

PROCEEDINGS OF THE TWENTY-NINTH ANNUAL
MEETING OF THE MINERALOGICAL SOCIETY OF
AMERICA AT NEW YORK, N. Y.

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

The twenty-ninth annual meeting of the Society, which was held at the Hotel Pennsylvania, New York, on November 11-13, 1948, was attended by 232 members and fellows. Scientific sessions were held in the afternoon on November 11th and in the morning on November 12th and 13th, at which thirty-four papers were presented. Five additional papers were given in the afternoon on November 12th at a Conference on *The Teaching of Crystallography*, prior to which the retiring President, Martin A. Peacock, addressed the Society on *Prospect of Mineralogy*.

The annual luncheon of the Society on November 12th was the best attended of any in the history of the Society; 190 fellows, members and guests were present. Following the luncheon George Tunell introduced the recipient of the Roebling Medal, W. Lawrence Bragg of the Cavendish Laboratory, Cambridge, England. Sir Lawrence is the eighth recipient of the medal and the second from England to receive this award. On the following pages are given the reports of the officers for the year ending October 31, 1948, as read before the Council at its meeting on November 10, 1948.

REPORT OF THE SECRETARY

To the Council of The Mineralogical Society of America:

SOCIETY ACTIVITIES

During the past year two committees, in addition to those handling the routine business of the Society, have been active. One of these, with Clifford Frondel as Chairman, has been considering the desirability of awarding a medal for a single outstanding contribution to the Science of Mineralogy. The other is the Committee on Mineralogical Research, composed of ten Fellows with Michael Fleischer as Chairman. Its function is to bring mineralogical science to the attention of other groups by:

1. Pointing out recent accomplishments.
2. Outlining major work in progress.
3. Looking to the future with the hope of stimulating research and directing it in certain channels.

The reports of both committees will be published in a future issue of *The American Mineralogist*.

In June of 1948 Michael Fleischer was appointed for three years as the representative of The Mineralogical Society to the National Research Council.

Following action taken by the Council in 1947, The Mineralogical Society of America became a member organization of The American Geological Institute, and two of its Fellows, Paul F. Kerr and Earl Ingerson, have been appointed Directors of the Institute.

During the summer of 1948 the First Congress of the International Union of Crystallography was held at Harvard University. The Mineralogical Society of America was one of the sponsoring organizations.

The Society was represented by several Fellows at the 18th International Geological Congress held in England during the summer of 1948.

ELECTION OF OFFICERS AND FELLOWS

Four hundred and sixty ballots were cast in the election of officers: 310 by members and 150 by fellows of the Society. The officers elected are:

President: John W. Gruner, University of Minnesota, Minneapolis, Minnesota.

Vice-President: J. D. H. Donnay, The Johns Hopkins University, Baltimore, Maryland.

Secretary: C. S. Hurlbut, Jr., Harvard University, Cambridge, Massachusetts.

Treasurer: Earl Ingerson, U. S. Geological Survey, Washington, D. C.

Editor: Walter F. Hunt, University of Michigan, Ann Arbor, Michigan.

Councilor (1949-1952): Lewis S. Ramsdell, University of Michigan, Ann Arbor, Michigan.

According to the provisions of the constitution the following have been elected to fellowship:

Helen Blair Barlett, AC Spark Plug Company, Flint, Michigan.

William Howard Barnes, National Research Council, Ottawa, Canada.

Thomas Fulcher Bates, Pennsylvania State College, State College, Pennsylvania.

G. F. Claringbull, British Museum (Natural History), London, England.

Julien Drugman, Uccle (Brabant), Belgium.

Jesse Harlan Johnson, Colorado School of Mines, Golden, Colorado.

G. G. Lemmlein, Institute of Crystallography, Academy of Science, U.S.S.R.

Marie Louise Lindberg, U. S. Geological Survey, Washington, D. C.

Arthur Montgomery, Boston University, Boston, Massachusetts.

Hans Jurie Nel, Geological Survey of South Africa, Pretoria, Union of South Africa.

Willard Hall Parsons, Wayne University, Detroit, Michigan.

Arthur Lindo Patterson, Bryn Mawr College, Bryn Mawr, Pennsylvania.

Raymond Pepinsky, Alabama Polytechnic Institute, Auburn, Alabama.

John Charles Rabbitt, U. S. Geological Survey, Washington, D. C.

Joseph Leon Rosenholtz, Rensselaer Polytechnic Institute, Troy, New York.

Richard Edwin Stoiber, Dartmouth College, Hanover, New Hampshire.

Elysiario Tavora, University of Brazil, Rio de Janeiro, Brazil.

Benno Wasserstein, Geological Survey, Pretoria, Union of South Africa.

Herman Yagoda, National Institute of Health, Bethesda, Maryland.

CHANGES IN THE BY-LAWS

On the recent ballot fellows and members were asked to vote on the following proposed changes in the By-Laws:

1. That the last three sentences of Article II, Section 1 be changed

From

The annual dues for fellows shall be five dollars (\$5), payable at or before the annual meeting in advance. The annual dues for fellows of the Mineralogical Society of America who also pay dues as fellows of the Geological Society of America shall be two dollars (\$2), payable at or before the annual meeting in advance. This provision shall continue in effect as long as the Geological Society of America shall contribute funds which the Council of the Mineralogical Society of America shall consider adequate to assist in publication of the Journal of The Mineralogical Society of America.

To

The annual dues for fellows shall be five dollars (\$5), payable in January.

2. That Article II, Section 2 be changed

From

The annual dues for members shall be three dollars (\$3). No person shall be accepted as a member unless he pays the dues for the year within three months after notification of his election. The annual dues shall be payable at or before the annual meeting in advance.

To

The annual dues for members shall be four dollars (\$4), payable in January.

The first change was approved by a vote of 370 in the affirmative with 45 in the negative. The second change was approved by a vote of 398 in the affirmative with 50 in the negative.

MEMBERSHIP STATISTICS

	November 1, 1948			
	1947	1948	Gain	Loss
Correspondents	6	5	0	1
Fellows	254	270	20	4
Members	677	686	177	168
Subscribers	501	592	127	36
	<hr/>	<hr/>	<hr/>	<hr/>
	1438	1553	324	209

The above figures show a net gain of 16 fellows, 9 members and 91 subscribers. Considering the four groups together there is a total gain of 115. Thus for the sixth consecutive year there has been a steady increase in members and subscribers, bringing the grand total to 1553.

The Society lost through death one Correspondent, A. Lacroix, and four fellows: Alfred C. Lane, James G. Manchester, Lewis G. Westgate, and Herbert P. Whitlock.

Respectfully submitted,

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

REPORT OF THE EDITOR FOR 1948

To the Council of the Mineralogical Society of America:

Presenting an annual editorial report for the calendar year at this time offers certain difficulties as regards particular details not encountered when meetings were held and reports given in late December. However, with five issues published and distributed and only one still in press, sufficient data are now available to give a general survey of the year's activity. By the time the Editor's report appears in print the missing data will be available and be incorporated, so that the then complete published report can be compared on the same basis as the summaries of previous years.

I think you will agree that from the standpoint of scholarly productivity the Journal for 1948 has moved forward. From present indications the volume will approach the 800 page mark a considerable increase in size (nearly 100 pages) over a year ago. In the main the policy of former years has been followed with some slight departures. For some time, in certain quarters, there has been expressed the hope that the journal might include, from time to time, a number of the more lengthy contributions. This year, as you may recall, we have included several of that type. For example, in the May-June number the first article covers 61 printed pages, and a number of other lengthy articles have appeared in other issues. Also in the matter of articles involving folded inserts, here, likewise, the attitude

has been one of liberality. Two colored plates have also added attractiveness and scientific value to the issues in which they appeared. The cost of one of these was charged against the funds of the Geological Society while the cost of the other was met by the Bausch & Lomb Optical Company. Also, in the matter of illustrations, here again the policy has been a very liberal one. In one 33-page article appearing in the July-August number 20 figures seemed necessary, 16 of which were full page illustrations.

It is the Editor's belief that all these items increase the value and effectiveness of our Journal as a national scientific publication. But it will also explain, unfortunately perhaps, why the current volume has been such an expensive one. Perhaps in this connection the question might very appropriately be asked whether the time has come to consider an increase in our working capital by advancing our subscription rates.

There seems little possibility, in the near future, at least, of reducing costs unless we limit the length of articles, eliminate folded inserts and colored plates (except when this does not involve expenditure by the Society), and reduce the number of free reprints. These measures, I am sure, would be considered retrogressive and should only be adopted as a last resort. It would seem more desirable to maintain our present standards and policies but increase somewhat our subscription price, if increased revenue is needed.*

The field that we attempt to cover is a large one, and the service rendered is by no means restricted to mineralogy in the narrow orthodox sense. To illustrate this extended service to related groups, last year the *Mineralogist* published the abstracts of 28 papers presented before The Crystallographic Society of America which was held in March, 1947. This year a joint meeting was held of The Crystallographic Society of America and The American Society of X-ray and Electron Diffraction, and a considerably longer program resulted. The 53 abstracts and five titles of this joint session, as well as the Presidential address, appeared in the November-December issue.

During the past year, there has been no heavy backlog of accumulated manuscripts under our present bimonthly system. The expansion in size of the individual issues has thus far been able to take care of the papers submitted. Ordinarily, the time interval between reception and appearance of the printed article has been from four to six months. In some instances a longer time is required, especially if the manuscript is returned to the author for revision. This average six months' interval does not seem unreasonable under present conditions, especially when compared with many other scientific publications, where the delay may be a year or even longer.

To the publishers should be accorded their full share of credit for continuing their high quality of workmanship and for maintaining a printing schedule that has assured delivery without undue delay.

Once again recognition and deep appreciation is here expressed for the generous and timely assistance received from The Geological Society in the form of financial support toward defraying a substantial portion of the ordinary publication costs and likewise for aid received when colored plates were deemed desirable.

In a detailed analysis of the Journal for 1948, we find that volume 33 contains 790 pages, exclusive of index. Leading articles, which number 55, occupy 77.6% of the total space. Table 1, which accompanies this report, indicates the distribution of the leading articles in the various fields listed. It might be of some interest to note that the average length of each of the main articles was slightly over 11 printed pages.

If to the 55 leading articles we add 18 shorter papers, appearing under the heading of Notes and News, we obtain a total of 73 published manuscripts for the calendar year.

* At a meeting of the Council held on Nov. 10, 1948, it was announced that a slight increase in dues for members and subscribers would be effective beginning Jan. 1, 1949.

These contributions were received from 85 contributors associated with 44 different universities, research bureaus, and technical laboratories.

The Journal for 1948 carried a detailed description of one new mineral—mansfieldite. One hundred and ninety-five illustrations of various types assist in clarifying the descriptive portions of the text. Twelve contributions were received from contributors residing outside of the States, representing the following seven countries: Australia, Belgium, Brazil, Canada, England, Sweden, and Switzerland.

The accompanying Table 1 summarizes in detail the distribution of subject matter in volume 33.

TABLE 1. DISTRIBUTION OF SUBJECT MATTER IN VOLUME 33

<i>Subjects</i>	<i>Articles</i>	<i>Pages</i>	<i>Per Cent of Total</i>
Leading articles*			
Descriptive mineralogy.....	11		
Chemical mineralogy.....	16		
Structural crystallography.....	8		
Geometrical crystallography.....	2		
Petrography.....	2		
Optical mineralogy.....	8		
Mineralography.....	1		
Memorials }.....	7		
Miscellaneous }			
	55	613	77.6
Shorter articles.....	18	42	22.4
Notes and news.....	43	12	
Proceedings of Societies.....	7	104	
Book reviews.....	10	9½	
New mineral names.....	28	9½	
	161	790	100.0
Illustrations.....	195		
Index, Title page, Table of contents.....		18	
Grand total.....		808	

Respectfully submitted,
WALTER F. HUNT, *Editor*

* Leading articles average 11.2 printed pages each.

REPORT OF THE TREASURER FOR THE FISCAL PERIOD BEGINNING
DECEMBER 1, 1947, AND ENDING OCTOBER 31, 1948

To the Council of the Mineralogical Society of America:

Your treasurer submits herewith his report for the fiscal period beginning December 1, 1947, and ending October 31, 1948.

RECEIPTS

Cash on hand, December 1, 1947.....	\$ 1,752.17
Dues and subscriptions.....	4,290.95
Sale of back numbers.....	1,519.82
Authors' charges on separates.....	687.96
Interest and dividends from endowment.....	2,937.30
Payment on principal of Trenton Mortgage stock.....	405.32
Geological Society of America aid in printing the Journal.....	3,165.21
Advertising.....	143.30
Sale of 20-volume Index.....	5.00
Sale of Index to volumes 21-30.....	262.05
Sale of U. S. Treasury bond.....	5,251.56
	<hr/>
	\$20,420.64

DISBURSEMENTS

Printing and distribution of the Journal (5 issues).....	\$ 7,950.07
Printing and distribution of separates.....	872.61
To the Editor, Secretary, and Treasurer.....	1,208.34
Postage.....	357.08
Clerical and secretarial assistance.....	509.30
Office equipment.....	3.00
Printing and stationery.....	273.21
Safety deposit box.....	7.80
Telephone and telegraph.....	9.70
Committee expenses.....	3.55
Society luncheon.....	27.59
Roebing Medal.....	139.40
Exchange charges on checks.....	2.14
Refund of dues.....	8.50
Travel expenses of officers to Annual Meeting.....	104.12
New securities purchased.....	5,997.67
Commission on new securities.....	3.13
Dividend adjustment on stock.....	7.75
Program and abstracts (1947).....	313.45
Duty on programs sent to Ottawa.....	9.00
Back numbers of the Journal purchased.....	34.00
	<hr/>
	\$17,841.41
Cash balance, October 31, 1948.....	2,579.23
	<hr/>
	\$20,420.64

The endowment funds of the Society as of October 31, 1948, consist of the following securities:

BONDS

6M Atlantic Coast Line, 4½.....	\$ 5,257.50
5M Cleveland Union, Terminal, 5.....	5,068.75
5M Illinois Central, 4.....	3,887.50
5M New York Central, 5.....	4,300.00
5M Southern Railway, 5.....	5,743.75
4C Great Northern, 5½.....	400.00

PREFERRED STOCKS

200 shares, Southern California Edison, 4.88.....	\$ 5,250.00
100 shares, Union Pacific, 4.....	4,570.25
60 shares, Jones and Laughlin, A, 5.....	4,987.50
55 shares, U. S. Steel, 7.....	6,946.20
50 shares, Virginia Electric & Power Co., 5.....	5,942.50
24 shares, Public Service Electric & Gas Co.....	728.40
10 shares, Consolidated Edison.....	1,066.64
37 514/1000 shares, Trenton Mortgage Service.....	1,076.05*

COMMON STOCKS

50 shares, Chesapeake and Ohio Railway.....	\$ 2,368.75
50 shares, Pennsylvania Railroad.....	1,468.75
35 shares, American Telephone and Telegraph.....	4,819.32
26 shares, Standard Oil of New Jersey.....	1,390.72
1 share, New York, Chicago & St. Louis Railroad.....	37.00

\$65,309.58

* Residual value.

Respectfully submitted,
EARL INGERSON, *Treasurer*

DANA FUND

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

RECEIPTS

Available balance, December 1, 1947.....	\$471.25
Interest.....	1.17
	\$472.42

DISBURSEMENTS

Disbursed.....	\$100.00
Available balance, November 1, 1948.....	372.42
	\$472.42

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 period ending October 31, 1948. 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 West End Branch of the Washington Loan and Trust Company in Washington, D. C.

Respectfully submitted,
JOHN F. SCHAIERER
GEORGE SWITZER
K. J. MURATA, *Chairman*

ABSTRACTS OF PAPERS PRESENTED AT THE TWENTY-
NINTH ANNUAL MEETING OF THE MINERALOGICAL
SOCIETY OF AMERICA, NEW YORK, N.Y.,
NOVEMBER 11-13, 1948

URANIUM MINERALS FROM THE HILLSIDE MINE, YAVAPAI COUNTY, ARIZONA

JOSEPH AXELROD, FRANK GRIMALDI, CHARLES MILTON, AND K. J. MURATA
U. S. Geological Survey, Washington, D. C.

A mineral assemblage, forming coatings on gypsum at the 300-foot level of the Hillside mine, contains a variety of hitherto unknown uranium minerals, together with schroeckeringerite, previously known only from Wyoming and Czechoslovakia. The new minerals are bayleyite, $Mg_2UO_2(CO_3)_3 \cdot nH_2O$, andersonite, $Na_2CaUO_2(CO_3)_3 \cdot nH_2O$, and swartzite, $CaMgUO_2(CO_3)_3 \cdot nH_2O$. There are also two other new unnamed substances which are dehydration products of bayleyite and swartzite. Bayleyite, swartzite and andersonite have been synthesized. Analyses, optical data and x-ray patterns of the new minerals are given together with x-ray patterns of the dehydration products. Schroeckeringerite has been analyzed and its formula found to differ from that given in the older accounts in the literature; our analysis agrees closely with that of the Wyoming schroeckeringerite recently reported by Jaffe, Sherwood and Peterson.

ELECTRON MICROSCOPY OF THE KAOLIN MINERALS

THOMAS F. BATES, FRED A. HILDEBRAND, AND ADA SWINEFORD
Pennsylvania State College, State College, Pennsylvania

The development of the electron microscope has made possible detailed morphological studies of the clay minerals.

Nacrite, dickite, and some kaolinites have been effectively studied with the petrographic microscope because of their relatively large, well-defined crystals. Endellite, halloysite, and allophane particles can only be observed in detail at magnifications greater than 5000 diameters.

Kaolinite crystals from different localities show appreciable variation in size but in only a few instances depart from the characteristic pseudo-hexagonal shape.

Endellite and halloysite crystals, previously described as "lath-shaped," are actually slender hollow tubes which show a considerable diversification in both shape and size in different specimens. The tubes are essentially cylindrical but in many cases are partially or completely flattened into ribbons. They are commonly split lengthwise and are often "unrolled" to a varying extent. Two, or occasionally more, concentric tubes are frequently observed.

Allophane particles are irregular in shape but similarity to some of the poorly crystallized halloysites suggests the possibility of a transition between these two minerals. Morphological evidence of the presence of intermediate members in a kaolinite-halloysite series is lacking.

Previous electron microscope work by the writer on the illite minerals (hydromicas) has shown that morphological differences bear a direct relation to the geological history of the rock in which they occur. The present work suggests that variations in the morphology of the kaolin minerals can be related to the mode of formation and subsequent history of the clay.

X-RAY MEASUREMENTS ON VAUQUELINITE

L. G. BERRY

Queen's University, Kingston, Ontario

New observations on vauquelinite crystals from Beresovsk, Urals, yield the following data: Monoclinic, $P2_1/n$. The unit cell, with $a=13.68$, $b=5.83$, $c=9.53 \text{ \AA}$, $\beta=93^\circ 58'$, $a:b:c=2.3465:1:1.6346$, contains $(Pb, Cu)_{12}[(Cr, P)O_4]_8$. Specific gravity 6.06 (measured, Dana), calculated 6.03 for $4[Pb_2Cu(CrO_4)(PO_4)]$. A well marked pseudo-cell with half the volume of the true cell and $2a'=[101]$, $b'=b$, $2c'=[\bar{1}01]$ has the same orientation and axial ratio as the morphological unit chosen by Goldschmidt.

REMAINS OF A GABBRO-GRANITE TRANSITION IN
NORFOLK COUNTY, MASSACHUSETTS

FELIX CHAYES

Geophysical Laboratory, Washington, D. C.

In a gradational transition specimens from the actual transition zone ought to be characteristically intermediate in composition. Compatibility with a "rectangular" or "equal frequency" parent distribution in the range of intermediate composition is suggested as a minimum criterion of gradation, and the statistical device of a one-sided chi-square test is proposed as a means of testing this compatibility.

The test is applied to a suite of specimens taken from a "gabbrodiorite"- "granodiorite" contact zone well exposed along route 128 in the townships of Dedham and Westwood, Norfolk Co., Mass.

These rocks are all extensively altered, but the alteration seems to have had little effect on the distribution of quartz. The quartz distribution is clearly incompatible with the proposed definition of gradation, rocks of intermediate quartz content being very scarce. It is concluded that this contact offers no evidence of an original gradation from gabbro to granite.

LITHIUM-BEARING PEGMATITES IN NORTHERN QUEBEC

DUNCAN R. DERRY

Toronto, Ontario

Lithium minerals, especially spodumene, are typical of many of the pegmatites occurring along the margins of a granitic stock in LaCorne Township, north of Val D'Or, Quebec. Recent diamond drilling has shown some interesting features in the structure and composition of these dikes.

The majority of the dikes strike nearly parallel to the nearest part of the granite contact and dip towards the centre of the stock. They occur both within the granite and just outside it in basic lavas or sediments.

The unusual feature of their composition is the uniformity in texture and average percentage of the spodumene in individual dikes. One series of such dikes on the north side of the stock shows an average spodumene content of about 25%. The crystals are arranged in a parallel pattern normal to the walls and are accompanied by feldspars, quartz, and minor amounts of beryl and tantalite. The texture of the more consistent dikes is finer than is usually seen in pegmatites. These finer-grained, uniform dikes are usually close to the granite contact while those closer to the centre of the stock are more variable in texture and spodumene content and contain more beryl.

No evidence has so far been seen that the present minerals were formed by replacement of earlier minerals in the dikes.

LIQUID INCLUSIONS IN HALITE AS A GUIDE TO GEOLOGIC THERMOMETRY

ROBERT M. DREYER, ROBERT M. GARRELS, ARTHUR L. HOWLAND
University of Kansas, Lawrence, Kansas; Northwestern University,
Evanston, Illinois

The gaseous phase of primary liquid inclusions in sedimentary Kansas halite vanishes between 70 and 100°C. This temperature probably is much above those temperatures generally prevailing in the Permian seas at the time of salt deposition. It is suggested that, if the liquid inclusion method is a valid guide to geologic thermometry, the method gives, after pertinent pressure corrections, only the temperature of the solution at the surface of the crystallizing material and that the general temperature of the mineralizing solutions may be much below that indicated by the liquid inclusions.

RETGERSITE, $\text{NiSO}_4 \cdot 6\text{H}_2\text{O}$, A NEW MINERAL

CLIFFORD FRONDEL AND CHARLES PALACHE
Harvard University, Cambridge, Massachusetts

The well-known artificial compound, tetragonal $\text{NiSO}_4 \cdot 6\text{H}_2\text{O}$, is described from five natural occurrences: with morenosite and minasragrite at Minasragra, Peru; with annabergite at Cottonwood Canyon, Churchill Co., Nevada, at Lobenstein, Thuringia, and at Lichtenberg, Bayreuth, Bavaria; and with ferroan chalcantinite at the Gap Nickel Mine, Lancaster Co., Pennsylvania. Tetragonal trapezohedral, with $a:c=1:2.7038$ (artificial; Scacchi, 1863); $a_0=6.765$ kX, $c_0=18.20$, $a_0:c_0=1:2.690$ (Minasragra). Uniaxial negative, with $nO=1.510$, $nE=1.486$ (natural). Crystals from Minasragra are short prismatic [001] with {001}, {110}, {011}, {012}; also found as fibrous crusts and veinlets. Color blue-green. G 2.04 (Nevada). Cleavage {001} perfect, {110} in traces. Analysis gave: NiO 26.87, MgO 0.65, FeO 0.63, SO_3 30.32, H_2O [41.53], total [100.00] (Nevada). The name retgersite is proposed for the mineral in honor of J. W. Retgers (1856-1896), Dutch chemical crystallographer.

Only four of the twenty-three reported natural occurrences of morenosite, orthorhombic $\text{NiSO}_4 \cdot 7\text{H}_2\text{O}$, can be said definitely to be of that species.

BASALTIC FAN JOINTING INDUCED BY AQUEOUS CHILLING

RICHARD E. FULLER
University of Washington, Seattle, Washington

At Rock Island, Washington, the eastern escarpment of the Columbia River Valley exposes a thick basaltic flow with marked "ball and socket" columnar jointing. Locally this flow shows the development of well defined columnar fan jointing radiating from vertical cracks which formed cooling surfaces. Laterally the fans grade rapidly from fine to coarse horizontal columns which have been confused with dikes. An alternation of smooth and rough transverse surfaces on the joint prisms of the fans as well as on the vertical columns of the flow also suggests exceptional acceleration of chilling. This chilling is considered to have been induced by the flooding of the surface of the flow with water, the presence of which is indicated by overlying palagonitic breccia formed by the aqueous granulation of a subsequent flow.

HYDROTHERMAL SYNTHESIS OF ENARGITE AND TENNANTITE

R. V. GAINES
Harvard University, Cambridge, Massachusetts

Crystallized enargite (Cu_3AsS_4) and tennantite ($\text{Cu}_{12}\text{As}_4\text{S}_{13}$) have been synthesized hydrothermally at temperatures in the range 350°-430°C. Arsenolite, orpiment, and several

unidentified substances were obtained in minor amounts in some instances concomitantly with enargite or tennantite. The reactants, which variously included Cu, CuCl, CuCl₂, CuS, As₂S₃, As₂O₅, S and Na₂S, together with water, were sealed in Vycor tubes and heated within steel pressure bombs of conventional design. The laboratory conditions favorable to the formation of enargite and tennantite were explored by variation of temperature, composition and pH of the solutions.

SOME ASPECTS OF THE SYSTEM NaAlSi₃O₈-CaO · Al₂O₃

JULIAN R. GOLDSMITH

University of Chicago, Chicago, Illinois

The thermal-equilibrium relationships in the system NaAlSi₃O₈-CaO · Al₂O₃ have been investigated. Complex relations exist at temperatures above the carnegieite-nepheline inversion range, the system at these temperatures being quaternary in nature. At lower temperatures, in the stability field of nepheline, simplification to a binary system is observed over a considerable portion of the system, due to the ability of nepheline to take up somewhat over 60 per cent CaO · Al₂O₃ in solid solution. The complexity at higher temperatures is due to the inability of carnegieite to include more than a small amount of CaO · Al₂O₃ in its structure, and to the intrusion of fields of β-Al₂O₃, corundum, and CaO · 2Al₂O₃.

Soda volatilization is significant in the system, and apparently the rate is increased as lime is added. As soda is lost, β-Al₂O₃ or corundum tend to crystallize. The possibility of this effect being related to the corundum present in some alkaline rocks, particularly those associated with limestone, and to soda enrichment (albitization, etc.) of the country rock is discussed.

RETROGRESSIVE ALTERATION FOLLOWING GRANITIZATION AND RHEOMORPHISM

G. E. GOODSPEED

University of Washington, Seattle, Washington

At Cornucopia, Oregon, some areas of granitic rock are transected by numerous parallel alteration bands a few feet apart. They range from a fraction of an inch to 2 inches in width and have outer borders of sericitized and kaolinized granodiorite. Quartz is the chief mineral with some microcline and orthoclase. Were it not for the strong evidence that the granitic rock has been formed by metamorphism rather than consolidated from a magma, these bands would be interpreted as of deuteritic origin. The sericitization and kaolinization are indicative of temperature lower than that which obtained during granitization.

Rheomorphic dikes in this region exhibit crystalloblastic microtextures and pronounced flow structures. Some of these dikes, which are 4 or 5 feet wide and nearly vertical in attitude, are horizontally transected by light-colored alteration bands, up to 2 inches in width, several inches apart. These bands pinch out in the wall rock within 2 inches from the dike. They contain a few horizontal veinlets of epidote and chlorite. In a large thin section, it can be seen that the contacts with the unaltered part of the dikes are indistinct and that relict flow structure continues through them. Most of the original mafics of the dike have disappeared and even some of the plagioclase has been partially epidotized as well as kaolinized. There has been an apparent increase of alkali feldspar and quartz. It seems, therefore, that there is a close analogy in the mode of origin of these alteration bands to deuteritic processes in igneous rocks.

PRE-BELTIAN ROCKS NEAR DILLON, MONTANA*

E. WM. HEINRICH

University of Michigan, Ann Arbor, Michigan

Three major units of pre-Beltian metamorphic rocks occur near Dillon, Montana. The oldest consists of a series of banded gneisses that are similar to rocks of the Pony Series. Above these lies a group of marbles, schists, and quartzites, about two miles thick, belonging to the Cherry Creek Series. Hornblende gneiss, which is interlayered with these metasediments, represents chiefly metamorphosed mafic sills, for vestiges of earlier contact metamorphic effects are preserved and locally the gneisses transect the marbles. Cutting both Pony and Cherry Creek rocks is a batholith of red granite gneiss (Blacktail granite gneiss). Transecting these units are dikes and irregular sheets of pegmatite, diabase, and peridotite, unmetamorphosed and of uncertain age.

THE MOORE COUNTY METEORITE; A FURTHER STUDY WITH COMMENT ON ITS PRIMORDIAL ENVIRONMENT

H. H. HESS AND E. P. HENDERSON

Princeton University, Princeton, New Jersey; U. S. National Museum, Washington, D. C.

The Moore County meteorite in bulk composition resembles a Sudbury norite. The pyroxenes present were initially a single phase, pigeonite. This has undergone a complicated series of changes from which it is deduced that the temperature of the original environment was approximately 1135°C. and that the meteorite left this environment with catastrophic suddenness. Investigation of the fabric of the meteorite indicates a well-developed dimensional orientation of the plagioclase and pyroxene. The plagioclase *b* and *c* crystallographic axes and the pyroxene *c* axis tend to lie in one plane. The fabric is considered to represent primary layering developed by crystal accumulation on the floor of a magma chamber. This crystallization differentiation must have occurred in the original environment. Various lines of evidence suggest that the parent body from which the meteorite came was of the same order of magnitude of size as the Earth.

THE DISTRIBUTION OF ACCESSORY ELEMENTS IN PEGMATITES

H. D. HOLLAND AND J. L. KULP

Columbia University, New York

A mathematical theory for the distribution of accessory elements in the minerals of pegmatites is derived. The admittance of accessory elements by crystal lattices, the distribution of accessory elements as a function of the distance from the wallrock-pegmatite contact, and the effect of disturbing factors on the cooling history of a pegmatite are discussed. The theory is illustrated with an artificial example, and suggestions are made relative to its testing by experimental data. It is proposed that such testing will elucidate the mechanism of pegmatite formation.

ABSORPTION OF INFRA-RED RADIATION BY CLAY MINERALS

W. D. KELLER

University of Missouri, Columbia, Missouri

Absorption of infra-red radiation by clay minerals varies both in intensity and in wave lengths with the variety of clay mineral in the absorption chamber. Preliminary measurements suggest that certain clay minerals have characteristic infra-red absorption patterns, and that the absorption curves may be of help in the identification of clay minerals. Examples of absorption curves are shown.

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THE PHYSICAL ANALYSIS OF POLYCOMPONENT GARNET

S. BENEDICT LEVIN

Signal Corps Engineering Laboratories, Fort Monmouth, New Jersey

The widespread occurrence and compositional variation of garnet, in relation to the character of the rock facies in which it is indigenous, make it a useful diagnostic mineral in many petrologic problems. This places a premium on methods for the relatively rapid and accurate determination of garnet composition, especially where many specimens or very small amounts of clean material are involved. For detailed compositional correlation the 3-component solutions afforded by the triangular diagrams of Ford and Winchell do not suffice, since most garnet specimens (probably over 85%) contain 4 or 5 of the theoretical component "molecules" in significant amounts, that is, one mol percent or more. Good 4-component solutions are afforded by the measurement of 3 physical properties which are independent (non-parallel) functions of the compositional variation, viz: index of refraction n , specific gravity G , and lattice constant a_0 . These values may readily be applied to an algebraic solution or to the tetrahedral graphical solution of Philipsborn, and (with the same data) will yield quantitative results considerably better than the geometric estimates of Stockwell.

For most occurrences, however, only a 5-component solution in terms of pyrope, almandite, spessartite, grossularite, and andradite, will account for 99% or more of each garnet specimen. Such solutions are afforded by supplementing the 3 physical measurements (n , G , a_0) with a rapid partial chemical analysis for either MnO or FeO. With these 4 measured quantities, and the summation to 100% providing the fifth, it is possible to set up and solve 5 simultaneous equations to yield the values of the 5 unknowns, i.e. the molecular proportions of the 5 component molecules. In connection with a recent study of Adirondack garnets, a general solution of the 5 simultaneous equations has been made and the algebraic calculations thereby abbreviated to about 20 minutes of machine calculating. In laboratories having the usual equipment, an x -ray diffraction camera, thermally calibrated high-index liquids, a micro-pycnometer, etc., this composite method results in considerable saving of time over wet chemical methods, especially where many analyses are needed. By measuring N to $\pm .001$, G to $\pm .005$, a_0 to $\pm .002$ Å, and MnO to $\pm .2\%$, results accurate to ± 1 mol per cent are obtained. Examples from the author's recent work are cited in illustration.

ARROJADITE AND GRAFTONITE FROM THE NICKEL PLATE MINE, SOUTH DAKOTA*

MARIE LOUISE LINDBERG

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

The iron phosphate described by Headden in 1891 from the Nickel Plate mine, South Dakota was reexamined. This material, not originally named, was later termed headdenite by Quensel and Mason, but is now known to be type unoxidized arrojadite. The massive sample appeared homogeneous, but a fresh interior surface showed graftonite, quartz, muscovite, and cassiterite. Thin sections show that the cassiterite occurs as subhedral grains or as thin seams containing rows of halos in the cleavage of the arrojadite. The analysis of arrojadite is: insoluble 0.11, Na₂O 6.40, K₂O 1.74, CaO 2.46, FeO 28.22, MnO 15.78; MgO 1.04, Li₂O 0.09, Al₂O₃ 2.66, Fe₂O₃ none, P₂O₅ 40.00, H₂O+0.91, F 0.80; total 100.21, less O=F₂ 0.34, total 99.87. Optical constants are: $\alpha=1.664$, $\beta=1.670$, $\gamma=1.675$, biaxial negative, $2V=86^\circ$, $r < v$ strong, X colorless, Y pale green, Z pale yellow green. The three strongest lines in the x -ray powder pattern are 3.04 Å, 2.715 Å, and 3.22 Å. The analysis of the graftonite is: insoluble 0.16, MnO 21.81, FeO 30.70, Fe₂O₃ none, Al₂O₃ 0.20, TiO₂ none, CaO 6.00, MgO 0.10, P₂O₅ 39.66, H₂O 0.60, Li₂O 0.05, Na₂O 0.28, K₂O none, F 0.20;

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total 99.76, less O=0.08, total 99.68. The optical constants are $\alpha=1.713$, $\beta=1.719$, $\gamma=1.739$, biaxial+, $2V=60^\circ$, $r>v$ strong, X=Y= colorless, Z=pink. The three strongest lines are 3.96 Å, 3.21 Å, and 4.18 Å.

ANALCIME SUITE OF IGNEOUS ROCKS, BREWSTER COUNTY, TEXAS

JOHN T. LONSDALE AND KATHRYN K. O'NEILL
University of Texas, Austin, Texas

In southern Brewster County, Texas, a distinctive suite of alkalic rocks containing analcime is present in small laccoliths, sheets, sills, and dikes. The most abundant rock types are plagioclase-orthoclase (orthoclase, soda orthoclase, anorthoclase) rocks with augite, aegiritic pyroxene, olivine, apatite, analcime, and ore minerals. Biotite and hornblende are present in some specimens. Two masses contain nepheline rocks. These rocks have been called *analcime* basalt, nepheline basalt, trachybasalt, trachydolerite, syenogabbro, syenodiorite, and plagioclase syenite depending upon differences in texture and small but distinct mineralogical differences.

In many of the masses syenitic differentiates containing analcime, alkalic feldspar, aegiritic pyroxene, hornblende and biotite are present. Blebs, stringers, and small irregular bodies of syenite are common. In a few of the masses much larger bands and irregular masses are common. Some of these appear to be pegmatitic, others aplitic in character. The manner of occurrence and constant association of the differentiates preclude separate intrusions.

In all the rocks analcime formed late but is present in chilled borders of the larger masses as well as in the differentiates. There is evidence to indicate that it was nearly contemporaneous with alkalic feldspar, hornblende, and aegiritic pyroxene in the differentiates.

The complete suite shows a considerable range in composition and together with the mineral sequence suggests that the magmas were undergoing reaction when solidification occurred. The range of analyzed specimens is SiO₂, 40.17-61.28; Al₂O₃, 13.44-18.75; Fe₂O₃, 1.81-4.21; FeO, 1.53-9.72; MgO, 0.40-12.32; CaO, 1.24-12.55; Na₂O, 2.22-6.44; K₂O, 0.71-6.56; TiO₂, 0.67-3.51; P₂O₅, 0.11-1.04.

CHARTING FIVE AND SIX VARIABLES WITHIN THE BOUNDING TETRAHEDRA OF HYPERTETRAHEDRA

JOHN B. MERTIE, JR.*

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

Triangles, tetrahedra, and hypertetrahedra may be used as reference frames for charting variables whose sums equal unity. The number of variables that may theoretically be charted equals the number of vertices in the figure.

Hypertetrahedra of n dimensions are bounded by points, lines, triangles, tetrahedra, and hypertetrahedra of $n-1$ and fewer dimensions. Direct geometric charting within hypertetrahedra is impossible, as such figures can not be envisaged or constructed; but the variables may be plotted in groups within the bounding triangles of tetrahedra.

Methods have recently been presented by the writer for charting five, six, or seven variables in the bounding triangles of hypertetrahedra of four, five, and six dimensions. Methods are now given for charting five and six variables within the bounding tetrahedra of hypertetrahedra of four and five dimensions. For seven variables, these methods have little advantage over charting within the bounding triangles.

Analyses are arranged in all possible groups of four variables, and each group is recomputed to equal unity, or 100 per cent. These groups are plotted as points within the bounding tetrahedra; and each point is then projected orthogonally onto some selected tetra-

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hedral face. From an assemblage of such projected points, contour maps are made. Thus five variables are represented by five maps, and six variables are represented by fifteen maps.

Quadriplanar and trilinear coordinates are used. Negative coordinates and their uses are explained; and methods are given for amplification of scale when needed. For drawing contour maps, empirical arrangements of the tetrahedral faces of the bounding tetrahedra are presented.

**THE ISOTHERMAL BOLYBARIC SATURATION CURVE AT 400° IN THE
SYSTEM $H_2O-Na_2O-SiO_2$**

GEORGE W. MOREY

Geophysical Laboratory, Washington, D. C.

The system $H_2O-Na_2O \cdot 2SiO_2$ can be treated as binary, and the lowering of melting point determined under increasing water pressure, only until about 600°. Then the solubility of Na_2O and in the vapor SiO_2 begin to be significant; and since the vapor contains more Na_2O than corresponds to the compound the system must be considered as ternary. Just below the critical end-point of water the solubility of $Na_2O \cdot 2SiO_2$ falls to practically zero, and the first critical end-point is practically at the critical point of water. The second critical end-point is a ternary one. Mixtures corresponding to the eutectic between sodium disilicate and water have a continuous solubility curve, so there must be a critical region bounded on both the high-silica and the high-soda sides. The isothermal polyboric solubility curve at 400° has been studied, with analyses of both vapor and liquid phases.

GEIKIELITE, A NEW FIND FROM CALIFORNIA*

JOSEPH MURDOCH AND J. J. FAHEY

University of California at Los Angeles, California, and
U. S. Geological Survey, Washington, D. C.

Geikielite, a magnesium titanate, has been found at the Jensen Quarry, Riverside County, California.

The mineral occurs in tiny grains and crystals sparingly disseminated through the crystalline brucite-limestone of the quarry, associated particularly with concentrations of minute grains of flesh-colored spinel.

In color it is deep red to nearly black, transparent red in thin crystals or fragments. Its specific gravity is 3.79.

Measurable crystals are rhombohedral, with the base dominant, one rhombohedron usually well developed, three others occasionally present. Forms, (0001), (10 $\bar{1}$ 1), (20 $\bar{2}$ 5), (02 $\bar{2}$ 1), (01 $\bar{1}$ 2).

X-ray powder photographs, which can be completely indexed, confirm the structure to be $C_2^2_i$, with $c/a=2.67$, checking with the ilmenite group.

Composition was determined by chemical analysis of carefully purified material: TiO_2 64.9, Al_2O_3 1.3, MgO 31.8, FeO 1.4, MnO 0.4, SiO_2 0.9.

IGNEOUS ROCKS OF THE CAPITAN QUADRANGLE, NEW MEXICO

LEROY T. PATON

Texas Technological College, Lubbock, Texas

Igneous rocks of the Capitan quadrangle, New Mexico, occur in the Capitan, Patos, Carrizo, Vera Cruz, and Sierra Blanca mountains, and in numerous small intrusions, dikes, sills and extrusive flows. The results of quantitative mineralogical analyses and the modes of the rocks are given.

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SCORZALITE FROM SOUTH DAKOTA: A NEW OCCURRENCE*

W. T. PECORA AND J. J. FAHEY

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

The mineral association, chemical analysis, and physical properties of scorzalite from a new occurrence are described. Analyzed material from the Victory pegmatite, near Custer, S. D., contains 17.06 per cent FeO, 2.93 per cent MgO, and has a Fe:Mg molecular ratio of 3:1. Scorzalite from this locality is the richest in iron of the known members of the lazulite-scorzalite isomorphous series.

HIGH POTASH VOLCANIC ROCKS, ST. FRANCOIS MOUNTAINS, MISSOURI†

FORBES ROBERTSON AND CARL TOLMAN

Montana School of Mines, Butte, Montana; Washington University, St. Louis, Missouri

The Pre-Cambrian of the St. Francois Mountains of Missouri is characterized by acidic igneous rocks including granites, intrusive porphyries and volcanics of various types. There are also some regionally distributed small gabbroic intrusions. The felsite flows are divided into two groups, both of which are characteristically high in potash feldspars. The feldspars of the younger group are characteristically perthitic. The feldspars of the older group and the rocks as a whole are high in potash and deficient in soda and lime. These rocks, especially the very high potash ones, are unique. The distribution, petrographic character, and chemical composition of these rocks are given.

THE SYSTEM K_2O - MgO - SiO_2

EDWIN W. ROEDDER

Columbia University, New York

The phase diagram of the more geologically significant portions of the condensed system has been determined by the quenching technique. Four new ternary compounds were found and their thermal relationships determined. Their compositions are $K_2O \cdot 5MgO \cdot 12SiO_2$, $K_2O \cdot MgO \cdot 5SiO_2$, $K_2O \cdot MgO \cdot 3SiO_2$, and $K_2O \cdot MgO \cdot SiO_2$ (?). The first of these may possibly occur naturally but has not been reported. The second and third appear to be isomorphous with leucite and kalsilite respectively, and the last is of comparatively little geologic interest. Composition and temperature have been determined for 23 of the invariant points occurring in the system. The geologic significance of the diagram in connection with the determination of the stability relationships of biotite is discussed, and a synthesis of phlogopite from a K_2O - MgO - Al_2O_3 - SiO_2 glass at a temperature of 900°C. and 15,000 P.S.I. water pressure is reported. These studies were made at the Geophysical Laboratory during 1947-48 on a Carnegie Institution of Washington fellowship.

VARIATIONS IN DIFFERENTIAL THERMAL ANALYSIS CURVES OF SIDERITE

RICHARDS A. ROWLAND AND EDWARD C. JONAS

Houston, Texas

Differential thermal analysis curves of siderite obtained from samples minutely ground, diluted, variously packed, and combinations thereof are shown to frequently suppress the endothermic loop associated with the loss of CO_2 . The effect of these variations on siderite DTA curves, which involve the loss of CO_2 followed by oxidation of FeO, is attributed, in part, to the diffusion of gas, both ways, through a packing and to differences in heat transfer.

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PHASE EQUILIBRIUM RELATIONS IN THE QUATERNARY SYSTEM
 $K_2O-MgO-Al_2O_3-SiO_2$

J. F. SCHAIRER

Geophysical Laboratory, Washington, D. C.

Phase equilibrium studies are in progress or have recently been completed on six triangular joins within the quaternary system. Data are complete for the joins leucite—forsterite—silica, leucite—forsterite—potassium disilicate, and cordierite—forsterite—leucite; nearly complete for the joins leucite—clinoenstatite—potassium tetrasilicate and cordierite—leucite—silica; and in progress on the join cordierite—clinoenstatite—leucite.

Only one of these joins, leucite—forsterite—silica, is a ternary system within the quaternary system. This ternary system is, therefore, a composition plane which locates a temperature maximum in each quaternary univariant line which pierces this plane and thus effectively partitions the quaternary system. During crystallization of any type, no liquid can cross this composition barrier. This ternary system illustrates in a very striking manner the direction of change of composition in residual liquids from the fractional crystallization of a simplified magma. The femic constituents (in this case the olivine, forsterite and the pyroxene, clinoenstatite) are nearly completely removed first, leaving residual liquids that are potash-alumina-silicates. Appropriate compositions in the system, even though there is less than one half of one per cent forsterite in their total composition, crystallize the femic constituent clinoenstatite first and yield a residual liquid almost quantitatively free from the femic constituent.

The phase equilibrium data for the six joins are the first evidence bearing on the mutual stability relations of the rock-forming minerals—olivine, pyroxene, cordierite, leucite, potash feldspar, spinel, mullite, tridymite and cristobalite—in this quaternary system. There is evidence for solid solution in cordierites, and solid solution between leucite ($K_2O \cdot Al_2O_3 \cdot 4SiO_2$) and $K_2O \cdot MgO \cdot 5SiO_2$ and between $K_2O \cdot MgO \cdot 3SiO_2$ and kalsilite ($K_2O \cdot Al_2O_3 \cdot 2SiO_2$).

PETROLOGY OF VOLCANIC ROCKS OF NORTHEASTERN NEW MEXICO

HELEN STOBBE

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The igneous rocks described in this paper, were collected in an area about 86 by 50 miles in northern Union and eastern Colfax Counties, northeasternmost New Mexico. Lava-capped mesas and volcanic cones form prominent topographic features. The rocks are classified on a mineralogic basis. Basalts are the most widespread, dacites and andesites occur in subordinate amounts, and alkaline rocks as phonolites and soda trachytes are localized in about 24 square miles in central eastern Colfax County. Petrology substantiates three main periods of basaltic extrusion which physiography indicates; namely, Raton (earliest), Clayton (intermediate) and Capulin (recent). Olivine basalts predominate in all three periods and are mineralogically similar with textural variations. Raton basalts are the most uniform in texture and mineralogy. Clayton flows are predominately olivine basalts but include olivine basalts with quartz inclusions, analcime basanite, nepheline basalts, hauyne basalt and olivine-free basalts. Red Mountain dacites have built volcanic cones and occur as plugs and necks. The alkaline suite is sodic in character. Chico phonolites occur as flows chiefly; and Slagle trachytes associated with tinguaites and analcime microfoyaite occur in lesser amounts than the phonolites and are usually intrusives. The sodic rocks fall in line with the other alkaline groups which occur along the eastern front of the Rocky Mountains from British Columbia to Mexico. Dike rocks include leucocratic varieties as hornblende dacite, phonolite, tinguaites and analcime microfoyaite; and melanocratic varieties as olivine basalt and lamprophyres (vogesite and monchiquite). The diverse rock types are believed to have originated from a parent olivine basalt magma.

**THE ANALYSIS OF ROCK-FORMING MINERALS BY SPECTROCHEMICAL
METHODS IN PETROLOGICAL RESEARCH**

LESTER W. STROCK

Saratoga Laboratories, Inc., Saratoga Springs, New York

The possibility of using spectrochemical methods of analysis for determining the chemical compositions of rock-forming minerals in petrology has been examined, with a view of making both more unique and rapid characterizations of rocks than is at times possible by conventional petrographic methods. Such methods can at least provide data to supplement and check those obtained by optical crystallography; if not largely replace them.

Methods have been devised for determining the major and important minor constituents in garnets and ferromagnesian minerals. Work on micas and feldspars is in progress and will be reported later. The methods are applicable for analyzing rocks and minerals separated from the rocks. Samples weighing as little as 1 mg. may be accurately analyzed which makes it possible to study individual mineral grains and fragments of zoned crystals. Actual mineral samples of accurately known chemical analysis were used as standards. In addition to the major constituents, minor elements, such as Cr, Ti, V, etc., which are known to influence certain optical properties, can be determined simultaneously. One limitation is the necessity of determining only total iron.

ARTIFICIAL QUARTZ BY HYDROTHERMAL METHODS

A. C. SWINNERTON

Antioch College, Yellow Springs, Ohio

Quartz has been grown by several investigators but obtaining continuous growth to produce large single crystals is a special problem. The present investigation, sponsored by the U. S. Army Signal Corps, has canvassed systematically the growth fields for a range of concentrations of NaCl, NaCl with alkalinity adjusted with NaOH, at 400°C, with and without temperature gradient, in the range of 3000 to 6000 psi, using fused silica as source material and AT-cut plates (crystalline) as seeds. The results are presented, the effect of the critical temperature is discussed and suggestions are made regarding the chemical reactions involved.

**THE VARIABLE INVERSION TEMPERATURE OF QUARTZ AS A
POSSIBLE GEOLOGIC THERMOMETER**

O. F. TUTTLE

Geophysical Laboratory, Washington, D. C.

The inversion temperature of quartz has been found to vary as much as 1.89°C. All quartz specimens so far investigated from high temperature sources (e.g., phenocrysts in lavas) invert at a lower temperature than quartz from low temperature deposits (e.g., grown in vugs in limestone). The variation is believed to be due to solid solution, probably predominantly of the interstitial type. The high temperature modification has a more open structure, permitting a greater amount of solid solution with consequent lowering of the inversion temperature.

WHAT IS A MINERAL?

ALEXANDER N. WINCHELL

Hamden, Connecticut

The old definition of a mineral as a natural inorganic substance of definite chemical composition is criticized, a new definition is proposed, and its effects are illustrated.

THERMAL STUDY OF RHODOCHROSITE

HAROLD D. WRIGHT, J. LAURENCE KULP, AND RALPH J. HOLMES
Columbia University, New York

Representative specimens of rhodochrosite from many localities have been examined by the method of differential thermal analysis in order to establish the form and variations of the thermal curve of the mineral, and to study the effect of cation substitution on its thermal behavior. The optimum conditions of sample and apparatus providing reproducible thermal curves for this mineral group are discussed.

The endothermic peak was found to reproduce more consistently than the exothermic, varying from 609°C. to 724°C. but only one specimen gave an endothermic peak higher than 667°C. The majority range from 609°C. to 635°C. The temperature at which the endothermic peak occurs is raised by the presence of Ca and Mg and is lowered if iron substitutes for manganese in the lattice.

The materials used in the thermal work were checked by means of x-ray powder patterns and semi-quantitative tests for the cations in question.

Several specimens of manganocalcite varying widely in manganese content indicate that the substitution of Mn for Ca in the series calcite-rhodochrosite is probably continuous and unlimited.

ACTIVITY MEASUREMENTS OF MICRO-RADIOACTIVE INCLUSIONS

HERMAN YAGODA
National Institute of Health, Bethesda, Maryland

The activity of minute radioactive segregates in polished sections of rocks or micro-inoculated biological tissue is determined by counting alpha particle tracks recorded in nuclear type emulsions. Precise localization of particular segregates whose area exceeds 10^{-4} cm² is established by a double-exposure technique. The track count affords, in certain instances, an approximate measure of either the U or Th content. Applications of the method in the study of segregates in feldspar, beryl, and other minerals associated with radioactive ores will be described.

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- | | |
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| 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 Toronto, Canada | 1944 No meeting held |
| 1931 Tulsa, Oklahoma | 1945 Pittsburgh, Pennsylvania |
| 1932 Cambridge, Massachusetts | 1946 Chicago, Illinois |
| 1933 Chicago, Illinois | 1947 Ottawa, Canada |
| | 1948 New York, N. Y. |

RECIPIENTS OF THE ROEBLING MEDAL

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|--------------------------------------|---------------------------------------|
| Charles Palache, December 1937 | Edward H. Kraus, February 1945 |
| Waldemar T. Schaller, December 1938 | Clarence S. Ross, December 1946 |
| Leonard James Spencer, December 1940 | Paul Niggli, December 1947 |
| Esper S. Larsen, Jr., December 1941 | William Lawrence Bragg, November 1948 |