Canada	1944 No meeting held
1931 Tulsa, Oklahoma	1945 Pittsburgh, Pennsylvania
1932 Cambridge, Massachusetts	1946 Chicago, Illinois
1933 Chicago, Illinois	

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